# Integrating Agriculture, Conservation and Ecotourism: Societal Influences

# Issues in Agroecology – Present Status and Future Prospectus

## Volume 2

*Series Editors*
W. Bruce Campbell and Silvia López Ortíz

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Editors

# Integrating Agriculture, Conservation and Ecotourism: Societal Influences

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ISSN 2211-2405 ISSN 2211-2413 (electronic)
ISBN 978-94-007-4484-4 ISBN 978-94-007-4485-1 (eBook)
DOI 10.1007/978-94-007-4485-1
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2012940848



Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

# Foreword

## Managing for sustainability is a necessary adaptive strategy

Agriculture is a human practice that provides for human needs (e.g., Pretty 2008). Early forms of agriculture were rooted under natural conditions, and date back over 10,000 years (Rowley-Conwy 2009; Pringle 1998); practices which provided for the needs of the small human populations/settlements in existence at the time. Natural ecosystem services (e.g., pollination, regeneration of soil fertility, pest control, and water) maintained the significant and natural productivity of the small-scale agrarian and agroforestry practices. Yet, as millennia passed, human societies evolved and grew, eventually forcing these practices to become uncoupled from their original societal locations, and from nature in size and scope, and in complexity and longevity (by doing the same thing for a long time within and over years). Over the last 300 years, agriculture has expanded globally, with the tropics currently expanding rapidly while Europe and North America have substantially reduced their rate of expansion (Johnson et al. 2011). Crop variability and heterogeneity have declined over space and time, production has become primarily a resource extraction industry, and distribution of food often is not equitable. Over the last 65 years (post World War II), the increased availability of pesticides, fertilizers, and ever-more technical machinery have strongly promoted agricultural intensification, simplified management and landscapes, and increased the extent of monocultures. These commercial operations, although successful at feeding much larger and rapidly growing human populations, quickly depleted the soils of natural nutrients, requiring ever-growing quantities of industrial fertilizers and water to compensate, as well as the expansion, shift, or conversion of areas into those for new cultivation. Yet, such verdant growth over abnormally large spaces and long time-periods, while beneficial to human society, also provided an increasing attraction for invasive pests, leading to increased pesticide use to control them. Although the publication of 'Silent Spring' (Carson 1962) resulted from the response to a culmination of environmental effects caused by society as a whole, modern agriculture at the time played the largest role in its development (e.g., the use of DDT as a universal insecticide).

This moment in time marked a turning point for human society in industrialized regions of the world toward a reduction of environmental impact and an improvement in the quality of life; a reconnection between agriculture, society, and environment/ecology, and formalized the different but interwoven trajectories of agroecology as a practice, as a movement, and as a science. Yet, change at the societal level is much slower due to entrenched societal dependencies (e.g., market stability and expectations, product availability) and the large and complex spatial and temporal scales involved (e.g., Jackson and Hobbs 2009). Although progress is being made, some species and habitats have never recovered from this historic growth of human influence, and more are likely to reflect a similar fate in the future; a time-delayed legacy of negative impact.

Very rapidly, agriculture and society responded by regulating the use of pesticides, managing effluent discharges into the environment, and banning the use of some chemicals. In addition, given the negative impacts brought about by some agricultural techniques (e.g., increased nitrates in groundwater, increased soil erosion), many field practices were improved to reduce off-farm impacts (e.g., increased use of compost, altered tillage practices). Gradually, a greater degree of appreciation for less resource/energy-intensive agriculture was promoted, including that of organic cultivation and ranching, indicating a movement toward a re-coupling of agriculture, society, and the environment for improved sustainability and quality of life (e.g., Robertson and Swinton 2005); although the continued rise in human population on the planet and in violations of planetary thresholds (e.g., biodiversity, freshwater, nitrogen; Rockstrom et al. 2009) may yet impede this progress. While developed countries benefited from these capacities to buffer against such negative changes and began to reduce the amount of land used for agriculture, underdeveloped or developing regions were quickly growing their capacities because of previous investments based on future international commercial trade and growing domestic and international usage as means of alleviating poverty. Such regions of the world very often have a predominance of poverty, sociocultural and political divisions, and cultural and gender inequities, and are now experiencing additional influences with delayed effects and uncertain and complex consequences. On the one hand, there is great investment in their development and cultivation of products for export, and a general benefit in the quality of life for these areas due to greater income and capital; provided this economic injection is equitably distributed (gender equity included). Many people see the benefits gained by earlier efforts in the Global North and seek to promote similar improvements in the Global South. At the same time, however, the tropics and other similar regions are subject to a greater rate of loss of biodiversity (e.g., Bradshaw et al. 2009), unequal access to environmental resources (e.g., clean freshwater) or production equity (food or revenue), loss of environmental quality as a result of rapidly expanding societies and agricultural production, and insufficient infrastructures for constructing adequate levels of treatment for the resultant wastes or damage. Such declines have fueled the rise in sustainability certification programs to ensure an ever-more consumptive public that the commodities for sale were produced under conditions that did not promote negative influences. Yet, such programs are themselves subject to different dynamic socio-economic

pressures within developed, developing, and underdeveloped regions and countries, leading to distributors and consumers increasing their doubts that sustainability efforts are satisfactory or being made at all. This overall situation provides the general backdrop for both Volume 1 – *Integrating Agriculture, Conservation, and Ecotourism: Examples from the Field*, and Volume 2 in the series – *Integrating Agriculture, Conservation, and Ecotourism: Societal Influences*. Both volumes approach the issues and recovery (advances and setbacks, costs and benefits) from different angles, but without losing connections with or necessities for the other; human beings and their activities are inextricably part of the agroecological landscape. Clearly, agroecological concepts, definitions, and processes are complexly intertwined with social, political, economic, and cultural issues across dynamic spatial and temporal scales, and this perspective is very different from that envisioned nearly 40 years ago.

Our intention here is to present progress in agroecology (as a science, movement, or practice) as sets of significant positive deviations from past trajectories connected with negative impacts and lack of sustainability (agricultural, environmental/ecological, societal). Increases in sustainable agriculture through conservation efforts, the injection of economic benefits, ecotourism and agritourism, certification, and food, financial and gender equity represent substantial and tangible means of acquiring capital and infrastructural support that may not otherwise have been or currently be available for many people. This is especially true with regard to the high international values of large-scale agricultural conservation strategies (e.g., shade coffee, cacao, agroforestry, birds, and pollinators); small-scale commodities may not be as well-benefited unless they can, for example, be coalesced into regional cooperatives that hold similar value, or be independently provided with sufficient access to the diverse domestic and international markets that contain greater financial opportunities. While not every method employed to improve sustainability will be equal in benefit, or be a 'magical cure' for what ails us in all circumstances, it is important to see these attempts, long- or short-lived, slow or rapid to develop, as means of continually moving forward (e.g., Tomich et al. 2011), of constantly exploring novel in-roads in the search for improvement; of becoming or being more adaptive to changing or evolving needs. In this sense, such attempts are the results of experiential learning exercises built collaboratively from science, agriculture, education, society, economics and trade; exercises that span large spatial and temporal scales, and multiple stakeholders from all walks of life both young and old. Given that society, people, and nature are indeed dynamically intertwined and changing, the exercises and results they deliver must also be, and by their very nature, are adaptive. The continued progress toward improved sustainability can thus be seen as a necessarily adaptive strategy (e.g., Nyberg and Taylor 1995; Walters 1997), but one that must be hastened with rules and regulations modified to be more adaptive if we are to significantly stem the negative effects from past, present, and future sources of influence.

This series was developed not only to provide timely reviews of important issues involving agroecology, but to identify gaps in knowledge, novel routes of valuable information in the pursuit of sustainability, and avenues of investigation and application that continue to help keep our focus on the path ahead. As well, the design of

this review series is such that topics can be revisited rapidly with new information, thus assisting routes of investigation and application by providing an adaptive influence. It is our sincerest wish that the reviews contained in these and succeeding volumes of this series provide a significant boost in achieving this objective.

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Dr. Silvia López Ortíz
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## References

Bradshaw CJA, Sodhi NS, Brook BW (2009) Tropical turmoil: a biodiversity tragedy in progress. Front Ecol Environ 7(2):79–87

Carson RL (1962) Silent spring. Houghton and Mifflin Co., New York

Jackson ST, Hobbs RJ (2009) Ecological restoration in the light of ecological history. Science 325:567–569

Johnson RJ, Jedlicka JA, Quinn JE, Brandle JR (2011) Global perspectives on birds in agricultural landscapes. In: Campbell WB, López Ortíz S (eds) Issues in agroecology – present status and future prospectus, Volume 1, Integrating agriculture, conservation and ecotourism: examples from the field. Springer Science + Business Media B.V., Dordrecht, pp 55–140

Nyberg JG, Taylor B (1995) Applying adaptive management to British Columbia's forests. In: Proceedings of the FAO/ECE/ILO International Forestry Seminar, Prince George, BC, 9–15 Sept 1995. Canadian Forest Service, Prince George, BC, pp 239–245

Pretty JN (2008) Agricultural sustainability: concepts, principles, and evidence. Phil Trans R Soc B 363:447–465

Pringle H (1998) The slow birth of agriculture. Science 282:1446–1450

Robertson GP, Swinton SM (2005) Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. Front Ecol Environ 3:38–46

Rockstrom J, Steffen W, Noone K, Perssone A, Chapin (III) F (plus 24 additional coauthors) (2009) Planetary boundaries: exploring the safe operating space for humanity. Ecol Soc 14(2):32. http://www.ecologyandsociety.org/vol14/iss2/art32/

Rowley-Conwy P (2009) Human prehistory: hunting for the earliest farmers. Curr Biol 19:R948-R949

Tomich TP, Brodt S, Ferris S, Galt R, Horwath WR, Kebreab E, Leveau J, Liptzin D, Lubell M, Merel P, Michelmore R, Rosenstock T, Scow K, Six J, Williams N, Yang L (2011) Agroecology: a review from a global-change perspective. Ann Rev Environ Resour 36:193–222

Walters C (1997) Challenges in adaptive management of riparian and coastal ecosystems. Conserv Ecol 1(2). http://www.consecol.org/vol1/iss2/art:1–22

# Acknowledgements

The realization of this review series constitutes a significant step forward for agroecology as a science, a movement, and a practice on an international scale, as well as for its sustainable evolution. Such endeavors require a great deal of continuous and tireless collaborative effort from a diverse array of people. Hence, we are indebted to Dr. Maryse Walsh, Jacco Flipsen, Albert Paap, and Melanie van Overbeek of Springer Science and Business Media B.V., Dordrecht; to Raaj Vijayalakshmi (Project Manager, Springer Publishing, SPi Technologies India Pvt Ltd., Pondicherry); and to the many manuscript referees and reviewers of the initial series plans whose past and present commitment to the concept and publication of this series has been and continues to be invaluable. We thank the members of the international editorial committee, Dr. Alexander Wezel, Dr. Louise Jackson, Dr. Ted Lefroy, and Dr. Juan J. Villalba, who have given of themselves tremendously to promote the birth and continued production of this series. Lastly, we thank the authors not only for their tireless commitment to their respective reviews, but to their fields of study and work as a whole. Our efforts lay bare the paths before us all…

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# Future Visions for Experiential Education in the Agroecology Learning Landscape

**Charles Francis, Shannon Moncure, Nick Jordan, Tor Arvid Breland, Geir Lieblein, Lennart Salomonsson, Mary Wiedenhoeft, Suzanne Morse, Paul Porter, James King, Catherine A. Perillo, and Michael Moulton**

**Abstract** Experiential learning is gaining momentum as the favored educational strategy in agroecology and similar applied fields in agriculture, food systems, and other sectors of university education. Based on centuries-old methods of apprenticeship and hands-on learning, this approach has gained recognition in the academic community starting with the pioneering research and applications by John Dewey more than a century ago. With the added theoretical rigor of David Kolb's learning cycle, experiential learning as a cyclical process is now at the forefront of educational innovation. With a goal of preparing agroecologists for responsible dedication to the goals of stakeholders in farming and in rural communities, strategies in *systems action education* are being developed to move important structured learning activities out of the ivory towers of academia and into the context of real world challenges. Systemic analysis and evaluation of

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W.B. Campbell and S.L. Ortíz (eds.), *Integrating Agriculture, Conservation and Ecotourism: Societal Influences*, Issues in Agroecology – Present Status and Future Prospectus 2,
DOI 10.1007/978-94-007-4485-1_1, 

current systems and development of viable future alternatives using multiple criteria for measuring success are central to the learning process. Moving from a focus on systems components to holistic visions of how those systems can better meet human needs, we help students articulate their personal goals to preserve the environment and increase future production potential. Building competencies in future agroecologists requires learning and practicing biological, ecological and social science methods, and both individual and social learning are essential to the process. Several models that have been implemented in the Nordic Region, United States, and France are presented to illustrate the learning approach, and open-ended case study methods in the field and community provide the heart of this education. Agroecology students acquire and develop new knowledge and skills, examine and critique their personal attitudes toward stakeholders and integrated systems, and recognize the importance of underlying values in the conduct of their work. Agroecology as the ecology of food systems provides a framework for students to understand and integrate multiple objectives in production, economics, environmental impacts, and social viability of farming and food systems, and experiential learning is central to their education.

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**Keywords** Action learning • Agricultural education • Agroecosystems • Blended courses • Capacity-building • Components and systems • Distance learning • Educational history • Educational learning models • Graduate study • Holistic systems learning • Open-ended cases • Stakeholder involvement • Systems action education • University structure

## 1 Introduction: Current Perspectives in Agroecology Education

This review begins with the history of experiential learning and examines how accumulated experiences are being applied today in the context of agroecology, holistic farming and food systems education. Many educators are seeking ways to increase motivation and relevance of higher education to a student population that appears increasingly disconnected from the "real world out there" during the university or college years. We relate the history of experiential learning to current theories and applications of systems learning. Building on a robust record of research and teaching about components of systems, we are seeking ways to fit these pieces together into a coherent whole in order to help students and instructors successfully apply appropriate components and design systems in each specific context. More importantly, we observe that much progress in the future will relate to understanding and manipulating the multiple interactions among components, and thus realize and deal with the emergent properties of complex systems. The potentials for on-line education are explored as an emerging dimension of the learning landscape. In collaboration with clients in farming and food systems, we can seek new ways that the educational environment may be expanded to embrace diverse and credible sources of knowledge, as well as become more relevant to those we wish to impact in the future. Specific models and examples of programs that have proven successful are described from both the European and North American contexts, along with the potentials and challenges that face us in academia as we attempt to introduce more experiential learning into current universities and colleges. In this review, we move beyond the literature and pose questions to stimulate a discussion that will lead to improved systems learning, exploring ways to employ a holistic and comprehensive approach. The combination of review and future visioning is intended to contribute to new and creative applications in education. A parallel review that is specific to development of education in sustainable agriculture has been published (Francis et al. 2011). A historical perspective on experiential learning in agroecology has recently appeared (Moncure and Francis 2011).

Interest in practical applications as integral to higher education has led instructors to focus more on experiential learning – in the classroom, the field, and the community. Some have suggested that today there is a smaller gap between ignorance and knowledge compared to the larger gap between knowledge and action (Lieblein et al. 2008). For example, educators may have fine-tuned the practice of one-way transmission of knowledge in each discipline, using ever more sophisticated electronic

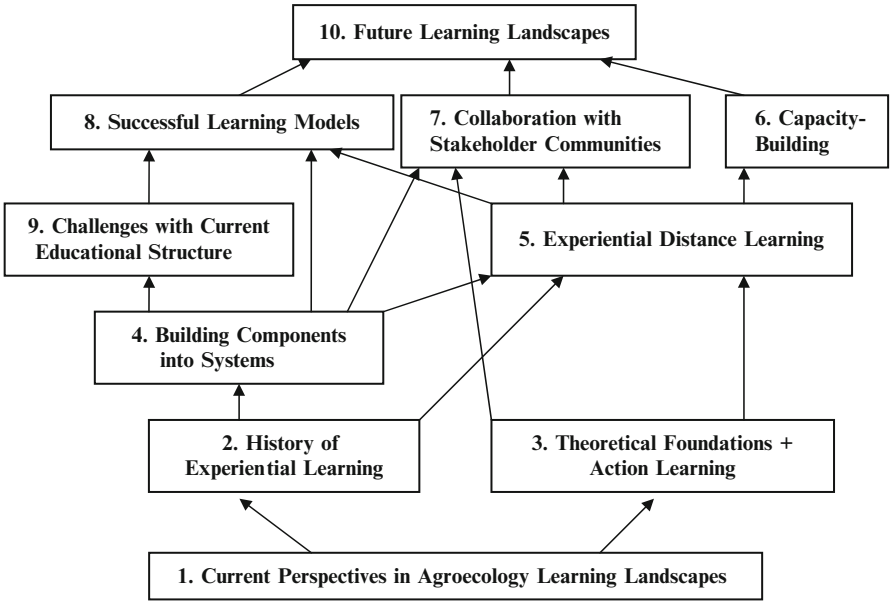


**Fig. 1** Diagrammatic relationships among sections in this review

overhead projection systems and multiple media, while losing sight of applications in the world outside academia. Thus the conclusion, that we have refined our focus on knowledge for knowledge sake, particularly within ever-narrower specialized fields, while deemphasizing a long-term goal of education to improve the human condition.

Successful models of experiential learning in higher education have followed a certain thought pattern in their development and application. We provide a 'conceptual road map' of the review in Fig. 1, with boxes identified with a number that corresponds to the topics addressed in this review. There are obviously more interactions among the steps, and the process is less linear and far more complex than shown. Using an ecological model as a guide, we recognize that everything can be envisioned as connected in a web-like structure rather than as a linear chain of events. In general we move in the review from lesser to greater complexity, and from lower order to higher order questions, as the learning process for us as instructors has progressed from the lower levels of the figure toward the applications near the top. Practical applications include greater collaboration with clients as part of student capacity-building, designed to enhance the learning process. We as instructors continue to learn, and provide in this review's concluding summary some useful visions of where experiential learning for responsible action is likely to move in the future. With authors coming from North America and Europe, there is some bias toward their experiences, but close collaboration with other agroecology educators is reflected in the review.

## *1.1 Current Perspectives*

We have defined agroecology as an umbrella field that embraces the ecology of food systems, from use of natural resources through the production process, to processing and marketing, and to food consumption (Francis et al. 2003). In the future it will embrace the recycling of what are today called "human wastes" back into the food web. This definition greatly broadens the scope of learning about food systems, from prior definitions that relate primarily to describing agricultural practices in ecological terms, or to applying ecological principles to the design of farming systems. Context becomes extremely important, and the nature of food systems in a given place becomes very much a function of the ecoregion and community in which they are embedded. Somewhat parallel to the concept of precision agriculture, a current trend in high-tech management of farming, this embracing definition of agroecology suggests that each area in a field, each farm, each watershed, and each community is to some degree unique. Thus, the design of a food system in terms of all the resources needed to manage efficiently for long-term sustainability should carefully reflect the local conditions. Other definitions are evolving in this emerging field, and their various interpretations of agroecology as a science, as a set of practices, and as a movement are reviewed by Wezel et al. (2009) and Wezel and David (2011). Success in attracting students to programs in Norway, France, Sweden, Ethiopia, Uganda, and the United States suggests that the application of experiential learning in agroecology is an idea whose time has come. We further postulate that the best way to gain perspective, to broaden appreciation of challenges on farms and in food systems, and to develop student confidence in working with farmers and communities to meet these challenges is through immersion in the field and in social networks of the community (Østergaard et al. 2010).

There is often confusion about the terms *multidisciplinary*, *interdisciplinary*, and recently our preferred term *transdisciplinary* to describe research and education that incorporates multiple disciplines, perspectives, and methods. These are all terms commonly used to illustrate a systemic or whole-systems type approach to research and learning, and all three are found in this review. Caporali et al. (2007) make a clear distinction among the terms, and provide rationale for adopting the use of *transdisciplinarity* as the most appropriate in agroecology. They define the three words as follows:

- *Multidisciplinary* approaches bring together multiple disciplines and depend on the cumulative effects of combining multiple approaches, but do not guarantee any integration of methods or the emergent value of the combination; it is an approach that "shapes the research process" but does not necessarily have an equal or appropriate emphasis on the parts (Schunn et al. 1998).
- *Interdisciplinary* approaches suggest a "transcending of boundaries" and thus an integration of perspectives and methods, and as suggested by Mittelstrass (1998), these are useful to deal with "certain problems that escape the confines of a single discipline". He cites the importance of bringing together environment, energy, and health perspectives for dealing with larger issues facing society. There is still

a concern that not all aspects or interactions in a challenging situation will be addressed.
- *Transdisciplinary* approaches "concern that which is at once between the disciplines, across the different disciplines, and beyond all disciplines. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge" (Basarab 2002).

Systems thinking, as we perceive this approach, deals with issues between, across, and beyond all disciplines, and this is one reason why we have difficulty accepting agroecology as one more among a large array of traditional disciplines. The reasons will become more apparent as the reader moves through the following sections about experiential learning. The balance of this introduction provides an overview of each of the topics for the review sections illustrated in Fig. 1, and Sect. 1 can stand alone as a useful resource as well as a guide for the reader to sections of greatest interest.

## *1.2 Historical Precedents*

We surmise that experiential learning in the family, the clan, and the village has been the norm for most of human history, as people lived first in small family groups and later in aggregations of families for security and an eventual specialization in food production and other pursuits. This is important to us because of its predominance over millennia, and for the lessons we can learn from hands-on experience and learning to work within a local context. Increases in crop and animal production with early technologies allowed some people to branch out and work to produce for other needs of early societies, and this began a long journey toward the specialization we observe today.

The current largely disciplinary and often theoretical focus in education operates in near-total contrast to the foundations of experiential learning established by John Dewey (1897) over a century ago. Dewey insisted that all learning is based on prior experience. He argued that it was essential for students to integrate new knowledge and experience into what went before, including the context in which this was learned and applied. If we tend to ignore or even discount the value of prior experience by students related to a specific class topic, we may well lose an opportunity for integration, application, or rich learning experience. It is also important to recognize that the limited time students have in a given class period should relate to or complement any concurrent learning activities in other courses or outside the classroom.

The reference to Dewey leads to concern that contemporary and conventional higher education in agriculture is generally focused on lower-level spatial concerns such as genetics and physiology of individual crops, for example, and the mechanisms that influence their behavior in relatively short time spans (Langer et al. 2007). Often ignored are the crucial applications of education to impact socially important issues, for example food production, food safety and security, and equity of access to food and other critical needs (Francis et al. 2008). At the very least, we deprive

students of the valuable experience of integrating knowledge from multiple sources into a coherent and credible total learning that adds to and enhances prior experience. More importantly, we too often discount the potential motivation for learning that would come from students clearly recognizing the potential impacts of what they study and how this relates to their future endeavors. In Sect. 2, we track the historical development of experiential learning with speculations about the beginnings of learning in organized agriculture, through the time of Dewey up to present, with a detailed focus on how this history has impacted the design of several programs for M.Sc. students.

## *1.3 Theories Guiding Systems Action Education*

Since one of the primary goals in experiential learning is to bridge the gap between theory and practice, it is useful to begin with a 'practical theory' to guide systems action education (SAE) in agroecology. Beyond the scope of this review, SAE may be considered an important frontier for agricultural and other applied education at all levels. This strategy has unique potential for helping learners gain and practice their capabilities for management, stewardship and sustainable development of agriculture. SAE is a system of education that engages the 'hands, hearts and heads' of learners in learning experiences, similar to the popular 4-H strategy in the United States (head, heart, hands, health), through active engagement with agriculture as well as with broader food, water, energy and land systems. Learners invoke all their senses and prior experiences to make sense and meaning of this learning landscape. The farms or other project locations in which students and faculty work together with stakeholders need to contain challenges as well as hopeful solutions. Such experiences are designed to inspire pathways of cognitive development that are not supported by most current agricultural curricula, yet could be considered essential to develop the inclinations, world views, capacities, skills, and ethical orientations needed in a new generation of agriculturalists.

To provide a theoretical foundation for experiential learning in agroecology it is important to focus on the antecedents in systems thinking in science and specifically in agriculture. The pioneering educational program initiated by Richard Bawden's team of instructors at the University of Western Sidney in Hawkesbury, Australia, is often cited as one of the key examples of systems education in practical agriculture (Bawden 1991). Students worked with farmers and ranchers near the university and observed firsthand the challenges faced by those engaged in food production. A body of theory emerged from the faculty at this agricultural university, including concepts such as double loop learning and how students built on their practical experiences to reach higher orders of questions and inquiry (Sriskandarajah et al. 1991). Double loop learning is a step-wise, iterative process that takes into account the "theory of action" which involves more than merely the immediate and obvious biophysical dimensions of the farm and its challenges, but also individual values and behavior that impact decisions. This became one of the early pillars of farming

systems research and extension. An explicit consideration of the vital human dimensions of the system can lead to improved decision-making, and a capacity to adjust to change in what are often complex situations (Argyris and Schon 1974). Recognition of the intimate involvement of people as key components of the farming and food system has been central to our planning and implementation of the agroecology education programs.

As a basis for our focus on human dimensions of farming and food systems, we have incorporated and expanded the soft systems methodology presented by Checkland (1981) and further elaborated by Checkland and Scholes (1990). As the latter state, "To 'manage' anything in everyday life is to try to cope with a flux of interacting events and ideas which unroll through time. The manager tries to improve situations which are seen as problematical – or at least as less than perfect – and the job is never done … because as the situation evolves new aspects calling for attention emerge, and yesterday's solutions may now be seen as today's problems." We also rely on a foundational text by Wilson and Morren (1990) who describe well the methods used in systems research, a book in which they aptly combine theory and practice. These several resources provide a workable mix of theory and application of systems analysis that is accessible to most students. Competence development is a direction described by Bawden (2007) as central to our educational quest.

As described in detail in Sect. 3, the systems action education strategy is applied in agroecology to study agricultural and food systems challenges through multiple perspectives across a temporal and spatial hierarchy. These perspectives are often lacking in the methods of single disciplines. Given the growing constraints on resources needed in food production and the complicating new dimensions of globalization, a holistic and systemic methodology is needed to observe and analyze complex situations. Although we are building on a long tradition of component research, new strategies of investigation and learning are most valuable when they are pursued within the perspective of whole systems. Beyond the immediate biological and economic questions are longer-term issues involving quality of the environment and the social viability of alternative future systems. By blending biological and social science methods, agroecology provides a framework to lead students through logical steps to plan and evaluate multiple future scenarios and to recommend steps to responsible action by their stakeholders in the field. The serious study of whole systems is as rigorous as the study of any of its components, but can be orders of magnitude more complicated because of the many factors involved and their multiple interactions.

## *1.4 Moving from Components into Systems*

Current academic majors are assigned to convenient subject matter disciplines, often in administrative departments, and these are connected to the larger scientific community of specialists in science through technical journals, professional societies, and annual meetings where results are shared and sometimes debated. The majority

of research and teaching has been accomplished over the past century in these organizational units. Substantial advances have been made through focused research. For example, plant breeding coupled with better management led to the Green Revolution; chemical pesticide development helped farmers manage weeds and insects in labor-efficient ways; and agricultural engineering research led to efficient irrigation through water-saving center pivots or drip systems. We observe that many of the easy gains in food production that were made possible by introducing high-yielding crop hybrids and varieties, applying chemicals to sensitive pest species, and supplying uniform irrigation to thirsty cereals have now been accomplished. In a world with increasingly scarce resources for agriculture, an unpredictable climate, negative environmental consequences and unexpected emergent properties of some high-tech methods, and growing disparities of wealth, education and access to food we find today that the challenges are more complex and far-reaching. Most future problems are unlikely to be solved by the methods inherent to single disciplines.

From an ecological perspective, biological action can be particularly high in the ecotones between disparate systems, along the fencelines and field boundaries, in the interface between forest and field, and in the small areas between two crops in a strip cropping rotation in the field. We consider it likely that many of the solutions to complex problems in the future likewise will come at the interface(s) of two or more disciplines. Thus, the emphasis in agroecology has been the blending of biological and social science methods. A systems perspective allows us to identify the positive interactions in crop/animal integrated systems, the complementarities in soil biology and economically efficient methods of providing soil fertility, and the emergent advantages of local food systems that depend on peri-urban farmland and a labor source and market in the nearby community. We are developing a logical parallel in experiential learning and have found that agroecology provides a platform using integrative educational methods to prepare new professionals to help their stakeholders meet future goals. Approaches used in research and in education for sustainable agriculture that move the focus from components to systems have been reviewed (Francis and Porter 2011), along with strategies for learning about sustainable systems (Francis et al. 2011). Section 4 explores this theme in detail, providing a basis for transdisciplinary learning to solve the emerging "wicked problems" that will face our graduates in the future (Batie 2008).

## *1.5 Experiential Learning by Distance*

Distance education is becoming a standard component of learning in many universities, and an option for place-bound students to complete a degree that might be otherwise unattainable. At our universities, some students who are resident on campus take distance courses as an alternative that is more convenient for work schedules, for avoiding other classes with time conflicts, or for finishing a degree more quickly through overloads. Although first attempts to offer courses by distance involved instructors converting existing courses and offering videos by mail of lectures,

exercises, and exams, the current potentials for information delivery and interaction allow much more sophisticated communication in either synchronous or asynchronous schedules for courses. Instructors have learned by experience that distance courses may be created for the best available platform of delivery, rather than just converted from an existing lecture course. Research has shown that learning can be equally successful in either resident or distance courses (Simonson et al. 2012).

How do we design experiential learning as a component of distance courses and degree programs? One of our authors completed a M.Sc. degree in Education with an option in On-Line Teaching and Learning at California State University – Hayward by using distance learning techniques (California State University – Hayward 2011). There were ten three-credit courses, all taught by distance. Several of the courses involved team projects and hands-on exercises, often completed through intensive cooperation by distance with other students. As a final project in the last course, each student planned and delivered a distance course to the other students. This is but one example of distance degrees, and these are currently offered by hundreds of universities in the United States, Europe, and elsewhere.

A prototype *Introductory Agroecology* on-line course has been offered in the Nordic region for the last 8 years (Lieblein et al. 2005a). Supervised and conducted by instructors from agricultural universities in four countries (Sweden, Norway, Denmark, Finland), the 8 week course has a seamless transition each week from one instructor to the next. As a case study, a livestock farm in Denmark is available on a website and students make virtual "visits" to the farm to meet the farmer, see the facilities and fields, assess production as well as economics and marketing, and learn about the local environmental and social context in which the farm is embedded. Interactive project work with small groups of students provides the social learning essential to preparing for future working team environments. Weekly conference calls keep instructors in coordination, and the student assignments are available for all instructors to read and evaluate. This is one example of how experiential learning has been used in agroecology. Section 5 provides a more detailed history of how distance learning is evolving in the context of agriculture and food systems, and includes numerous examples of relevant and successful programs. We also describe a new program currently in the planning stage, an international Ph.D. degree curriculum in Agroecology and Capacity-Building that will assemble a roster of international faculty and provide degree candidates with opportunities for courses, advisors, and dissertation research projects in more than 20 major universities in the United States, European community, and several African countries.

## *1.6 Focus on Capacity-Building*

Education in capacity-building is found in universities, special training sections of governments and private institutions, and in action groups of non-profit organizations. Some have speculated that there is more education and training conducted on the

job by private companies than by colleges and universities, although this would be difficult to quantify. Much of what specialists learn is on the job, and since learning is a continuous process it is obvious that much of the capacity-building potential is "learned by doing" in the workplace. However, it appears that there is an important gap in professional university programs, with little specific focus on helping to build this capacity so that graduates can 'hit the ground running' and be better prepared to enter the job market capable of quickly acquiring the methods and attitudes they will need to succeed. The current plans for a Ph.D. degree program in Agroecology and Capacity-Building is one initiative to help fill this void.

In 2010, we organized three workshops around the topic of stakeholder integration into the planning and implementation of learning in agroecology (Lieblein et al. 2010a, b; Lieblein and Francis 2010). A process of participant interaction with experienced agroecology instructors led to a number of practical suggestions on how farmer and food system stakeholders can be more closely involved in the education agenda. Section 6 describes the history of education in capacity-building, the blending of academic training and practical experience, and plans for the future, while Sect. 7 includes a detailed description of a working model in the Nordic Region where students are closely involved with key leaders in rural communities that are interested in improving their food systems and increasing the production and consumption of local foods.

## *1.7 Working with Non-University Stakeholders*

Action learning has been described as a strategy to involve students in real-world issues, often working with different stakeholder communities in the field. Such engagement functions as a bridge between what is learned in class and what those outside the university see as their challenges on the farm and in the community. An application of this type of action learning in agroecology has been described by Jordan et al. (2005). It is highly important, but often difficult to incorporate relevant interactions into the flow of activities in the conventional classroom environment, although inviting guest speakers, requiring students to do interviews in the community, and basing project work on current issues in communities can be introduced into class activities. Often budgets and student work obligations preclude scheduling much of this learning during the regular semester and during normal class hours. Creative options must be sought out and implemented, and participation of the clients in setting priorities, organizing collaborative activities, and implementation of projects is essential (Lieblein and Francis 2010).

One current example of stakeholder-oriented learning is a cooperative project between the faculty and students in the Agroecology M.Sc. Program at the Norwegian University of Life Sciences (UMB) in Ås, and a national *Økoløft* (Ecological Lifting) project that has the objective to increase public consumption of organic food. It is part of the Norwegian national program that aims to increase

production and consumption of organic food to 15% by the year 2020. In four participating communities, student teams were invited as part of their field project activities to inquire of farmers about production and of town people about their food system goals over the next decade. After assessing the local resource base, investigating processing potentials, and studying the possibilities for local marketing, the students developed a series of possible scenarios for the farmers and community residents to meet their goals. Thus they pursued what could be called an "open-ended case" approach (Francis et al. 2009) that was cooperative among students, instructors and clients in a situation where none of the three participating groups knew the correct final answer but all worked together to explore strategies to achieve a future desired situation for the community. The process became even more realistic when communities began providing half of the funding for travel and accommodation for the student team, a step that raised the level of responsibility and accountability for all involved. This and other examples are discussed, along with an extended discussion of other types of client-oriented learning in Sect. 7.

## *1.8 Successful Models in Norway, France, and the United States*

Experiential learning has been at the heart of a semester-long agroecology course at UMB in Norway for more than a decade (Lieblein et al. 2005b, 2007) and in a cooperative multi-state agroecology travel course in the U.S. Midwest over a similar time frame (Wiedenhoeft et al. 2003). A comparable travel learning course with similar objectives has been offered since 2006 in the U.S. Pacific Northwest and a semester-long course schedule with some components built on the experiential, field-oriented model is offered in autumn semesters at the Institut Supérieur de l'Agriculture Rhône-Alpes [ISARA] in Lyon, a private university that is part of the Fédération des Écoles Supérieures d'Ingénieurs en Agriculture [FESIA] consortium in France. The semester in France is one component of a 2-year double degree program based on cooperation between UMB and ISARA.

The antecedents of these courses included much experience of the instructors from a range of perspectives, including university, non-profit, international research center, and consulting roles in a number of countries. Their empirical experience was put to use in designing a series of Ph.D. courses in farming systems and food systems in Norway from 1995 to 1997 (Lieblein et al. 1999). Development of the M.Sc. program in agroecology in Norway began with a prototype in 1999, and now attracts 25 students each year during the first semester in a 2-year curriculum, and these students enroll in a stand-alone, semester-long course. The autumn semester courses in Lyon were initiated in 2005, and then integrated into a double diploma program with UMB which started in 2007 (A. Wezel, personal communication; www.agroecos.fr). A M.Sc. program similar to the one in Norway was initiated at the SLU campus "Alnarp" near Lund, Sweden, in 2010. Two additional programs

are now offered, one at Uganda Martyrs' University and another at Makele University in Ethiopia. Section 8 describes these successful models of experiential learning, as well as contemporary initiatives by other universities.

## *1.9 Challenges in Implementation*

The highly practical and inherent problems that we face in a conventional university in moving toward greater integration of experiential learning into our courses include available time and student schedules, financial resources for mobility of students and faculty, infrastructural needs, accessibility of clients outside the university to participate in the educational process, and a certain level of inertia and tradition that infuses the current courses and curriculum. At the University of Nebraska students normally take three to five courses each semester, and over 80% work on at least one job on campus, in the community, or on the farm. Such schedules make it nearly impossible to organize anything academic/experiential with extended time needs during the normal school day, after regular hours, or on weekends. With budgets limited and many instructors already teaching extra courses or sections on an overload basis, there is little flexibility to add faculty or identify resources to move students off campus to experiential learning sites. At least as important as these impediments is the tradition surrounding lectures, theory, and laboratories on campus, and the inertia to some extent in making change of any type. To be sure, there are innovative instructors who continue to fine tune their communication and exercises beyond the lecture and rote lab procedures, but all these constraints weigh heavily against innovation in experiential learning outside of campus.

In the Agroecology M.Sc. autumn course in farming and food systems in Norway, the students take only this one course. Similar academic structures are found in other places, for example the quarter-long classes at Evergreen State College in Olympia, Washington (United States) where students enroll in a single course (called a program). Such a class structure allows for more innovation, such as scheduling field trips for several days to a week at a time without interrupting other courses. Student work obligations are another issue that needs to be overcome. Assignment of resources for mobility is a question of priorities. There is the option to charge an additional "activity fee" over and above the listed tuition and fees for a semester or quarter. Some engineering and geology programs receive special funding from industry to finance field activities. In Norway, the students in the autumn course receive part of their cost compensation for housing and transportation from the communities in which they work and learn, similar to a paid internship. Most instructors who become immersed in experiential learning are so committed to the concept and its results that they often volunteer to take on overload assignments, or invest personal resources. In Sect. 9 we explore some of these options in more detail, and examine how some creative alternatives are more feasible in small, liberal arts colleges than in large, research-oriented major universities, including the land grant institutions in the United States and the national agricultural universities in Europe.

### *1.10 Future Learning Landscapes*

Over a decade ago, we presented three conceptual, structural models of agricultural universities that represented (1) the current norm, (2) a transition structure we called an integrative university, and (3) a future active learning university (Lieblein et al. 2000). These are reproduced in Sect. 10 to help illustrate the concluding remarks and visions on future learning landscapes. Still today, some of the innovations published in 2000 ring true to those who are beginning to restructure their ideas about learning and curricula, one class session or course at a time. Figures 9, 10, and 11 are accompanied by discussion of their components, and especially about the integration of future thinking and activities that, in fact, embody much of what is described through this review.

In the Agroecology M.Sc. program in Norway, we have conceptualized the learning process as following a "learning ladder" that illustrates the need for skills, for theory linked with knowledge, for practical experience where these are applied, for visioning an improved future situation based on the previous three steps, and finally for responsible action (Lieblein et al. 2007). These steps on the ladder are shown in Fig. 7, and described in more detail in that section.

The experiential learning strategy we follow in several agroecology programs is to enter the learning landscape at the middle step of the ladder, exploring, rather than at the bottom steps where most university courses begin with training and memorizing. In working with European, United States, and other students over the past decade, we have observed that they are much more highly motivated when they enter the program on a step where their previous experience is immediately put to use, where they can build on their own and on fellow student capacities, and where they clearly see the goal as working toward an improved future situation. The largest motivator is the immediate introduction of the long-term goal of responsible action, the bridging of what is often a large gap in education between knowing and doing (Lieblein and Francis 2007).

With this introduction into experiential learning, including a brief look at the history of the concept and its applications, we now expand the topics in each section to provide building blocks for an in-depth understanding of the literature as well as the important recent applications in guiding students on a practical journey through the learning landscape. Although many of our examples come from agroecology, we consider this path a logical one for other applied disciplines in agriculture and development, wherever students are preparing to deal with complexity and uncertainty in their future employment.

## 2 Historical Precedents for Experiential Learning

We are all familiar with the videos of lion and tiger cubs playing at stalking each other in preparation for adult lives as hunters and providers, and how their parents guide the process while young ones follow along. A recent observation by our editor

showed crows exhibiting a similar learning behavior for feeding: "I was watching a pair of parental crows this morning, with their offspring. Each adult would search for examples of a foraging opportunity and then call (using a cooing sound) to its offspring. The young fledgling would 'run' to join its parent, and the parent would then point out the targeted objective (by tapping its beak repeatedly on the target) and the method of overturning a leaf or scraping off a carcass from the sidewalk to acquire the object. Although the latter was easiest, it took a little time to learn to discard the leaf as a non-object. Nevertheless, it only took minutes to learn…learning by doing" (W.B. Campbell, personal communication, 11 September 2011; for further information on the culture and language of crows, see http://www.crows.net/index.html, accessed 11 September 2011). What we observe in ourselves appears to be common in the animal kingdom.

Especially in academia it is useful to keep in mind the historical insight that experiential education in people did not begin with John Dewey at the University of Chicago and Columbia University. A recent paper by Richard Green and colleagues (Green et al. 2010) reports for the first time the Neanderthal genome, with a conclusion that a portion of the genetic complement of these early hominid people was identical to other Eurasians who co-habited the continent for a time. Similarities of some aspects of the culture of these people to our early selves were described with incredible clarity and imagination in the first novel of the "Earth's Children" series by anthropologist and popular author Jean Auel (1980); *Clan of the Cave Bear* was an astounding re-creation of the lives and culture of a Neanderthal clan in Central Europe about 25,000 years ago. This book is a novel to be sure, along with the rest of the series on Cro-Magnon culture, but one created on a foundation of sound archeological and anthropological research, and telling stories is an effective strategy for learning. To many of us this fictional account opened a window, albeit with a necessarily shadowy and obviously speculative view, on a long unknown part of our history.

Most likely without a clearly spoken language, rather through small sounds and gestures, information and culture were transmitted from one generation to the next. Young people learned by doing. The behavior patterns of animals used for food were observed and learned, and this information was employed mostly by male members of the clan to increase success of the hunt and assure a protein supply. Nutritious plants and plant parts such as seeds or roots were gathered for storage or immediate preparation, mostly by females of the clan, assuring a balanced food supply, medicines, and some security through winter. Such activities certainly involved learning with the hands, but involving the head and the heart as described for systems action education in the next section. Archeological evidence assures us through discoveries of animal bones and plant seeds that both animal and plant materials were essential to the diverse diets of this early hominid race.

Our Cro-Magnon ancestors continued this type of hands-on, experiential education. Without formal activities or infrastructure for what we today call education, these early people passed the accumulated wisdom about hunting and gathering on to their children. Everyone learned by doing. It was not until the advent of organized agriculture, perhaps 10,000 years BCE [Before Common Era], when there was enough surplus produced by some people to allow others to specialize in activities other than primary

food production, that villages and larger organized societies began to emerge and with them the roles of some people as teachers or indoctrinators.

By the time of the Industrial Revolution, strict control methods and rote memorization had become the norm in both children's and higher education. In the United States we celebrate this history with student visits for 1 day to century-old schoolhouses where they copy on slates what the teacher writes on the board, practice recitations as a group, and eat a typical lunch carried in a folded scarf. It is a useful lesson in how things once were on the prairie. Yet this model has continued to some extent into modern times, with emphasis on note-taking, memorization-based examinations, and routine group project reports using PowerPoint® as the normal educational presentations by students as well as by the educators who teach them.

Before moving to specific contributions of some influential thinkers in the area of education, it is useful to explore the context into which these ideas are being applied. Turning history on its head, the idea of "experiential" learning has become something new and innovative – in fact it is attracting study and impacting instruction. For some current educators, integrating experiences into their teaching seems only necessary when teaching "hands-on" subjects, often conscripted to labs and highly controlled classroom activities. However, we have found "hands-on and minds-on" practical methods widely applicable to study farming and food systems, with student teams interacting directly with stakeholders as they explore the broad ecology of food systems.

Because of long exposure to less liberal learning methods, students often have difficulty at first adapting to the open-ended case approach where they in fact must design their own methods and take responsibility for the results. But the long-term genetic connection to ancient learning methods and integration into social learning groups traced back to our ancestors has been alive and well in apprenticeship programs to learn the trades, and we can reestablish a similar deep connection into academic programs in order to integrate new learning into our past experiences. One could even suggest that our own evolution has led to some "hard wiring" that predisposes us to embrace experiential learning as preferable to memorizing facts out of context.

Challenges to the effectiveness of learning by memorization have stimulated the development of several important alternative learning theories, and their translation into teaching strategies that involve greater initiative and individual participation by students (Schunk 2008). Recognizing that much of human educational history over 10,000 years reflects a reliance on hands-on experience, practical learning from mentors in the field and forest, and just-in-time learning by trial and error can help explain why our species is perhaps "genetically predisposed" to learn by doing. When this approach is drastically altered to rely on lectures, often without real-world context as in many conventional courses, it should not be surprising that many students fail to learn what they are being taught.

The field of agroecology lends itself well to activity-based learning, and often its educators organize field trips and other activities. But many of today's instructors who use constructivist or active learning methods are not well acquainted with the beginnings and past century of experience with these methods. Teachers may use these methods with a natural sense of the value of "hands-on" activities, but often

are not motivated to explore the literature or realize the depth of theory associated with the field. Too often "experiential" learning is equated with a farm field trip or other visit to an outside facility, as examples rather than as openings for further learning. The educator needs to carefully plan these sessions, so that structure, goals and reflection will maximize potential impacts on students' integration of new ideas and experiences into their mental frameworks. For those who are interested, it can be helpful to examine past thinkers in the field and their contributions to associated theories, as well as to examine how agroecology and other such practical arenas are better suited to integrating those theories into educational planning and execution.

Even with its extensive informal history, the study of experiential education in modern times is actually a young field; many times its thinking and theories, as its practitioners, exist in their own world of ideas and methodologies as well as research. Agroecology, among many practical fields, integrates work-study and internship programs, as well as field trips and labs, into classroom-based learning, and we have found many more opportunities for true experiential learning to be introduced into such programs (Francis et al. 2011; Østergaard et al. 2010; Lieblein et al. 2005b). In order to do so, it is useful to learn from key resources in the literature to add theory, depth and value to our empirical teaching experiences. When agroecology is defined as the study of the ecology of food systems, education in this broad discipline embraces the production, economic, environmental, and social complexity of this vital sector of human activity and requires careful design of educational strategies (Francis et al. 2003). Within such a transdisciplinary field of study, there are creative opportunities for students to learn by doing, by experimenting, by reflecting and by problem-solving in a real-world context.

This section enriches our current understanding of current and potential experiential learning options in agroecology by examining the historical context of learning in general. We ask, what is education for? What is the role of lectures versus experiential exploration? The contributions of John Dewey, Kurt Hahn, Paulo Freire, and David Kolb all serve to inform modern organization of experiential learning, and those connected with examples of activities used by groups currently integrating such strategies into agroecology education. The impacts of these historical academic and philosophical thinkers include the meanings and value of experience and reflection, and how the educational goals of an agroecology program can be met when educators and students engage in carefully designed and shared learning activities. Including modern-day programs in this review can promote the translation of theory and research in experiential education into practice, and an emergent property is to spur ideas for evaluating the outcomes of such programs now and in the future. The overall goal is to explore how experiential education in agroecology, by building on foundational experiential practices in other fields, can meet the challenges of a complex future for agriculture and food systems, with uncertainty surrounding resource availability and climate variability. It is useful to observe that much of our current academic tradition has been strongly impacted by several highly influential educators and researchers who recognized the importance of experiential learning to meet these challenges. The historical literature was reviewed recently by Moncure and Francis (2011).

## 2.1 Research and Writing of John Dewey

In the midst of the Industrial Revolution, when the form of education was still strongly influenced by the hierarchical structure of the church, John Dewey emerged as the founding researcher and most influential early advocate of experiential education (Itin 1999; Katula and Threnhauser 1999; Carver 1996, 1997; Trigg and Balliet 1997; Hopkins 1994). He was influenced by the late nineteenth century connection between philosophy and psychology, during which time researchers and teachers in philosophy generally taught young people through this single lens. Even working within a highly theoretical framework, Dewey focused strongly throughout his career on pragmatism, and "argued that thinking and acting should be considered as one coherent entity and not as separate endeavors" (Null 2000). He pointed to the importance of thinking, analysis, and evaluation rather than studying to pass a test. Concerned with producing well-prepared and effective young United States citizens, and in alignment with the progressive education movement, Dewey asserted that "education was … the central part of preparation for participation in a community" (Itin 1999). In considering which of the many possible experiences to approach with a given student or group of students, Dewey considered both the experience itself and the structure necessary to make that experience a tool for learning. In *Experience and Education* (Dewey 1977), he addressed this dual responsibility, as well as the situation presented by traditional school subject matter now as then: instructors base their choices of educational materials on what has succeeded in past situations and with past students, without considering the needs of the students with whom they are presently working. Dewey found that "the material to be learned (in typical learning settings) was settled upon outside the present life experience of the learner" (Dewey 1977), and asserted that subject matter should begin in each student's present situation. In this way of thinking, new learning experiences or knowledge are built into a student's past experience base which then become integral to their lived knowledge. Østergaard et al. (2010) describe how, in ongoing agroecology learning experiences, we start each new student group with a shared farm experience. In addition to helping the farmer and creating a common context for the group, added value can emerge from creative student imaginations. One group on a farm in Norway in 2010 spent a day stacking firewood, superficially a dull activity once the first cord is in place. Yet students launched into discussions of renewable energy resources on the farm, how to add value to this internal resource, and the global energy crises and the extent to which firewood would solve some current challenges.

Dewey wrote that the most important connections would be those discovered and/or constructed by the students themselves: "The way out of scholastic systems that made the past an end in itself is to make acquaintance with the past as a means of understanding the present" (Dewey 1977). He proposed a dialectical process of learning, "integrating experience and concepts, observations and action, learning and being taught" (Katula and Threnhauser 1999). This process depends on a fluid relationship between thought and action; Dewey's view was that "philosophers derived valid assertions only through the translation of their ideas into practice"

(Null 2000). Dewey put this into practice in his laboratory school at the University of Chicago, where shared experiences led to learning for students, but also for teachers, as they explored together. In current agroecology application, we use "open-ended cases" – learning situations in which answers are not known by farmers, instructors, or students – where all are searching together to derive relevant questions and design potential scenarios for the future (Sect. 6.4).

Dewey emphasized the importance, especially in this recursive learning model, of the educator's plan for both experience and reflection. Dewey's "principle of interaction" defines experience as a "result of the interaction between the student and the environment" (Carver 1997). His "principle of continuity" builds on the initial experience, where it "both takes up something from those which have gone before and modifies in some way the quality of those which come after" (Dewey 1977). In this way, those experiences that are reflected upon and found to support, enrich or challenge the learner's current thinking are integrated into the whole of the student's life, and cannot therefore be viewed singly or in isolation from other experiences or perspectives, even those in the student's future. Learning in context, the modern term, attends to both this temporal consideration and the eminence of academic, personal, or social learning. We consider this to be an essential part of phenomenon-based learning (Østergaard et al. 2010).

Holistic learning is explored by Carver (1997), who built on Dewey's foundation considering the educational value of both formal and informal lessons learned through experience: the value is based on "not only the explicit curriculum but also the lessons people acquire by participating in activities … lessons acquired collaterally as well as formal curriculum are the substance of students' learning." The past experiences of students – as well as their feelings about those past experiences and the meanings they have assigned to them – influence the potential learning value of the present situation, no matter how thoroughly planned by the educator. Habit itself, which is often carried out unconsciously, can positively and negatively impact the learning experience. Dewey emphasized the differences "between habit, 'the great flywheel of society' that enables society to function predictably when faced with recurring challenges, and the habit that tyrannically traps us into behaving in a particular way without thinking of alternatives" (Beard and Wilson 2002). This unthinking and unfortunate type of habit has been recently described by Barker (2001) as "paradigm paralysis," in which certainty prevents the mind from opening to new possibilities. These cultural and psychological influences were in Dewey's day, as now, generally not explicitly considered when designing learning experiences. Taking on such influences opens new possibilities to support students' exploration of not only alternative habits, but also alternative futures, and the concrete planning necessary to make those futures real. As discussed later, Fig. 7 illustrates a *learning ladder* that summarizes the learning process (Lieblein et al. 2007). In order to be able to work with students in this way, we must understand and incorporate into our planning those students' habits of learning, often highly influenced by their less open-ended prior educational experiences.

The second essential element to experiential learning, according to Dewey and central to the field, is what could be defined as thinking combined with action in

experience: reflection. In fact, experiential educators are quick to caution that success in experiential situations cannot happen with experience alone; reflection must be an explicit part of the process (Brooks-Harris and Stock-Ward 1999; Itin 1999; Raffan and Barrett 1989; Stremba 1989; Kolb 1984). It may seem reasonable to simply insert a reflective assignment after each activity. However, reflection can actually occur at any point during a learning experience. In some cases, reflection is quite valuable at the beginning of an exercise, laying the groundwork for later learning by helping students examine their current framework and knowledge base, and prompting memories of past experiences (Brooks-Harris and Stock-Ward 1999). The more common type of reflection, happening right after an experience, helps students assimilate the experience into their working knowledge, and reconstruct their theoretical understanding of pertinent content related to their experience. Here we describe reflection in our agroecology classes.

It can be especially beneficial for educators to structure learners' reflection in an ongoing or recursive process, rather than in one, often final, activity. In this format, students are given a structure within which to practice a more continuous manner of reflection, and have the opportunity to experience more than one type of reflection, especially both group and individual reflections. While individual reflection often takes the form of written or art-based journal entries, group or pair reflection can take many forms, including discussion or debate, sharing of written work, role play, shared art work, or rich pictures of a farm or community situation.

Dewey's classic definition of reflection, while focused on the intellectual rather than the emotive, has formed the basis for reflection in use to this day: "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and further conclusions to which it leads…it includes a conscious and voluntary effort to establish belief upon a firm basis of evidence and rationality" (in Beard and Wilson 2002). We consider reflecting on one's action as central to learning in connection with experiences.

## *2.2 Outdoor Education and Kurt Hahn*

For many, Kurt Hahn, the creator of Outward Bound, is the most well known and even most important contributor to the tenets of experiential education. The idea of experiential education as consisting of mostly ropes courses, survival challenges, and other outdoor learning experiences is related to the spectacular success of Outward Bound and its focus on the outdoors. Hahn created the principles that would later inform Outward Bound, now known as the Seven Laws of Salem (Salem School n.d.), to guide his first school in Germany in 1930:

- Give children opportunities for self-discovery
- Make the children meet with triumph and defeat
- Give the children the opportunity of self-effacement in the common cause
- Provide periods of silence
- Train the imagination

- Make games important but not predominant
- Free the sons of the wealthy and powerful from the enervating sense of privilege.

Although Hahn's first school taught teens, those same principles are quite applicable to higher education. For agroecology, bringing the theories of the classroom into the outdoors and testing them by interacting directly with farmers and people in communities are especially important. Thus Hahn's approach to learning dovetails nicely with the needs of agroecology educators, whose goal is to help students connect with real problems in the real world. Hahn's experiences with conventional classroom education in Germany and England, and his belief in the importance of helping young people to "speak their convictions" (Smith 2001) led to his conviction that a different educational approach was necessary to encourage true learning in his students: "Concerned that society was crumbling, he designed Outward Bound to 'protect youth against a diseased civilization' in which there existed a lack of 'care and skill', 'enterprise and adventure', and 'compassion'" (Carver 1997). Over time, these goals and the outdoor experiences proposed by Hahn have provided the foundations of what today is often termed "wilderness education" – the most widely recognized form of experiential education. Agroecology educators build on those same foundations by integrating on-farm or community problem-solving with reflections on the ethics and values inherent in both those problems and their potential solutions (Lieblein et al. 2007).

Agroecology experiential learning can follow Hahn's own methods as we plan structured and challenging experiences for and with our students, keeping in mind his stated goals for education and his methods of reaching those goals. In this way we can emulate his belief that the "foremost task of education [is] to ensure the survival of these qualities: an enterprising curiosity, an undefeatable spirit, tenacity in pursuit, readiness for sensible self-denial, and above all, compassion" (HIOBS 1990). James (1995) outlines Hahn's "four central elements … to education":

- Using a 'training plan' where students contract around specific personal goals and a code of responsibility
- Structuring the use of time to gently impel students into action
- Placing difficult challenges before students that involve a perceived level of risk and adventure
- Using the group to mirror a mini-community with shared experiences to help them begin to work together.

Even when students' experiences are less physically challenging than those central to the Outward Bound philosophy, placing students in intellectually and socially challenging situations, including those that expose them to differing cultural norms, perspectives and ways of thinking are directly reflected by Hahn's tenets above. Open-ended case studies, especially working in contexts and considering problems that the students and their teachers, will not easily solve will challenge the students' ways of looking at the world (Francis et al. 2009).

These holistic learning goals, undergirding experiences that consider the learner "as thinking, feeling, physical, emotional, spiritual and social beings" (Carver 1996),

also give students part of the teaching role, recognizing that they bring much to the learning community's prior and current experiences and may have very unique and valuable insights to share during reflections and within the larger context of the program. Hahn's original goals set down in the early 1930s still influence today's experiential learning values: "caring, compassion, communication, critical thinking, respect for self and others, individuality and responsibility" (Carver 1996).

## *2.3 Social Change and Paolo Freire*

Paolo Freire, often best known for his critical philosophy of education, has had a strong influence on the more specific realm of experiential education. This "Brazilian educator whose theory of adult education [was] set within a larger framework of radical social change" (Merriam 1987) developed in the early 1970s the "theory of conscientization" in an effort to help all people examine themselves, others and their cultural habits and systems. His hopes were to bring to the forefront social issues that may never before have been examined even by the people that were most negatively impacted by those habits, to help them see the alternatives available to them, and to strive toward those new ways of thinking. Freire was especially interested in examining educational constructs for their power to impact all members of a society (Freire 1973). As summarized by Burbules and Berk (1999), "Freedom, for Freire, begins with the recognition of a system of oppressive relations, and one's own place in that system. The task of critical pedagogy is to bring members of an oppressed group to a critical consciousness of their situation as a beginning point of their liberatory *praxis*. Changes in consciousness and concrete action are linked." It is especially relevant to our agroecology curriculum to include reference to the work of Freire because he epitomizes the search for social relevance and concern for equity of benefits from research and education, a dimension missing from most writings on the design of practical learning.

Praxis is a key concept for experiential educators, including those in agroecology. Freire defined this idea as "the authentic union of action and reflection" (Burbules and Berk 1999). In alignment with Dewey, Freire made the importance of individual experience and meaning-making explicit: "to attend to the experience of people is to empower them, to give them a voice, to challenge and disrupt established arrangements, to engage in dialogue and thus to evoke what Paulo Freire called 'generative themes' that point to change and reconstruction, whether in a classroom or in a society" (Hopkins 1994). This realization of the importance of agency – the ability of people to act independently and make their own choices – elevates the personal experience from merely important to vital in the formation of an independent thinker and powerful member of a community. Further, Freire insisted that when people have things done for (or to) them, or even do things for (or to) others, in either case the humanity of those people is diminished (Claus and Ogden 1999). It is in working together that groups of people can all achieve the shared sense of agency that lifts up both individuals and cultures, and works against power differentials.

This important aspect of experiential learning: working with others, rather than doing for them, has become more discussed in recent years, especially in programs that focus on helping others solve problems or doing "service learning" assignments outside of students' own communities. This consideration is vitally important when planning and executing open-ended cases in agroecology; the farmer and the student must both come to the program from a position of value rather than be unconsciously depicted as only receiving a handout.

## *2.4 Learning Cycle of David Kolb*

Our final historical figure, cognitive scientist David Kolb, is most well known in higher education. Kolb expanded on Dewey's work, hoping "to change the educational environment in this country [U.S.] to meet the needs of the new populations entering higher education: non-traditional students, minorities, and the poor, whose concrete experiences and socialization have not prepared them for traditional textbook approaches to learning" (Katula and Threnhauser 1999). Kolb's work aligns with Dewey's not least in the idea of individualized learning approaches, which "allow for the development of a community-based body of knowledge to be construed from the multiplicity of experiences brought into the contemporary classroom" (Katula and Threnhauser 1999).

Kolb is most well known for his experiential learning model, developed in 1975, and shown in some detail in Fig. 6 (Kolb 1984). This now-famous model is often divided into a circle, though the first descriptions of the learning cycle were as a spiral (Smith 2001). Typically the cycle begins with a *concrete experience*, then moves through *observation and reflection*, *forming abstract concepts*, and *testing in new situations*, or experimentation (Kolb 1984). "Knowledge results from the combination of grasping experience (concrete and experimental) and transforming it (conceptualization and reflection) … for Kolb, learning actually begins with experience" (Katula and Threnhauser 1999). In agroecology, we often begin our class with a shared farm experience, which can then naturally lead to the other portions of the cycle (Lieblein et al. 2007). Kolb describes his experiential learning cycle as connected with work-school relationships:

> The experiential learning model pursues a framework for examining and strengthening the critical linkages among education, work, and personal development. It offers a system of competencies for describing job demands and corresponding educational objectives and emphasizes the critical linkages that can be developed between the classroom and the 'real world' with experiential learning methods. It pictures the workplace as a learning environment that can enhance and supplement formal education and can foster personal development through meaningful work and career development opportunities (Kolb 1984).

Seen through this lens, experiential learning activities and programs can provide invaluable experience for the student and professional alike, connecting the "work" and "study" worlds so strongly that learners' learning experiences are their work, and *vice versa*. For Kolb, life is study, work is life, and to attempt to separate the two is to ignore the natural learning tendencies of all students.

Kolb's experiential learning cycle seems to provide a lightning rod for critique as a model: many educational theorists and teachers find it to be useful and practical as a planning tool, while others have challenged its validity (Miettinen 2000; Askew and Carnell 1998; Holman et al. 1997; Hopkins 1994; Anderson 1988). In balance, we observe that Kolb's experiential learning cycle has influenced many programs in secondary and higher education, as well as professional and continuing education programs throughout the United States and elsewhere. It is an important fixture in our planning for and reflection about agroecology courses in the Nordic Region (Lieblein et al. 2010a).

## *2.5 Other Historical Influences*

The second half of the twentieth century saw the rise of many experiential learning programs, both in formal institutions and informal learning scenarios. Increasing interest in United States humanitarian presence in areas across the globe spurred government programs that would train "citizens of the world who could work in the world through venues such as the Peace Corps and Volunteers in Service to America [VISTA]" (Katula and Threnhauser 1999), as well as others such as the Swedish International Development Cooperation Agency [SIDA], the Danish International Development Agency [DANIDA], and the German Agency for International Cooperation [GIZ]. Study-abroad programs, which had existed in many forms for decades, became more popular in the late twentieth century and continue to this day, encouraging learners to expand their perspectives through guided and structured experiences.

Such study-abroad programs, as well as internships and cooperative learning experiences, service learning projects, and other field experiences have recently been better supported by organizations dedicated to accountability and practical experience in secondary and higher education programs. In fact, the American Association of Higher Education (AAHE) has itself joined this effort. In 1995 the chair of the board of directors, Helen Astin, recognized the need of higher education institutions to "connect our research, teaching, and service to the needs of the communities and society at large" (Katula and Threnhauser 1999). The organization has continued to support this cause, for example through their 21-volume monograph series on service learning (AAHEA n.d.).

The National Society for Experiential Education (NSEE) and the Association for Experiential Education (AEE) both focus specifically on the promotion and support of experiential education. Rather than limit their interest to higher education, these two organizations work with students of all ages and disciplines. In 1998, the NSEE established its principles of good practice in order to "facilitate experiential education's goal of integrating the classroom and the out-of-classroom experience" (NSEE 1998, in Katula and Threnhauser 1999). Both the NSEE and AEE offer resources, collaboration, and consulting services to educators, and the AEE has also developed an accreditation for adventure programs.

Throughout the last century, the influence of historical theorists and those organizing practical applications of experiential learning created a new field dedicated to individuality, strengthening community, and experience. Philosophers and practitioners are cited today by experiential researchers and educators who are addressing the challenges of contemporary issues, including the never-ending questions surrounding definition of experiential education, experience, and sustainability. Grounded in the ideas of Dewey, Hahn, Freire, Kolb, and others, plus the practical applications in the Peace Corps and now in educational programs in agroecology and active learning, a clearer picture of the potentials of experiential education is emerging.

In the field of agroecology, we recognize that development of competencies in systems observation, analysis and evaluation is vital in a time when the need for systems thinkers is growing and challenges facing humanity become more complex. Through experiential immersion in the current context and reality of the farm and community, connected with reflection building on experiences, each student can bring their skills to a team that is becoming prepared to deal with uncertainty and risk, with complexity, and with multi-objective client groups where the challenges are not simple and may be revealed through continuous interaction with the clients and the local biological, economic, and social environment. The phenomenological approach is clearly within the realm of Dewey's experience-based learning, and the strategy can be understood by study of the steps of Kolb's learning cycle. Social implications of various development strategies and the influence of the political and power structure of the community and of society are better understood when viewed through the lens of Freire's perspective on democracy and equity and how they impact decision-making.

## 3 Theoretical Foundation for Systems Action Education

Experiential learning activities in agroecology build on a practical theory that guides systems action education (SAE) in agriculture and food systems (Jordan et al. 2008). Although our team's experience is principally with upper division undergraduates and Master of Science students, this learning strategy could be valuable for agricultural and other applied education at all levels. As a method to inform the design of curricula, it has proven useful in guiding and assisting learners in gaining special orientation and practical capabilities that appear crucial to management, stewardship and sustainable development of agriculture. We define SAE as a system of education that engages the 'hands, hearts and heads' of learners in meaningful and ongoing learning experiences through active engagement with agriculture and related food, water, energy and land systems. Students are placed in learning situations that require integration of cognitive, physical, ethical and even spiritual challenges to make sense and meaning of their first-hand experiences with farmers and with food system stakeholders. One example is the popular exchange program that helps young people learn about other cultures (e.g. States' 4-H 2011).

The learning landscapes through which we guide our students provide opportunities to engage in conversations both disturbing and hopeful. We posit that such experiences will inspire certain pathways of cognitive development that are not catalyzed by more traditional agricultural classes, courses, and curricula. Such development may be necessary to achieve the inclinations, viewpoints, capacities and skills needed in a new and creative generation of agriculturalists. This section on the theory supporting SAE begins with an outline of what we consider the major overarching challenge facing contemporary agriculture – a systemic 'up-scaling' of thought and action toward long-term resource efficiency, sustainability, and equity of benefits. We then describe new and modified institutions that appear well-organized to meet this challenge. The section outlines capabilities that we believe students must gain to participate effectively in these institutions. Finally we present a pedagogy of SAE that will enable learners to deal effectively with the uncertainty and dynamic change that will prevail in future agriculture.

## *3.1 Challenges to Our Life-Support Systems*

All human activity is dependent on physical life-support systems – food, water, energy, land – that together constitute our environment. Mounting evidence indicates that these systems are seriously threatened by a scale and intensity of human activity that currently appropriates half of all primary photosynthetic productivity for support of a single species, humans, and by the resulting dynamics of the earth system as exemplified by climate change. Consequently, the stewardship of life-support systems is one of the most pressing challenges we face in the twenty-first century. Agriculture is most closely associated with 'food systems', but in fact sits at the nexus of multiple life-support systems and is strongly and reciprocally coupled to many of them. Arguably, the most pressing contemporary issues and opportunities in the management and development of agriculture involve interplay between agriculture and the essential and interacting life-support systems within which it must function.

To better address this interplay, it is widely recognized that we must 'up-scale' analysis and action to better address broader spatial-temporal scales, biophysically and socially (Robertson et al. 2008; Jordan et al. 2007; Foley et al. 2005). This wider orientation is necessary because of an important disparity of scales: the predominant human scales of experience and perception fail to encompass the scales of many social and biophysical processes within which agriculture and life-support systems interact. For example, restructuring agricultural landscapes is seen as one critically important strategy in agricultural development. In the same vein, up-scaling of social organization with development of more extensive and effective social networks is recognized as crucial to recognize and address complex environmental challenges and opportunities. A similar broader-scale focus is required to evaluate techno-scientific developments, such as biofuel crops that pose potential

invasion hazards of introduced plant species and may create new emergent problems along with the intended opportunities and benefits (Beck 1992). Finally, growing awareness of multi- and cross-scale interactions among biophysical and social factors – plus coupled dynamics of these factors – has increased our appreciation of crucial new frontiers for learning and action. Taken together, these frontiers can be viewed as an 'up-scaling challenge' that deserves urgent attention in agricultural education at all levels.

Evidence suggests that such scale disparities can be reduced and up-scaling achieved by a range of emerging methods. These include model-based spatial information (Sieber et al. 2010; Tallis and Polasky 2009), visualization tools for communication (e.g. Tress and Tress 2003; Al-Kodmany 2000; Klosterman 1999), and participatory planning processes (e.g. Deyle and Slotterback 2009; Schively 2007; Forester 1999; Innes 1992). Such methods have potential to expand the spatial and temporal perspectives of decision-making groups. While such new technologies can enable broader understanding among those who are receptive, there is a critical need to build institutions that are organized and oriented to engage in activities that will create a societal capacity for up-scaling and thereby expand the goals and scope of agricultural development and the requisite underlying processes of knowledge generation and learning. An example of an institution that meets these criteria is described in Sect. 10 as an 'active learning university'.

Such an expanded societal capacity will be an emergent property of a network of interacting institutions that are jointly concerned with agricultural development and knowledge construction. Networks that support collective economic action and other forms of collective activity crucial to up-scaling appear to be essential to complement the limitations of 'regulation-based' and 'market-based' approaches to agricultural development (Ison et al. 2007). Such networks therefore appear to provide a crucial 'third path' for agricultural development that can meet high standards for social, environmental and economic performance. To create 'up-scaling' networks, many have argued that new institutions are required, as well as significant transformations of existing institutions. These changes involve both organizational *structure* changes as described in Sect. 10 in future universities, as well as the ways that we teach such as experiential learning, a change in *function*. To illustrate the nature of these new institutions in both structure and function, we provide brief sketches in several important categories.

## *3.2 New Systems of Social-Biophysical Innovation*

Major new growth opportunities are emerging in the agricultural bioeconomy. This growth means adding bioenergy, bioproducts and marketable ecosystem services to the food and feed production that are the backbone of our current agriculture and its essential contributions to our society and economy. The fundamental challenge is to develop new production systems that are compatible with existing

systems, that agricultural producers will readily adopt, that communities will embrace, and that meet the needs of the many economic sectors that have a stake in the agricultural bioeconomy. It is increasingly apparent that these new objectives and systems should enhance and not compete with current food production, due to the need to double output over the next four decades to meet increasing global population and consumer demand for better diets.

To build a new bioeconomy that meets these needs and expectations, we need to create new institutions that will expand capacity for bioeconomic innovation by strengthening learning and action across research, private enterprise, civil society and government sectors (Veldkamp et al. 2009). Together, these sectors have power and resources to design and build new markets, policies, and supply/value chains needed for profits, ecosystem services and public goods. Innovations will emerge from dialogue and deliberation about goals and visions for agriculture, and *via* new technologies that enable a wide range of stakeholders to visualize, model, design and evaluate new system components in terms of economic, social and environmental performance. New institutions are vitally needed to integrate the elements and activities required for sustainable bioeconomic innovations. These institutions will focus on bringing people who live and work in a rural landscape together with private groups and public institutions that want to invest in that landscape. In contrast to the popular term 'value-chain', as agroecologists we prefer to see these as 'value-webs' or 'networks' with many of the same interactions, feedback loops, internal controls, and complexities that characterize food webs in the natural environment.

### *3.3 Reflexive and Adaptive Governance*

This new conceptualization of management for complex resource systems with biophysical and social components (Mandarano 2008; Voß et al. 2006) emphasizes 'co-management' of resource systems at spatial scales necessary to increase systems sustainability, enabled by co-production of knowledge, adaptive institutions, and interactive and iterative formation of goals and subsequent collective actions. Such governance mechanisms may be important in changing the overarching climate of policy, regulation and public opinion to remove systemic barriers to change in agriculture and related systems. Reflexive and adaptive governance has a wide range of potential applications, but is particularly necessary for a ubiquitous challenge: management of cumulative effects of land-use and land-use change on common pool resources, such as water, watersheds and similar resource systems. Cumulative effects on resource systems are one of the major pathways by which agriculture affects other life-support systems, and can create major vulnerabilities for societies and resource systems, such as urban flooding risks (Foley et al. 2005) and water quality degradation. Cumulative effects are poorly addressed by most current management and decision-making systems and associated knowledge systems (Turner et al. 2007; Odum 1982).

### *3.4 Second-Order Research and Development*

This mode of scholarship aims to engage researchers in the search for durable improvements in complex, contingent and controversial problem situations. Such researchers place themselves among multiple stakeholders concerned with problem situations and orient their scholarship *via* critical and systemic thinking conducted by multi-stakeholder groups (Ison 2008). Such scholars are not external observers, but rather are participants in the design and development of biophysical and social aspects of agricultural lands; they are immersed and embedded in the complex systems under study. The goal is to improve the effectiveness of scholars in addressing major systemic problems (Henry 2009), through more effective feedback between scholarly knowledge production and other development efforts. As well, such feedback to scientific disciplines and other participating professions will promote their evolution into up-scaling institutions. Such investigation has been called 'phenomenology' by Edmund Husserl (1913) and others.

### *3.5 Boundary Organizations*

Certain organizations act to span key gaps among social sectors by a range of educational and applied activities. These institutions aim to enable qualitative, systemic change in complex 'management regimes' comprised of production, consumption and governance elements (Holtz et al. 2008; Wilson 2007) and to support coordinated transformations across multiple interacting regimes such as food, water and energy systems. Similar to the important biophysical activities in the ecotones of natural and agroecosystems, boundary organizations have many potential functions but one of the most fundamental is 'strategic communication', which is both a conceptual framework and set of strategies and tactics. The key premise of strategic communication is that virtually every significant activity of a group, organization or institution should be considered as a communicative act. According to this view, it is crucial for boundary organizations to embrace the new forms of 'story-telling' that are now recognized as highly powerful tools in a milieu of diffuse and fragmented governance. The idea is that moving sustainability initiatives forward is crucially dependent on 'selling a good story' that embodies a compelling vision of the future, and that this story must be told by the right people, with conviction, credibility, and power, at the right time, in the right place, and to the right people. Strategic communication emphasizes the communicative behavior of organizations, and critical awareness and skillful conduct of such communication.

### *3.6 Outcomes of Systems Action Education*

In order to construct the new institutions that are needed to substantially up-scale analysis, learning and action in agriculture, and to catalyze its interplay with other

life-support systems, we need people who are prepared to inhabit and embody these institutions. University instructors and others must be capable of playing new roles in their working lives, including roles as innovators, story-tellers, entrepreneurs, networkers, and civic scholars. To play these necessary roles, we contend that essential attributes, skills, visions, and world views are crucial outcomes of systems action education (SAE), and these are far beyond the normal expectations for skills and knowledge related to the biophysical functions and product outputs of agroecosystems. We summarize these in terms of four cardinal agencies or capabilities, and they are similar to those steps in the Kolb Learning Cycle shown in Fig. 6.

*Deep reflection.* A capacity for critical and constructive reflection on actions, underlying mental models, and worldviews of themselves and others is crucially important to competent performance in new roles that contribute to the success of new institutions for up-scaling learning and action in agriculture. This capacity is needed to address a fundamental and widely recognized challenge to sustainable development: the cognitive and practical capacities of individuals and groups imbedded in narrow disciplines and professions are too limited to manage complex sustainability problems (Pahl-Wostl 2007; Pretty 2003; Ravetz and Funtowicz 1999; Röling and Jiggins 1998). Rather, a process of intensive interaction among people in different disciplines with divergent "ways of knowing" is apparently necessary (Berkes 2007; Folke 2006; Warner 2006). To be most effective, such interactions appear to depend on reflection about other fundamental processes of learning and understanding (Toderi et al. 2007; Bawden 2005). The logic for such focus depends on the assumption that change in what we "do" in this world depends crucially on the way that we view or construe issues in it: *ergo*, to change the way we treat the world will demand a transformation of our views of it – our worldviews or "epistemes" (Maturana and Varela 1988). This is no easy matter, for our worldviews are constituted by our personal and social beliefs about such crucial matters as the nature of nature (our ontologies), of the nature of knowledge (our epistemologies), and the nature of human nature (our axiologies). Each is underlain by values and normative assumptions of which we are usually quite unaware – let alone skilled at challenging and confident and competent enough to change, even when they clearly impede progress on issues that are widely perceived as urgent and important.

*Rich observation.* This is a capacity to observe and construct useful models of complex situations. In agricultural SAE, complex situations are most fundamentally construed as 'coupled human-natural systems' (CHANS) which focus attention on interactions among social and biophysical elements of agriculture and the resulting dynamics of agriculture and its relations with other life-support systems. This coupling creates the potential for strong and rapid feedback effects and other 'biocomplexity' phenomena, including cross-scale interactions, tipping-point dynamics, and legacy effects (Liu et al. 2007). Such interactions could be termed the 'ecotones' between disciplines. In practice, a capacity for rich observation enables students to create heuristic models of agricultural systems, *via* an inductive approach that enables collaboration with people from many disciplines in the model-building process. To do so, students find it useful to develop a 'CHANS perspective' that is a capacity

to envision how the interplay of social and biophysical components of an agricultural system can lead to biocomplexity phenomena including emergent properties, feedback-driven dynamics, thresholds, legacies, cross-scale interactions, time-lags and resilience. The practical application of this perspective and creation of heuristic models involve a variety of methods for characterizing biophysical and socio-economic dimensions of eco-social systems in agriculture (Ison et al. 2007). Soft-systems methodology is an especially effective tool for creation of models of 'poorly structured' problem situations, where many different stakeholders involved in the situation hold divergent views of how that situation might be improved. As an important component, ecosystem conceptual models (Heemskerk et al. 2003) are effective tools for organizing understanding of biophysical dimensions of agroecosystems.

*Future visioning and design*. The ability to apply design-thinking to future challenges and to use design as a tool for visioning are fundamental to new institutions for up-scaling (Nassauer and Opdam 2008). Processes for visioning and design of new agricultural systems and their relations with other life-support systems must account for and draw energy and inspiration from the diverse priorities among stakeholders in this nexus of systems. Diverse priorities arise from divergent positions and interests among stakeholders, as well as from unresolved differences in worldviews and mental models. These differences make discussions of transition from current agricultural systems to more broadly functional systems highly contentious (Jordan and Warner 2010; Turner et al. 2007; Wilson 2007). As well, cultural factors, 'habits of mind' (Pickett et al. 2005), structural conditions, power relations, and strongly-held notions of agricultural system structure and function affect many decision-makers, favoring a narrow range of system patterns, features, and functional attributes (Kaplan et al. 1998; Kaplan and Kaplan 1989).

Emerging approaches to multi-stakeholder visioning and design aim to address these worldview-related challenges head-on (Jordan et al. 2008), enabling multi-stakeholder groups to search for landscape designs to accommodate divergent interests, facilitate changes needed to increase multi-functionality, and achieve the goals of multiple clients. These approaches depend on deliberation-based processes of planning and design (Ison et al. 2007; Wilson 2007; Pahl-Wostl and Hare 2004), involving facilitated dialogue and conflict mediation when divergence occurs among the views, priorities, and interests of multiple stakeholders. Such activities are linked and coordinated *via* new visualization and representation methods that illustrate how new agricultural systems for multi-stakeholder groups function. The strategy involves creating a dynamic, interactive process of visioning, visualization, design and deliberation. Such processes can address systemic change in a manner perceived as legitimate by multiple stakeholders, enabling collaborative decision-making and alignment of policies, regulations, and resources needed to implement change (Deyle and Slotterback 2009; Burby 2003; Margerum 2002; Innes 1992).

*Responsible participation.* In our view, this capacity arises from participation in a group whose members view themselves as essential to that group and its critical activities. The 'whole' entity might be a producer cooperative, or a watershed association, for example. The most basic activity of the group is collective determination

of the boundaries of practical and ethical concerns that define the whole entity. Thus the people define the relevant system, and recognize the group as a critical 'learning subsystem' of the larger whole. A second aspect of responsible participation is helping the group to be ethically and morally discerning, by deciding what *should* be done by the whole entity, within the broader range of actions that *could* be done, and how such action should be undertaken.

Responsible participation also suggests that the group takes part in 'metacognition', or learning about the group's own processes of learning, and questioning the adequacy of familiar knowledge sources. For example, the group may consider making use of additional "ways of knowing" (e.g. ethical, aesthetic, cultural, political, ecological and spiritual) to complement the economic, technological, social, and legal ones to which conventional development approaches typically restrict their attention (Bawden 2005). Such critical considerations exemplify a higher level of cognition above the group's conventional learning about immediate and obvious concerns, such as the question of what functions and actions should be performed by the whole entity as compared to individuals. A practical application of this theory through "agroecology education for responsible action" was described by Lieblein and Francis (2007).

Responsible participation also means taking part in a group's "epistemic cognition," by which that group becomes self-aware of the learning process and strives to develop morally and intellectually in order to overcome epistemic issues and constraints, such as challenges and perceived limitations to individual and collective worldviews. Finally, responsible participation means to help the group function recursively in learning and action, by participating in the "work" of the whole entity, observing subsequent outcomes, and then re-engaging at multiple levels of cognition in an ongoing process of action and self-critical learning that becomes integral to the work of the larger whole.

## *3.7 Systemic and Systematic Practice as a Fundamental Competence*

The four cardinal capabilities described above are necessary for persons who wish to participate and be most effective in the new institutions needed to meet the upscaling challenge. Each of these capabilities requires a certain mindset, as well as a familiarity and practice with an extensive set of skills. Such skills include willingness to understand a wide range of perspectives and viewpoints and to accord respect to these, as well as skills in communication that are grounded in an ability to understand multiple perspectives and viewpoints. Also crucial is the ability to think imaginatively, intuitively and critically about the integration of resources, skills and perspectives of multiple actors who are enrolled in a collective effort (Batie 2008). Finally, ability is needed to appreciate multiple contexts – social, historical, cultural, and political – that surround a situation of concern (Batie 2008). Consequently, these mindsets and skills are important outcomes of SAE. In turn, in our view there

is a fundamental competence that is essential to these mindsets and skills and hence to each of the cardinal capabilities.

Needed competence entails two forms of practice – the 'systemic' and the 'systematic' – in the context of a particular discipline or profession, and it also requires an ongoing dialectic between systemic and systematic thought and action. By systemic, we refer to an ability and inclination to interpret lived experience in terms of a systemic viewpoint, or 'systems thinking'. By systematic, we mean the application of a particular 'way of knowing' to better understand a matter of concern. As we describe below, evidence supports the view that a dialectical practice of thinking systemically about systematic thinking, and *vice versa*, drives learning and cognition that are essential to the successful exercise of the four cardinal capacities.

This dialectical theory has been advanced in a number of contexts. Ison and Russell (2000) presented theory and case studies on the interplay of systematic (1st order) and systemic (2nd order) approaches in agricultural research. Lieblein et al. (2007) proposed an agroecology pedagogy predicated on the interplay of systematic and systemic learning, based on their experiences with agroecology curricula in Norway. In their model, systematic learning addressed foundational knowledge of biophysical or social components of agroecosystems, and was likened to lower rungs on a 'learning ladder' (see Fig. 7). Systemic learning addressed 'higher order' learning outcomes such as critical reflection on the relation of theory and practice, visioning and design, and their implementation as steps of action on farms and in communities. Systemic and systematic learning were seen as mutually reinforcing, each creating 'need to know' for the other. Similarly, several educators have advocated the integrative application of 'hard' (systematic) and 'soft' (systemic) systems approaches (e.g. Rodriguez-Ulloa and Paucar-Caceres 2005). We elaborate on the notions of systemic and systematic approaches before describing their interactions and contributions to the cardinal capacities.

The basis of a systemic view is a decision to consider some aspect of the world 'as if it were a system' in order to achieve better sense and meaning. A system may be defined by a choice to view a set of factors as coordinated (Wilson and Morren 1990). This definition emphasizes that the systemic view is an epistemology, in which interconnections and interactions among factors are particularly important. Moreover, the systemic view requires conscious model-making, or viewing a set of factors as if that set were a system. It is useful to describe, abstract, and simplify reality, but the systemic view distinguishes between modeling reality as a system from reality itself. The systemic view recognizes that people continually create and use simplifying mental models of the world around them (Argyris et al. 1985), often without explicit awareness of this cognitive process. Ultimately, the systemic view is a "habit of mind" that identifies and reflects critically on the simplifying models that guide attitudes and actions (Mezirow 1996).

In the mainstream systemic tradition (Checkland and Scholes 1990; Churchman 1979), a systemic model must have three features. First, a model must specify the emergent properties of a collection of interacting factors; the outcome(s) of that interplay are emergent properties of the system. Second, a systems model must recognize nested (or hierarchical) structure by consideration of the relative dimensions

of the various interacting factors in the model. For example, these factors can have different physical sizes, work at different speeds, or have differing degrees of power. Factors that are relatively large are seen as forming the context or environment for smaller factors. Conversely, smaller factors can sometimes cause rapid change in larger factors. Third, a systems model must recognize feedback in the system. Feedback occurs when one part of a system affects a second part, which then affects the first part in return. In systems models, these reciprocal influences are seen as the mechanisms that drive the system's dynamics, including facilitation of change by positive feedback and resistance to change by negative feedback.

The systemic view is a highly general framework: the interconnected factors can be social, biophysical, intellectual, cognitive, affective, spiritual, or historical. Beyond the formal disciplines of systemic modeling, the most critical element of the systemic 'habit of mind' is an awareness that systems models are deliberate abstractions that result from intentional and necessarily subjective decisions about the boundaries of a system: what is included and excluded from the set of interacting factors, what relationships among factors are examined, and what emergent properties are seen as important. The supervening discipline of critical awareness of these subjective decisions and their consequences is termed 'critical' systems thinking (Bawden 2005). An extremely important implication of this critical awareness is that systemic thinkers take pains to create multiple systems models. These models reflect the distinctive viewpoints of individuals and groups that share a common concern but which have quite different systemic views of the situation. When a group works together to reflect critically upon multiple systemic viewpoints, critical systems thinking can create an 'intersubjective' appreciation of complex situations that can provide the basis for deliberation, shared understanding and collective action on a matter of common concern (Bawden 2005).

The other part of the systemic/systematic duality is the systematic element. To take the systematic view is to apply a particular way of knowing to better understand a matter of concern. This is to say, the systematic view applies a particular epistemology and associated rationalities, plus rules of evidence, that characterize a particular 'way of knowing'. Our common examples are particular disciplines or professions. Like the systemic view, the systematic view is a very general notion that encompasses all manner of rationalities, including ethical, aesthetic, cultural, political, ecological, spiritual, economic, technological, social, and legal ways of knowing. An inquiry is carried out using a particular way of knowing to address the unique facets and dimensions of a matter of concern to which that way of knowing pertains.

In our view, the dialectic between systemic and systematic is the basis of effective exercise of each of the four cardinal capabilities. For example, deep reflection by individuals is energized by thinking systemically about the systematic aspects of individual rationalities, exemplified by a person's critical reflection on the congruence of their personal 'espoused theories' and 'theories in use' (Argyris et al. 1985). The former are ostensibly used to guide thought and action, while the latter actually do so. Often, some significant discrepancies are evident, and such an exercise may reveal underlying values and normative assumptions of which we might have been unaware or about which different players disagree. This exercise is essentially systemic

because it creates a model of thought and action that recognizes nested structure in the control of thought and action by overarching elements of worldview. Such insights may then provoke change at the systematic level, by changes in theories in use and related actions and activities. Deep reflection by groups is also propelled by the interplay of systematic and systemic, as argued by Batie (2008) in challenging agricultural economics to consider how their discipline addressed complex issues in agriculture and environment. Such issues that she termed 'wicked problems' include how does agricultural economics:

- find and establish its role in addressing wicked problems?
- institutionalize processes in graduate education that are relevant to fulfilling those roles? and
- survive and thrive if more resources are allocated to address wicked problems?

Each of these questions asks how a systematic rationality such as agricultural economics can function as part of a larger system of knowledge production that addresses highly complex, contingent and controversial problems.

A similar creative tension between systemic and systematic can strongly affect future vision and design. Visioning and design can be undertaken systematically, when they are guided and motivated by a single rationality. For example, design for a particular aspect of function is a highly focused activity that applies particular logical and analytical approaches; visioning from this same point of view may emphasize predicting or forecasting most-probable future conditions on the basis of a particular approach or logic. Design can also be undertaken systemically (Ison et al. 2007), in which case there is a strong awareness of the history, circumstances and context of the situation to which design is responding. In this case, the contingency of the design process itself – including methods and elements of design – is keenly felt by those engaged in design. Thus, an act of design is understood as a performance, for a particular audience, where design done systematically produces an output as described by Ison et al. (2007). In the realm of visioning, scenario planning (Biggs et al. 2010) is a process that is typically highly systemic, as its success is dependent on a critical appreciation of the nature of and interactions among the worldviews and knowledge resources of participants.

## *3.8 Essential Elements of SAE Curriculum and Pedagogy*

We have argued that the fundamental outcome of effective SAE is a dialectical practice of thinking systemically about systematic thinking – and *vice versa*. We contend that this dialectic drives learning and cognition that are essential to the successful exercise of four cardinal capabilities. In our view, SAE can help learners become more skillful in using this dialectic and those capacities, and thereby enable them to better meet the up-scaling challenge in development of agriculture and related life-support systems. To build these skills and capacities, we believe that the essential task of SAE is to help learners progress along certain dimensions of cognitive and epistemic development (Jordan et al. 2008).

Our view is guided by multiple analyses of epistemological development of young adults, all members of the dominant Anglo-American culture in the U.S. (West 2004). This series of studies began with the famous work of Perry (1970); each examined changes in the approach of young adults to complex and controversial 'ill-structured' problems over time and experience. All reached a common conclusion: there is a well-defined and consistent path of cognitive and epistemological development in young adulthood. In essence, young adults pass through a stage in which absolute authority is recognized, followed by a stage in which different rationalities are seen as equally valid, to a stage in which a particular rationality and its 'rules of evidence' become predominant, to a stage in which multiple rationalities, multiple perspectives and deliberation among these are seen as essential to finding good ways to address ill-structured problems. The dialectical tension of systemic and systematic thinking and action that we posit as essential to the cardinal capabilities is of course congruent with the latter stages of epistemological development observed in this body of research. As well, these latter stages also emphasize a collective process of critical systemic thinking outlined above as the source of a shared and inter-subjective appreciation of an ill-structured problem. Consequently, we propose that SAE be designed and structured to enable epistemological development of learners in their approach to ill-structured problems.

A crucial insight from the scholarship of Perry and colleagues is that many post-secondary learners are moving through the earlier stages of epistemological development (West 2004; Salner 1986). Consequently, one of the most important tasks for SAE is to offer opportunities to learners that will stimulate their ongoing development. How might SAE enable such cognitive and epistemological development? We propose that SAE must strive to provide certain learning experiences that promote a dynamic interplay of different ways of experiencing and knowing a complex situation. Specifically, SAE must provide experiences that compellingly engage the 'hands, hearts, and heads' (Sipos 2009; Lieblein et al. 2008) of students and faculty, and this engagement must occur 'in community' (i.e., among a group of persons who share a significant level of engagement with a situation of common concern). We believe that when SAE provides such experiences, it will engage learners in the cycles of learning conceptualized by Kolb (1984). These cycles are understood to be propelled by a dialectic of 'finding out' and 'taking action' (Bawden 2006), in which hands, hearts and heads are each engaged in both 'finding out' and 'taking action' phases. Moreover, finding-out activities must have both systemic and systematic dimensions, with particular importance being placed on experiences that engage learners in systemic thinking that will surface underlying cognitive, worldview and moral/ethical frames and encourage appreciative and critical reflection upon them. Social and communicative learning is a crucial vehicle for such learning, building on the differences in worldviews and perspectives among students whose hands, hearts and heads have been engaged by shared experience in a situation of common concern.

In particular, our theory of SAE practice posits that the engagement of 'hands, hearts and heads' must meet certain criteria. The goal is to support cognitive and intellectual development that enables learners to make productive use of the duality of systematic and systemic. To support that development, we propose that educators

should strive to engage students holistically – hands, head and heart – with a narrative that has certain qualities. This narrative, or 'storyline', serves as a vehicle for dynamic processes that we see as essential to SAE. We must create a storyline that is compelling and which has certain elements of balance and proportion. The storyline must appealingly engage with all three elements of the trinity of hands, hearts and heads, and the students must perceive themselves as actors with agency in the situation. A certain balance and proportion are particularly crucial in the heart (affective) domain. In this domain, we must enable learners to experience discomfort and empathy for the characters of our narrative, and yet have some sense of hope and possibility. Indeed, we believe that narratives should be presented as ongoing and unfolding stories, in which our students can play a meaningful and significant part. We believe that if such a narrative can be constructed and experienced holistically and actively by students, it will provide a powerful basis for cognitive and intellectual development. In particular, we propose that the linked Kolbian learning cycles of 'inspirational' and 'experiential' learning posited by Bawden (2007) can be propelled by such experiences in narrative, and that these cycles provide a key pedagogical model for SAE.

In Bawden's framework, derived from his pioneering experience with SAE at Hawksbury College in Australia, the experiential cycle is Kolb's (1984) cycle with its phases of experience, reflection, conceptualization, and experimentation. Bawden proposed a parallel cycle of inspiration learning based on contemplative activities. Further, he proposed that educators can promote creative tension between the two cycles by artfully coupling them in pedagogy. When used in a setting of social and communicative learning, the coupled cycles are seen to jointly create a strong 'need to know' for students, in both systemic and systematic terms. In particular, the joint operation of these cycles is seen to strongly stimulate systemic perspectives and meta- and epistemic cognition. In systemic terms, Bawden argues that the two learning cycles create a positive feedback process that propels moral and intellectual development along the trajectory outlined by West (2004).

A process of inspirational learning is central to this theoretical framework. Bawden posits that a cyclic process of inspirational learning can be facilitated for students, involving a series of stages. Inspirational learning begins with facilitation of "meditative disengagement", by which a learner moves from the abstract conceptualization phase of Kolb's experiential learning to reflective contemplations on experience and its meaning and significance, followed by further facilitated phases of this learning cycle: from reflective contemplations to spiritual insights, from spiritual insights to active applications of these insights, and thus back to abstract conceptualizations. This dynamic between experiential and inspirational learning is seen by Bawden as promoting interplay between 'spiritual' and 'experiential' worlds. The notion of a spiritual world is based essentially on a learner's self-understanding as a part of some greater whole. Bawden supposes a dialectical relationship between insights resulting from inspirational learning in a spiritual world, learning from experience in an experiential world, and meaning created by this interplay, resulting in intellectual and moral development at the level of an integrative 'conceptual world' that is the basis of mental models and worldviews that guide thought and action.

### *3.9 Conclusions and Implications for SAE Practitioners*

The 'practical theory' of agricultural SAE outlined above is much in need of critical systems thinking. This certainly includes consideration of our students' natures: their backgrounds, mental models, previous cognitive and moral development, and their previous experiences with engagement of 'heads, hearts and hands'. We must also consider our own natures and roles as instructors, and what our programs of SAE consist of, in their totality. We certainly must consider the institutional context of programs in which our students are working and learning, and the milieu which our students experience with heads, hands, and hearts. We need to recognize our own biases and how they impact the choice of objectives, methods, and examples. Finally, we need to concentrate our critical faculties – and our own heads, hearts and hands – on how these interrelated dualities of systematic and systemic, first and second order, communicative and systemic, and hard and soft systems can be incorporated into the culture and incentive system of current and yet-to-emerge institutions of learning.

## 4 Building Components into Integrated Systems

Resource efficient and sustainable agriculture is based on location-specific, integrated, complex and coordinated systems designed using principles of ecology (Francis and Porter 2011). Such systems are more than collections of individual production practices, and it is difficult to improve complex systems by focusing on those single components. To understand the importance of "location specific", it is also critical to understand the importance of niche adaptation, and to move away from the "one solution fits all places" production philosophy. The rush toward an industrial agriculture generally has ignored the reality that agroecozones are internally diverse even within a farm or a single field. Much of the research and education taking place under the banners of agroecology and sustainable agriculture is based on the recognition of the primacy of ecology and natural systems as models, and an assumption that we need to work with knowledge gained from natural systems that can inform design of future agroecosystems.

Similarly, the present educational system is primarily based on understanding individual components through disciplinary teaching and learning, and for several decades we have attempted to combine these components and homogenize the production environment to maximize yields. From an ecological perspective, systems are more complex and often location-unique, depending on topography, soil types, weather and climate, and soil quality characteristics in addition to all of the human diversity that is directed to management on each farm. An ecological systems perspective requires the identification and understanding of the multitude of interactions in an agroecosystem, and the uniqueness of place, in order to solve the emerging 'wicked problems' our society faces including feeding a growing world human population. Future production systems must depend on ever more scarce resources, and minimize negative environmental impacts such as soil erosion and water quality degradation. A transdisciplinary learning approach to agroecosystems analysis to

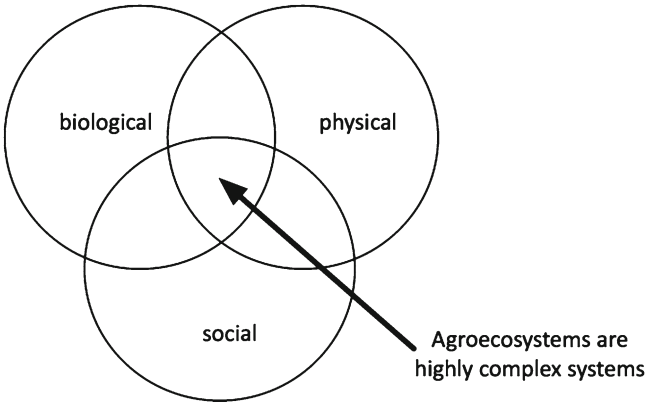


**Fig. 2** Fundamental components of an agroecosystem

address this complexity must often involve both quantitative and qualitative approaches, since farming in fact is a human activity system that we impose on the broader ecological landscape.

## *4.1 Research and Teaching in Complex Agroecosystems: Four Models*

Systems thinking and strategies are complex. How can we design learning activities to make systems thinking manageable for students, many of whose systematic thinking skills are still developing? How can we use the four steps in learning and the capabilities outlined by Kolb in our agroecology pedagogy? How can we help students develop capacity for deep reflection and the skills for rich observation that can contribute to more robust design of sustainable systems? In short, how can the complexity of systems be studied and illustrated, without losing an understanding of their components, in order for students to deal effectively with that complexity? Researchers and instructors attempting to answer these difficult questions have taken different approaches, while we have found the systems action education model to provide useful guidance for program design.

It is important to recognize that agroecosystems are human managed systems made up of abiotic (physical) and biotic (biological and social) components including the farmer decision-maker. To state that an agroecosystem is a complex system, but for simplicity can be diagrammed as in Fig. 2, suggests that biological, physical and social aspects of the system barely overlap. Such a visual diagram minimizes the importance of the overlap, but is illustrative of how we think about and also how we teach about systems in universities. To some degree, this de-emphasis on their common ground masks the truly intricate connections among these three system components; in reality, the overlap in an agroecosystem among the biological, physical

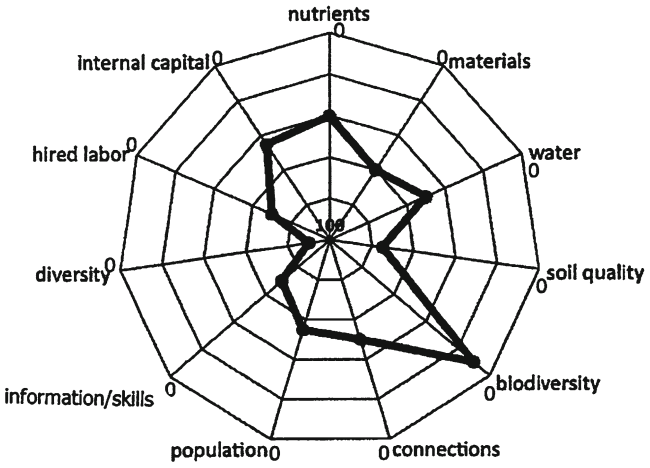


**Fig. 3** Spider plots and cobweb diagrams have been found to be useful tools in visualizing strengths and weaknesses of an agroecosystem, but they fail to indicate interconnectiveness among and weights for the several components

and social aspects of the system is almost, if not totally, complete. Since there are so many interactions and vital connections among the components, in order to better understand a complex system we often 'break it down' into smaller components and use reductionist strategies to attempt to understand how each component is structured and how it functions. Examples include our substantial experience in hands-on soil sampling and testing, measuring crop yields in response to fertilizers and other inputs, employing integrated pest management, and understanding soil biology and soil microbiology. The challenge is to integrate all the components of the agroecosystem so that the totality of the agroecosystem is appreciated, if not wholly understood, and to recognize that much of the action and excitement takes place at the interface between components, similar to the high level of biological activity at the ecotone between two parts of an ecosystem.

Rather than a reductionist's approach of focusing primarily on yield, agroecosystem analysis takes into account negative externalities as well as positive ecosystem services. Many of the components in the agroecosystem can be quantified. Several methods, such as the cobweb (Van Mansvelt and van der Lubbe 1999; Olson 1998; Gomez et al. 1996) or spider plot (Gareau et al. 2010) illustrate relative quantitative performance of various components of a system as shown in Fig. 3. Relevant components that may represent biological, physical, and social aspects of the system or components that represent externalities or ecosystem services are selected. The performance data is ranked and plotted and a line is drawn between plotted values on each axis to form a polygon. The size of the polygon reflects the balance of the system. This method also has disadvantages. Although it is useful to show various identified elements of a system, the illustration of components indicates neither their interconnectedness nor the relative weights of components in the system, unless these are embedded in the choice of scale for each component. Also, if equal weights

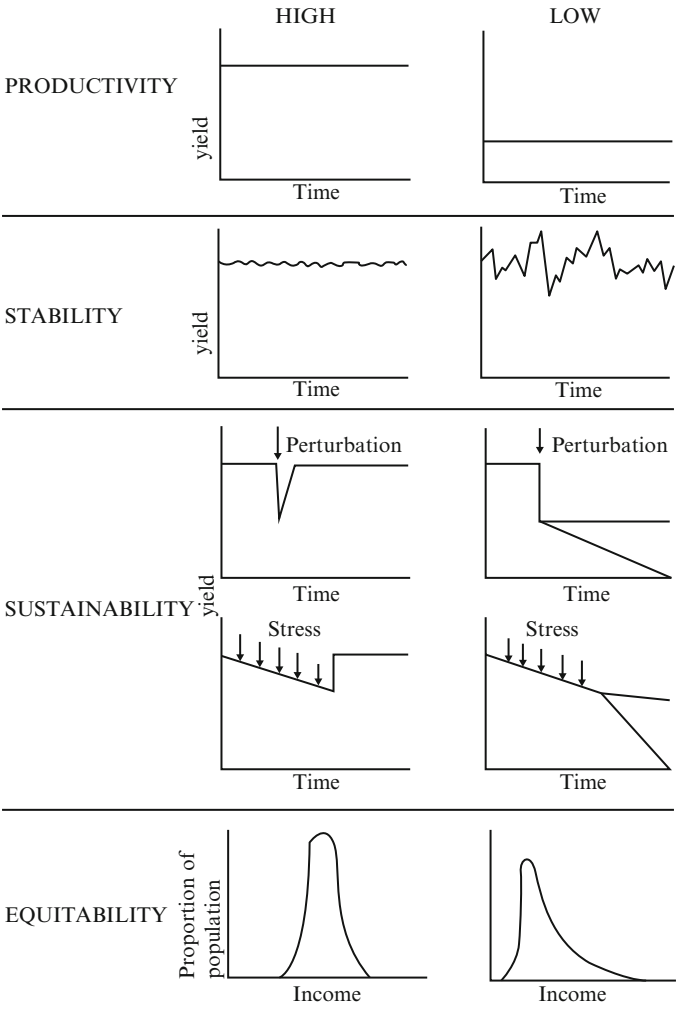


**Fig. 4** The systems properties of agroecosystems as defined by Conway (1985)

are given to all factors, it is not helpful in setting priorities. Finally, the crucial and multiple interactions among the components are not diagrammed, one reason that we often use a rich picture of the farm or community to illustrate interactions. If the chosen scale has high sustainability (100) in the middle, the smallest possible polygon could indicate a small ecological footprint and desirable economic and social outcomes; if low sustainability (zero) is in the middle, one seeks the largest possible polygon. In either case, a logical goal should be balance among the components.

Conway (1985, 1990) illustrated the complexity of a system by quantifying the productivity, stability, sustainability and equitability of the system as shown in Fig. 4. In Conway's quantifications, each of the four components was defined relatively as "high" or "low" over time or income level.

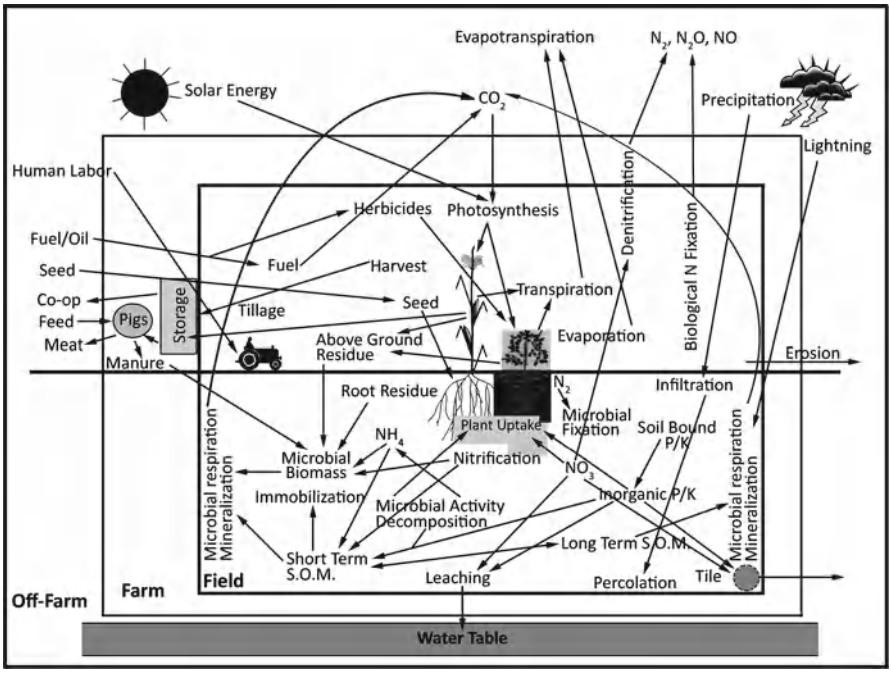


**Fig. 5** Diagramming the connectiveness of components of biotic and abiotic cycles and flows at the farm-scale begins to illustrate the complexity of agroecosystems analysis (Wiedenhoeft 2004)

Diagrams of the components of a system and their relationships to one another begin to show much more complexity as illustrated in Fig. 5. In a disciplinary approach there is a tendency to focus on one or two components, which we consider to be the critical or the controlling factors of the agroecosytem that we are studying. In doing so we often fail to realize the extent of the interconnections and interactions within the system that we are attempting to manage. One disadvantage of this model is that the connections do not illustrate the intensity of the relationship, only the fact that a relationship exists. Additionally, diagrams of this type can often become too complicated and difficult to understand; one of the major arguments for disciplinary research is to understand mechanisms and components, unencumbered by the multiple and complex connections and interactions in the real world.

An example of a more qualitative/descriptive model for agroecosystem analysis has been proposed by Bland and Bell (2007). Their Holon Model advocates that every farm or agricultural environment (agroecosystem) has many individual layers and is itself part of a larger whole. Using this concept of systems and subsystems, the farm is envisioned to be a "holon" which is both the whole in which smaller holons exist, and a part of larger entities, themselves holons. The farm holon is simultaneously embedded in multiple larger holons, each of which is a context in which the farm has meaning. Likewise, an agroecosystem exists amid many contexts including climate, soil resources, labor available, and government policies.

They argue that as the "ecology of contexts" is so complex and dynamic it is impossible to perfectly characterize a system.

None of the tools described here is perfect, of course. Yet each of them helps us better understand human impacts on their environment, one of the primary intents of agroecosystem analysis.

## *4.2 Beyond the Models: Designing for Complexity and Resilience*

These several methods of illustrating structure and function of agroecosystems provide some insight into how and why the combination of components and their interactions is greater and certainly more complicated than a simple sum of the parts. It is this principle that must be captured in both research and education on agroecosystems, since understanding only components often does not provide enough vital insight to help us design improvements in systems design and management. In fact, the manipulation of single components of systems often results in emergent properties, or unexpected consequences, that will substantially affect system performance. Understanding the structure and function of interactions is only the first step toward better comprehension of systems, and does not begin to tap into the rich trove of possibilities that emerge from complicated biological systems functioning in a complex and unpredictable environment.

It has been our experience in teaching agroecology that a viable alternative and better route to understanding systems does not begin with studying components. Although knowing what is involved with soil fertility and plant protection does help the agroecologist to scout fields and to diagnose certain production problems, too much focus on specific components in one's primary discipline can obscure an overview or system-level perspective on what is really happening. One story often told to illustrate limitations of disciplinary expertise describes a visit to a maize field by a team comprised of plant breeder, entomologist, pathologist, soil fertility specialist, and agricultural economist. Walking through the same field, the plant breeder observes the leaf structure and light interception by the particular hybrid, the entomologist sees the incidence of maize borer in stalks, the pathologist quickly sees a few symptoms of leaf rust, the soils person observes some minor nitrogen deficiency, and the economist speculates about what the price of maize will be at harvest and what the opportunity costs would be under various marketing strategies. Each has seen what was most obvious from the perspective of each discipline. Perhaps none has seen that the over-riding factor in the system may be a lack of adequate equipment to get the crop out before lodging occurs, that global energy prices will make transport to a distant and more lucrative market out of reach, or the opportunity to expand with a livestock enterprise and add value to the commodity. Each of these specialists would design a research project to find solutions to the problem that he or she identified. We often teach courses in the university using this same fractured perspective, and we propose that agroecology provides a broader way to look at systems and their many interactions, a capacity that will serve our students well in the future.

## 5 Potentials for Experiential Distance Learning

In inductive learning, the phenomenon to be studied is the starting point for the learning process. In our concept of studying agroecology, human activities taking place on a farm, thus 'farming' becomes the key phenomenon. The inductive approach to learning is based on several theoretical traditions, where experiential learning has a central position (Kolb 1984). The roots of experiential learning are found in the theories of John Dewey on learning and experience (Dewey 1977). The challenge in distance learning is to capture the process of starting with an important phenomenon, for example the farm and its multiple activities, and providing students with as rich an experience as possible through materials we can organize on-line so that they will all start on the same page in their understanding of concepts, strategies, and the group work process.

Among our team of authors, we have experienced a range of applications of distance learning in agroecology and other fields of study. The Nordic team has conducted a 7-week on-line course in spring semesters for the past 8 years. *Introduction to Agroecology* continues to attract enthusiastic students from a number of countries. The course has also served as a recruiting device for the Norway Agroecology M.Sc. program described in various sections of the review, and for other courses and programs (Lieblein et al. 2005b).

In this section, we provide an overview of our experiences and how they inform potential applications for the future, particularly as they apply to the systems view of learning (Moore and Kearsley 2011). We have all faced the challenge of designing into a course the background materials, activities, and resources needed to provide students with the full suite of learning modalities needed for the systems action learning described in Sect. 3. We strive to guide students to cycle fully through all of Kolb's learning cycle steps for the main points and objectives of the course, and to do this by observing, doing, processing, reflecting, positing, summarizing, and visioning for the future. Our challenge is to catalyze this process without benefit of face-to-face interaction, although with Skype™ and other communication tools this is becoming less of a barrier.

### *5.1 Experiential Learning Using Information and Communication Technologies*

We have discussed the theoretical basis for experiential learning and systems action education. To broaden the learning landscape even more we now explore the potential of information and communication technologies (ICT) to help students reach their learning objectives. Powerful new technologies are transforming education and training in ways previously unimaginable by expanding possibilities for using digital case studies, simulations, videos and other visual materials, reusable building blocks of content, capacities to reach dispersed communities of learners, and much more.

Taking a closer look at the courses offered to students internationally, we observe that in practical teaching situations the methodology used in computer-assisted instruction is moving more and more into ICT – assisted knowledge construction, distributed expertise and collaborative learning. In many cases, traditional books have been replaced by electronic knowledge sources such as multimedia and on-line learning tools. ICT and networking can make the learning environment more open in terms of knowledge acquisition in all stages of education (Simonson et al. 2012).

Based on the specific contexts of our courses or programs, on student demands, resource availability, and desired learning outcomes, and on our fundamental pedagogical basis discussed earlier, we ask "How can we utilize information and communication technologies (ICT) to support and improve our programs?" To answer this, we must realize we are dealing with a continuum, from simply providing some of our learning materials on-line to providing an entire course from a distance. Where we are or should be on this continuum depends on the specific contexts for the courses and programs we are designing, including access to learners. Our experience suggests that it is possible to be true to pedagogical ideals as we move more on-line, of course with some important tradeoffs. Demands from our student groups for learning environments that are less dependent on time and place, something ICT can provide, challenge our notion of the importance of the human, face-to-face contact for learning. However, we do not suggest an "either/or" proposition but rather we call for innovative course design based on our learning principles, the specific contexts we are addressing and an openness to and an understanding of the potentials for ICT in supporting learning. Innovative design entails the introduction of technology in such a way as to create and support desired learning environments, resulting in what could be called "blended courses".

## *5.2 Learning Principles and ICT*

Our students must learn skills and be able to operate in a complex and uncertain world. In this context, they will constantly need to make rational decisions and take appropriate and responsible actions. Ideally, our learning environments should reflect as much as possible the complexity and uncertainty of decision-making in real work contexts, and the methods used include open-ended, real world, digital case studies. Mind mapping is one tool used by teams to illustrate and better understand complexity and interactions in farming and food systems.

In contrast to discipline-specific subject matter focused courses, in agroecology students need to become comfortable with knowledge construction and collaborative, social learning. Our learners bring previous knowledge, experience and attitudes to the learning process and these will strongly influence the acquisition of new competencies. Among the useful tools are Learning Management System based peer review, and application of 'wikis' or on-line documents for collaborative writing.

Schön (1983) has developed the concept of the reflective practitioner which is very much at the heart of helping students to use reflection as a tool in order to

progress on their way towards becoming professionals and acquiring competencies. It is the self-responsible identification and definition of the problem which creates an attitude-based relation of learners to learning tasks. This means that for the pedagogical design of a course unit, a complex learning problem and the methods to solve it should be developed by the students themselves. Useful tools include e-portfolios (electronic portfolios maintained by individuals on the web) and blogs (weblogs, or part of the websites of individuals who may be interactive with others).

Since one of the key learning objectives is to become agroecologists who are prepared for responsible action, incorporated into the course activities is a rich array of presentation tools to examine, illustrate, publish and communicate results. When these involve presentations to stakeholders, in addition to interacting with peers and instructors, the level of responsibility is raised to a higher level. Students have told us in their reflection documents that the payment by communities of some of their travel and lodging costs raises the level of accountability for both students and stakeholders.

Multiple methods of assessment are essential to monitor progress in learning and to allow for adaptive management of the learning environment. We consider reflection and assessment as integral and ongoing in the learning process. Some of the management tools that can facilitate this process include Learning Management System-based self-testing, self-evaluation, and electronic peer review. It is also possible for instructors to monitor the entire process, and to enter into dialogue with individuals or teams when necessary.

## *5.3 Practical Methods for Distance Learning*

The authors' experiences using Systems Action Education (SAE) in distance education settings focus on active engagement with course content. For example, we have described the use of case studies in the Nordic region and the U.S. Midwest, where open-ended cases have been suggested and used in a number of agroecology courses (Francis et al. 2009).

For teaching, these cases can be developed as short paragraph-length cases or as longer, fully written cases with much complementary background and data. In on-line distance education using a course management system (CMS), such as BlackBoard™, Sakai™, Fronter™, or WebCT™, the instructor may put the case description in a specific "folder." Students are then directed to go to the folder, read the case, look at supporting materials, perhaps find other materials, and discuss in writing or with other students what they are "seeing" in the case. For example, they may find use or misuse of irrigation schedules, crop selection for certain conditions or terrain, community support for a local market, and so forth. Using an on-line discussion, students may present their descriptions and provide feedback on colleagues' similar work. Instructors or students can search for overarching themes in the descriptions and present those to other students to validate the themes. Instructors may ask students to probe deeper into the case, looking for connections among

elements, asking for precursors to the case, or asking what might happen "if"? All this can be done using text-based methods of reading, writing, and responding, cycling through several rounds of reaction and review, depending on the objectives of the assignment. The case should be open ended as described elsewhere in this chapter.

An on-line video version of the case could also be developed and assigned. Using in-phone cameras, flip cameras, or other video cameras, instructors or students can create "documentaries" of on-farm activities, such as livestock feeding operations, produce harvesting for market, coffee-shop producer discussions of best practices, and then post them to the CMS, or another website such as Google Sites® or YouTube™. These off-line sites could be hyperlinked from the CMS. Students would visit these sites and view the case rather than reading; they might still write a description of what they saw, or perhaps they might make a short video response to the case and post the video.

In both the text and video distance education settings, students would engage with the materials in an active manner and post and discuss their reflections. The discussions are monitored and guided by the instructor to push and lead the students toward more systems-based observations, comments, discussions, and reflections. These practical methods are among those available, and new technologies are emerging every day to open new opportunities.

## *5.4 Distance Learning Applications at the University of Nebraska – Lincoln*

In an on-line Entomology class, students engage in a project in which they learn about a model insect, the Madagascar Hissing Cockroach. The instructor sends the cockroaches (in a container) to the students who take care of and monitor the insects for 8–12 weeks. During this time, students have weekly on-line, real-time discussions comparing insect behaviors and observations; pictures and videos are sometimes attached to the discussions. At the end of the assigned time, students complete a report and post it on-line. A summary discussion follows. Not only do the students learn about insect behavior and environmental settings and impacts, but they often come to "like" their insects and frequently ask to keep them as "pets." The results of this learning exercise are more than details on nutrition and reproductive behavior of the cockroach. They include, perhaps, an appreciation and empathy with another species that has been on the planet much longer than we have, and even some reflection on how they can be so sustainable.

The instructor in a class about technology and distance education in the College of Agriculture and Natural Resources has students conduct a "visitation" to an on-line class (i.e., Stanford University on iTunes University©). Students are to visit an on-line class the same way they would a face-to-face class, making observations about what the teacher is doing, in what activities the students are engaging, what technologies are being used, and so on. Reports are written and shared on a group or large class discussion board. Then the instructor asks students to revisit their

"classroom" and try to determine what instructional strategies (e.g. setting expectations, providing feedback, assigning homework, using repetition) the on-line instructor is using, the students' evaluations of the strategy, and how the students might use those strategies in their own instructional settings. These observations are reported on the same discussion board for a "picture" of one instructional setting. When the entire class is surveyed and all the assignments are reviewed, individual students have an opportunity to get a sense of multiple on-line classrooms, plus their own visit, to develop a rich picture of on-line teaching and the uses of instructional strategies. This type of assignment allows students to make comparisons between and across observations and develop higher order generalizations. With emergence of additional Agroecology M.Sc. degree programs in France, Sweden, Croatia, Slovenia, Ethiopia, and Uganda, among other places, the potential for interactive learning among students increases almost exponentially.

In another on-line class in the College of Agriculture and Natural Resources examining leadership, the instructor uses case studies of leaders. Students study weekly case assignments individually using key questions. For examination and graded exercises, students analyze one case from a leadership perspective based on a feature film (e.g. Mandela); in another exam, they choose two leaders from a list and compare and contrast leadership styles; for the final exam, students choose individuals they feel would make a strong teaching case and report on that person and issues related to leadership. Next, they develop a teaching guide that could be used to teach the case from a leadership perspective. The class and the assignments build from simple descriptions to analysis, synthesis, and evaluation. All assignments are posted to on-line discussion boards and students both respond to other classmates' postings and supervise their own postings, acting as a moderator for discussions in their thread. Current development of on-line cases in a SIDA-supported project in Sweden opens the potentials for a similar type of exchange and enrichment of leadership capacities, especially in the emerging Ph.D. program in Agroecology and Capacity-Building (Sect. 6).

## *5.5 A Nordic Net-Based Course in Agroecology*

In 2004, a Nordic net-based course, *Introduction to Agroecology*, was set up by instructors at the several Nordic agricultural and life-science universities (Lieblein et al. 2005b). This introductory on-line course was designed to meet a number of learning objectives for students as well as long-term goals for the Nordic Agroecology Network (AGROASIS). Among the latter was a desire to attract potential students to the 2-year M.Sc. Program and in particular to the intensive course in *Agroecology: Farming and Food Systems* in Norway that is a keystone course in the Program. This course is taught in the autumn semester each year, and the introductory course would provide useful information for incoming students as well as a tool for identifying new students to participate in the program. The introductory course was mainly designed as a stand-alone module that could be used as an introduction to the systems approach and as a complement to specific courses for students in other disciplines.

In 2008, 32 students from 15 different countries around the world participated in the course, and in subsequent years the annual enrollment has been consistent at 20–25 students. The course has the following learning objectives:

- Understand the key concepts and principles regarding structure and function of farming and food systems
- Know how to deal with goals and value-bases of farmers and other stakeholders involved in such systems
- Be familiar with methodology, methods, and tools for describing, analyzing, and improving farming and food systems; and
- Know how to connect theory of learning and theory of farming systems to a practical case through a simulated field experience.

In addition to a course content focus on whole systems, it was essential to address the question of how the educational process should be run. It was important that the teaching of agroecology should mirror the key properties of agroecosystems. It was identified early in the planning process that the inductive and inquiry-based learning approach would be highly compatible with agroecology. The initial discussion about *Introduction to Agroecology* was based on several years of experience in design and implementation of Ph.D. research courses that combined biological and social science methods for better understanding of whole agricultural production systems (Lieblein et al. 1999). What was new this time was the use of e-learning in a subject where linkages between practice and theory are vital. Moreover, there was the realization that a closer collaboration between teachers within the Nordic agroecology network was needed to successfully run such a course. In the initial planning phase, an attempt was made to design the course in a fairly traditional way, with a certain amount of literature assigned to ten topics.

During our further discussions of a wide array of learning goals, as well as the didactical goal of making the process of the course compatible with the key characteristics of agroecology, it became evident to the teacher team that we had to address the question of how to incorporate the inductive learning approach into a net-based course. We decided to develop a case based on a real farm that would be the basis for student learning in the course. We chose a Danish organic dairy farm as a case, and case development involved collection of farm data as well as extensive interviews with the farmer and farm family. Although all the university teachers had earlier experiences in using farm cases in courses in agroecology, it was new to us to integrate this element in a distance or an e-learning environment. We were mindful that methods used in an intense resident course with face-to-face interactions would not likely be the best for a course using electronic communication over distance and across cultures.

Already well acquainted with experiential learning, the group decided to apply Kolb's (1984) learning cycle not only for perspective and as a general guide, but also as a tool for designing the course and student activities with respect to the case study. The core idea of Kolb's experiential learning process is that knowledge is created through transformation of experience, and that the transformation consists of four interrelated activities: divergence (observation), assimilation (thinking), convergence (planning), and accommodation (action). It is vital to appreciate that

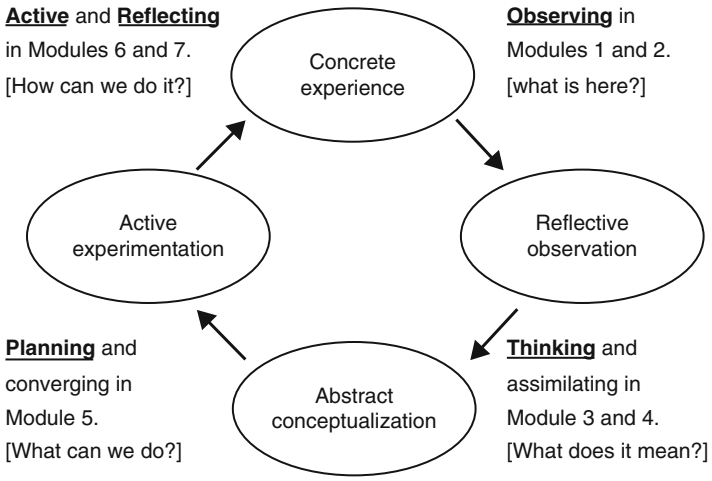


**Fig. 6** Design of the e-learning course "Introduction to Agroecology" with key questions framed in the context of Kolb's learning cycle (Adapted from Kolb 1984)

the learning process is more than cognition, since the process moves from the real world into the conceptual world and emerges back in the real world in the action phase. In the experiential learning process, the learner has priority over the subject matter knowledge of the teachers. The result of the planning is presented in Fig. 6.

Using the cycle as a guide, we were able to structure course activities with respect to student learning. In each phase, we asked key questions to guide student progress. To facilitate the awareness of their own learning process, students were asked to keep a log of their experiences. In addition, tools such as rich pictures and force-field analyses were introduced to help students make sense of and structure their experiences. These tools were particularly chosen to stimulate a number of creative options in the way students could present and discuss their assignments.

In conclusion, we cite Dillon and Granger (1998), who observed, "I am not a teacher of 'things', I am an 'orchestrator' of ideas. My educational institution is not a physical plant with classrooms and trees, but a 'hub' of resources no longer constrained by time and place. My students are no longer 'my' students, but we are all students together". This quote could be considered a key statement that describes our overall philosophy of experiential learning in agroecology courses.

## *5.6 Potentials for Blended Courses in Agroecology and Capacity-Building Ph.D.*

Development of a new international doctoral program in *Agroecology and Capacity-Building* is described later in Sect. 6. Today's rich multimedia environment provides multiple platforms that allow teachers to use more communication and media tools

to engage the students in active and ongoing activities. Where high-speed connections are available, it is possible for student project teams to operate in a virtual environment from any place in the world. For example, use of 'WebQuests™' gives the instructor a method of designing activities that incorporate existing websites (Dodge 1995). Students go on a "quest" and visit several, pre-selected internet sites looking for data to solve a given challenge, write a paper, or design a project response with others on a distance team quest. For example, if we want students to learn about the International Agricultural Research Centers, we might send them on a quest to centers in South America and West Africa. Students could discover different crops being researched, local extension systems' interfacing with the Centers, and the status of sustainability research; they might compare and contrast the centers, or they might be asked what ideas justify the location of the particular research center in those areas. WebQuests™ in a distance education setting offer many possibilities for teachers to design rigorous assignments using existing materials, for example contemporary real world information on websites that are updated regularly to reflect current reality.

## 6 Capacity-Building Through Experiential Learning

In the context of agroecology, we could define capacity-building as the process used in education to improve students' abilities to work effectively with challenges they will face in agricultural and food system development and research programs. We can, of course, facilitate their learning by providing literature and a forum for discussion in this field; it is more important to offer the hands-on field experience that can come through courses that use the open-ended case strategy for social learning and that involve working directly with clients in the field. Success in capacity-building requires a series of skills beyond those learned in technical disciplines, among them abilities to work well in teams, to display integrity and a strong work ethic, to recognize the challenges inherent in working within a complex systems environment, and to have respect for others and communicate well with colleagues and with the general public. These are the traits most eagerly sought by employers visiting job fairs at colleges and universities, although those employers also assume a certain level of technical skill and knowledge in the specific field of undergraduate study. One employer was heard to say, "In the university you should broadly educate your students, and then we will train them to do a specific job." Within this framework, we can examine the importance of capacity-building in our experiential education strategies in agroecology.

In this section we develop the case for the importance of experiential education in agroecology, in order to build capacity for our graduates to tackle the complex systems problems in the real world. Much of our discussion has focused on undergraduate and M.Sc.-level needs and approaches. However, experiential and action learning is dramatically important at the Ph.D. level, where this approach has only been found in a few dissertation research projects. In general terms, the practical

experience approach is used in class projects, internships, guided study while entering the work force part-time, and a combination of on-line courses coupled with outside learning for continuing education. Although this was once linked closely to theory and the science of agricultural education, for several decades it had largely disappeared. Now there is growing appreciation that this dimension has been lacking and should again become a vital part of our post-secondary educational programs. To be sure, practical models are working well in many of the trades, and especially in our community college systems, but these focus primarily on the practical skills needed to become adept as an electrician, a computer maintenance specialist, a medical technician, or an office manager.

Some colleges, such as the Nebraska College of Technical Agriculture (NCTA, http://ncta.unl.edu/), offer practical educational programs that help advanced undergraduates to learn by doing and enter farming and ranching with their own 100-acre farm or their own 100-cow herd of livestock. In contrast, our discussion of capacity-building in this section refers particularly to the higher order issues of working with institutions, in government, in the private sector, or in the non-profit sector. This capacity requires a complex set of social science skills and practice in community-building. People who leave academia with a B.Sc., B.A., or M.Sc. degree often become mid-level managers in these organizations. Many seek additional education, but have a difficult time finding a program that will accommodate their continuing work obligations.

## *6.1 Importance of Doctoral Programs in Capacity-Building*

In many cultures where few people attain the Ph.D. or terminal degree in science or related fields, these accomplished individuals are often tapped for administrative roles as quickly as they return from outside with an advanced degree. Most often they are highly prepared in a specialized area related to the field of their degree of study and dissertation project. They are at the cutting edge of their scientific specialty. Most often they are ill-prepared to face the myriad administrative and planning tasks that are expected, including preparing budgets and dealing with personnel management, supervising programs, dealing with politics of governments and funding agencies, and doing the visionary planning that is vitally needed in all organizations that hope to be sustainable and successful in the long term.

The concept of experiential learning to help people deal with these challenges has not often been found in Ph.D.-level education, as all the time and energy in research and science have been dedicated to specialization and disciplinary "depth". A Ph.D. candidate often is expected to be trained and educated in (1) the most cutting edge 'research frontier' within his or her disciplinary subject, (2) relevant theories and methods designed and applied in specific ways in that subject, and (3) general scientific skills in 'critical thinking'. This often leads to a very narrow focus in the period of graduate education and training. The knowledge and skills developed during this formative experience may have little use and application outside the field of

basic, academic research, especially if the training is focused on the first and second points. On the other hand, the 'development work' done with applied research institutes, NGOs and government agencies, often lacks people with capacity for the critical reflection needed on the theories and values foundations on which applied research is based. The situation calls for Ph.D. training in an interdisciplinary environment, where complex case situations outside the laboratory and field plot environment will be the norm, and 'critical thinking' will be a major emphasis. Without this broad orientation and experience, the new Ph.D. holder who returns to a development situation may become highly frustrated to not be able to continue with cutting edge research, and may attempt to do that narrow research whether it is relevant or not to his or her home situation. Another frequent behavior is the yearning to continue such research, and dedication of a disproportionate amount of time and energy seeking post-doctoral funding to return to the "womb of science" to continue along the high-powered prior research track. The scientist is frustrated, the organization and clients suffer from lack of directed attention and "responsible action", and the emergent property is lack of progress and overall weakness in an organization in trying to meet its practical development goals. Our proposed Ph.D. degree in Agroecology and Capacity-Building will help solve this perennial problem of disconnect between graduate education in science and real needs in the field.

## *6.2 Beyond Monocultural Agricultural Systems and Educational Thinking*

How did we reach this level of narrow technological specialization? As the introduction of fossil-fueled machinery gave human society almost infinite access to huge amounts of mechanical work power, at an apparently low price, the domain of interest started to shift in how an industrialized society would create its wealth. Large economies and wealthy societies were built over two centuries on this windfall of fossil fuel energy. In this process, the focus has been on maximizing the power from highly concentrated energy sources such as coal, oil, natural gas and uranium. The change away from reliance on contemporary energy was especially visible in changes in agriculture, from bio diverse contextually-adapted agricultural systems to monoculture 'one-size-fits-all' menu-driven systems. In these simplified systems, knowledge and skills have focused on mechanics, chemicals, and the systems supports required and generated by these energy-dense drivers. If a society has been 'industrialized' and has access to cheap oil and electricity, certain models have developed that are productive and efficient, at least as measured in short-term economic profits. Often many costs are externalized either spatially to other places, downwind or downstream, or temporally to future generations that will be required to clean up the mess or deal with scarce resources. The superficial success and glamour of these economies are compelling to those on the outside, and less fortunate people or societies will try to emulate that perceived success even if it is not built on the same resource foundation. The model could be called a "monocultural"

system and mindset, and we need to modify the educational opportunities now used to prepare narrow discipline-trained Ph.D. scientists to help them be successful in the leadership roles they will be thrust into once back home.

Moving into the post-industrialized era, these same societies are now learning to maximize the power from dilute energy sources such as sun, wind and rain to maintain a wealthy society. Agriculture has a unique role to play in this transformation, since our production systems based on green plants and photosynthesis are well suited to interception and collection of solar energy and precipitation. Both of these contemporary resources are received across the agricultural landscape, and used efficiently to produce food, fiber, feed for livestock, and fuel. Sustained economic success in the Global North will depend on the new knowledge and skills needed to capture, store, and efficiently use these two vital resources. In education this will take much more than business as usual and monoculture thinking, as we choose crop species, diversified crop/animal systems, and marketing of products in ways that benefit those who are the producers as well as benefiting the consumers. Business models are needed that can achieve modest and appropriate profits, in order to make the system work efficiently, and that exploit neither farmers nor consumers.

If a country and society or groups within that society do not have access to those energy resources, it is likely that great social disparities have evolved. Even when a country has an available fossil fuel resource, parallel situations occur when a small elite in business and government find ways to appropriate the local, exploitable energy resource and the derived profits from this business. In either case, this has contributed to the political unrest currently seen in many places, a challenge that may be at least partially overcome by leaders well-prepared to approach the situation in a more systemic or holistic way that includes an appreciation of natural resource, food, environmental, and social realities.

In many countries in the Global South, agriculture is mainly accomplished with small-scale farming systems, often providing the supply of essential food to the household. This subsistence activity frequently is combined with some level of sales or exchange with neighbors or a local market. These agricultural systems are designed to depend on the local natural resources and ecosystem services. The main energy drivers are sun, wind and rain in interaction with geological soil formation processes. Such agricultural systems are managed in a highly contextual way, and depend on flexibility, adaptation, local knowledge, initiative and creativity. The cultural circumstances and educational environment for local learning and experimentation are the most crucial characteristics for such a system to develop and adapt to new situations. The agricultural systems will then be highly integrated to the households' labor and food needs in each situation, and they often are highly diverse and multifunctional. These systems are very different from industrialized agriculture in both their aims, including food security for the household as the main goal, and in potential access to external support forces. Thus these agricultural production and food systems are both highly diverse and very different in the kinds of knowledge and skills that are most relevant for their development. It is into this environment that many people with a newly educated profession will enter, and their successful performance in developing local institutions will be highly dependent on the types

of prior orientation and education they have experienced. Of special importance is their motivation to pursue a professional agenda focused on development of local systems within the resource and cultural context that prevails, versus the yearning to continue in basic research. What is needed could be called a "multicultural and multi-dimensional" education and mindset. In an agroecological sense, one size definitely does not fit all.

## *6.3 Importance of Capacity-Building*

Within this perspective it is not strange that many "capacity-building" projects in national research and education programs, as well as in development aid programs that train agricultural expertise in Ph.D. programs in industrialized countries, have failed to adequately support small-scale farming systems. Newly educated specialists arrive back home with a goal to improve agricultural and food systems. A likely disconnect between what they have learned and the reality of resource scarcity and a multiplicity of unique farming systems that are adapted to diverse ecological situations may lead to frustration and difficulty in doing the job that is needed. This reality highlights the need for capacity-building programs with research education in agroecology as a transdisciplinary subject bridging the physical, biological, and social sciences, and the implementation of programs using experiential learning environments also at the Ph.D. level.

Most national agricultural research organizations in the South are modeled after their counterparts in the industrialized world, partly because of the success of these models and also because leaders have been educated and trained in universities where learning systems primarily serve high-tech agriculture. A logical extrapolation of the graduate research experience is to apply what was learned to achieve similar success, but often this is a challenge because of the very different resource constraints faced in other places. Many agricultural development programs in the South are managed by NGO organizations, often with staff members holding undergraduate university training in agriculture, and often in some kind of specialization such as crop or animal production, agricultural mechanization, plant protection, or agricultural economics. Their education is often focused on first-loop training, "Are we doing this right?" Less often do these programs include 'critical thinking' and 'second- and third-loop training', asking "Are we doing the right thing?", and "Why are we doing this?"

We propose that agricultural capacity-building programs in Agroecology, based on experiential learning on real world open cases that include second- and third-loop learning, could be highly attractive for an important category of graduate students: potential leaders and staff members in government administration, agricultural businesses, NGOs, and international outreach groups or aid agencies. These future leaders would embrace such capacity-building programs as highly relevant from their own real life experiences. Two current examples are the newly organized agroecology masters programs at Uganda Martyrs University

and Mekelle University in Ethiopia. Present students fit this profile, and their university administrators and future employers now strongly support their education in a broad agroecology masters program.

## 6.4 Capacity-Building Through Open-Ended Cases

Especially well suited to meet these needs of the professional in agriculture and development is the recently described "open-ended case" approach to experiential learning. The method must be distinguished from the better known decision case strategy that is well known in business and applied successfully in agriculture as illustrated with a collection of case studies assembled by a team of educators at the University of Minnesota and published by the American Society of Agronomy (Simmons 1998). In conventional decision cases, quite similar to what are generally found under the umbrella of problem-based learning, a situation is presented and students take the information provided and add their own experiences plus research on the topic to come up with a solution. The answer or solution is already known to the instructor, and if the clients or subjects of the study are involved in a first-hand way they also know the answers. Students quickly learn to play this game, knowing they must be clever enough to find out through questions and research what the instructor and/or client already know. Such a solution as well as the process through which it was derived will garner them a grade for the exercise. Their solution may or may not be presented to or critiqued by the client(s). This educational method has provided a valuable structure to learning that allows application of theory and knowledge to real world situations, yet the learning outcomes are somewhat constrained by students searching for something that is already known, and their need to "come up with the right answer" to achieve a satisfactory grade or evaluation.

In contrast, the open-ended case approach that has been developed in agroecology over the past decade introduces students to situations on farms and in communities where the challenges are real and the answers are not known (Francis et al. 2009). It is clearly recognized that there are multiple possible solutions, and that these are highly dependent on future resource constraints, changes in the economic and political climate, and expectations and visions of the clients. Two applications of this learning model have evolved in the U.S. Midwest and in the Nordic Region, and the differences in time available and other logistical constraints have resulted in two unique strategies using the open-ended case approach. They are described in detail in Sect. 8, but some general characteristics and observations are included here that are relevant to capacity building in a Ph.D. or other graduate program.

The goals of both programs are to prepare students to work with clients on the farm and in the community to help them assess their current situation and to chart a potential route toward an improved and desirable future situation. The Midwest program is focused primarily on farms and farmers, while the Nordic program includes both farms and communities. In both educational situations, students are provided with readings ahead of the course and are expected to digest them and

provide some feedback on what methods appear relevant. Students initially are frustrated with the minimal "teaching" from instructors and the need to seek out, discuss, and compare the possible questions they will pose to clients in the field. They appear to be well conditioned by years of conventional education to be told what methods to use, how to use them, and to apply this methodology to discover "the right answer." Further frustration quickly comes from uncovering many other methods and tools that were not provided and from which they must select appropriate ones, from learning that there may well not be a single right answer, and from finding that instructors are just as interested in the process they pursue as a team as they are in the final results. None of these observations fit into most of their prior educational experiences, even though they may have worked in teams and been expected to do problem-solving in a range of situations. Add in language and cultural differences, especially in the Nordic courses where students may come from ten or more countries each year, and it is not surprising to hear the question even after 2 weeks of the course, "Now what is it you really expect from us?" They gain little satisfaction from an instructor's answer, "You have been given the goals, a framework for learning, and some relevant tools, now what is it that you expect from yourselves?"

One of the goals of the courses reflected in an output called a "client document" is for each team to develop a series of potential future scenarios to improve the situation and help clients meet their own goals. These scenarios are evaluated, to the extent possible, to determine their likely outcomes given a certain set of assumptions about resources, economy, environment, and family or community situations. This document is presented back to the clients for their appraisal and review, and students are provided with the results. In Norway, the students actually present the scenarios to the farmer and members of the community during their second 1-week stay on site. This is an excellent way to receive first-hand feedback from clients and to help students assess their own work. In addition to the client document, each student prepares a "learner document" that chronicles their personal learning experience, and they present this in an individual seminar.

While an educational landscape in the university cannot completely emulate every job situation the graduates will face, it is obvious that the open-ended case strategy is closer to reality than much of what we teach in the conventional university structure. Problems are complex, location- and time-specific and sensitive, open to many interpretations, and often perceived differently by different clients. They could be called "wicked problems" in the terminology of Batie (2008). The solutions depend on natural resource, economic, political, and social constraints that are also unique to each situation. However, when students are in a decision-making position in a national program, university, or NGO their challenges will not arrive in the form of a two-page problem set or a series of short-answer questions. Rather they will be faced with real-world situations for which there may or may not be a solution, and that the answers they develop will be subject to challenge and have multiple economic, environmental, and social consequences. Although design of such open-ended cases is not simple, the instructors have found them effective in developing professional agroecologists who are prepared to face a range of future challenges.

We continue to learn together with each new class, as the larger teams of students–clients–instructors deal with the reality of conditions and goals on the farm and in the community.

## 7 Experiential Learning in Collaboration with Non-University Stakeholders

In our courses, we have experienced the benefits that working with stakeholders outside the university can bring to students and faculty who are striving to understand the larger system, and that can provide the kind of contextual knowledge that is challenging to get in the classroom. In addition, involving outside stakeholders can help remedy what some have described as real shortcomings in today's university teaching. For example:

> *Higher education's performance for the most part has fallen short of fostering an engaged citizenry. Despite pockets of extraordinary activity and a growing commitment to service learning, recent evidence indicates that today's college graduates are actually less engaged in the civic life of the nation than were preceding generations. NCPI's Collegiate Results Instrument (CRI), which looked at graduates six years after they received their baccalaureate degrees, documented just how seldom recent college graduates have worked on political campaigns, engaged in communitarian activity, or translated their commitment to social justice into action. More generally, the purposes of a college education have become primarily private and personal rather than public and societal. What has diminished is an awareness of the implicit social charter linking the nation's colleges and universities, both to one another and to the society as a whole. This shift has cast many campus leaders more as CEOs than as public servants, and the campus itself, less and less as a place of public purpose* (NCPI 2002).

What does society perceive as the need for universities and colleges? Since we view agroecology as a kind of workshop for the revitalization of agricultural and life-science universities, this is a useful question with which to initiate a review. We believe that universities are in real jeopardy, with a tendency toward socially-disconnected methods and professional practices within outdated organizational structures. Disciplinary specialization and educational activities that in a real sense have become disconnected from the real world have taken over the program of instruction. There is an urgent need to reconsider what could be deemed the dual mission of higher education. The first goal is to educate professionals and the second is to foster civic engagement. The education of concerned citizens remains as a central mission of the university (Dyrdahl and Karseth 2006), and it implies "a constant concern for the whole person" (Englund 2002).

With this in mind, we have designed the agroecology learning landscape to enhance a broad goal of bringing back "social trustee professionalism" in an age where "expert professionalism" has taken over (Brint 1994). This goal addresses the challenge of fostering engaged citizenry, as expressed in the quote above from The National Centre for Postsecondary Improvement (NCPI 2002). What is needed for addressing the dual mission of higher education is systemic and phenomenon-oriented research

and teaching that redefines disciplinary boundaries, professional identities, and where the relationships between university and non-university stakeholders are re-contextualized. We have argued that action research can be a research and teaching strategy that both supports relevant knowledge production and at the same time creates a closer link between university and society, an important emergent property.

The study of agriculture, food, and environmental systems, including their integration with society, has become increasingly complex and dynamic. Research results on systems are not available as a pile of data, knowledge, or quick facts on websites that can be easily assembled in a textbook or a lecture, to be assimilated and reproduced by students. Kurt Lewin's major argument is that the best way to gain comprehensive knowledge about a complex system, such as a contemporary agroecosystem, is to work towards changing it (Lewin 1948). When a complex structure is changing, more of its component elements emerge. It is therefore hard to gain substantial agroecological knowledge without engaging in some kind of field activity, taking a role not as a distant observer but immersing in the situation as an active participant.

The active participant position is characterized by establishing trust and close collaboration among teachers, students and non-university stakeholders. Teaching is broadened to involve learning opportunities that build on real-life situations and the stakeholders' desires to improve those situations to better meet their goals. Theory and methods are used to inform the design of a change in process towards the long-term aspirations the stakeholders are striving to reach, and the process enables what Greenwood and Levin (2007) call co-generative learning. Through this activity the students learn to be both involved in praxis and at the same time analytical at a distance (Levin and Ravn 2007). More importantly, they have opportunity to develop knowledge that is different from the de-contextualized, theoretical knowledge that too often dominates university life. We should recall that 24 centuries ago, Aristotle presented and discussed these different kinds of knowledge in the Nichomachean Ethics (Bostock 2000).

## *7.1 M.Sc. Students Participating in Real-Life Project Work*

The idea of re-establishing the extra-university territory including its stakeholder actors as a core arena for learning was at the heart of the M.Sc. in Agroecology when it was launched at the Norwegian University of Life Sciences (UMB) in 2000. The goal was to develop interdisciplinary, action-oriented education in agroecology. The program now starts with a semester-long course, *Agroecology: Action Learning in Farming and Food Systems*. In this course, students collaborate closely with farmers and other actors in the food system. They write a Client Report that is aimed at supporting the development process of the stakeholders, and in addition they write an individual Learner Document, in which each student reflects on experiences and links them to relevant theory. This conceptualization is vital for the learning process and for enabling students to apply their knowledge in other settings later in life.

Since 2008, the field part of the course work was extended to students spending two full weeks in the field, and their work is linked to a project of the Norwegian government called "Eco-uplift" (Økoløft). The overall aim of the project is to increase public use of organic food, and 52 municipalities throughout the country participate. Each of the 52 projects has a project leader, and we link groups of 4–6 students to the project leader in each of five communities. Each student team works with that project leader and other key contact people through the entire semester to experience the complexity and richness of real life situations and also to learn the frustrations and successes involved in trying to achieve something in the real world. In addition, the students work with one farmer in that same municipality, with the aim of supporting the farmer in his or her search for more sustainable practices and production systems. This activity additionally helps the students to learn more about the production component of the food system in which they are working. The real-life character of the students' work in these communities has been the basis for financial support from the County Governor's Offices in each of the regions, a move that has raised the levels of responsibility and commitment in the project for students, teachers, and stakeholders.

The task the students are given does not contain a concrete problem formulation, a set of methods to follow, nor a goal to find fixed answers. The assignment is simple: (1) go to the assigned farms and municipalities to explore the present and future desired situations of farmers and key stakeholders in relation to public use of organic food, (2) develop a series of scenarios for how the situations as a whole could be improved, and (3) present the results back to the stakeholders for their comments. Following initial preparation on campus, including lectures and seminars on key concepts and suggested methods for dealing with the task, student groups spend one full week exploring the present situation in its full richness in five municipalities located in southern Norway. This is facilitated through the local "Eco-uplift" project leader and additional interviews with a range of stakeholders. The teacher group splits up to visit groups on location during this week. On returning to campus, the students discuss then analyze and summarize their findings, which are presented to the class and teachers for feedback. Copies of the presentations are also sent to the key clients for their suggestions.

The teachers lead workshops on Soft Systems Methodology (Checkland and Poulter 2006), to improve student skills in dealing with complex situations, and on visionary thinking (Vidal 2004; Parker 1991), to explicitly introduce the importance of creativity. In-class exercises and discussions on methods such as creating rich pictures, force-field and SWOT (Strengths, Weaknesses, Opportunities, and Threats) analyses, and spider diagrams provide additional tools for student groups to use in analysis, evaluation, and reporting on their field experiences.

Based on these activities and on reflection about the first field experience, the groups design their plans for the second visit to case community locations. Aims of this visit are to move from understanding the present situation to exploring the desired future situation and a series of alternative actions potentially useful to move towards that goal. During the second visit, the students are given the additional specific task of planning and facilitating a public meeting with local stakeholders.

After 4 weeks of study on campus, the teams return to the municipalities to present their findings in workshops tailored to their casework. The teams incorporate the results and feedback from these visits into finalized scenarios for action that stakeholders and key clients could carry out to improve the local and organic 'foodsheds' where the students worked.

## 7.2 A Dual Learning Ladder Model for Action-Oriented and Stakeholder-Involved Learning

In the project work, the students enter the learning process at step three, *exploring*, on the learning ladder shown in Fig. 7. They explore the situation through communication with a key client as well as other stakeholders, and through their own observations. If the students lack information at this stage they can step back on *the external learning ladder* to search for existing knowledge, on the web, consulting with university experts, and organizing their own special topic workshops. It is up to the students to decide just how much knowledge they need. Knowing when enough information is learned about a situation in order to proceed is an important question to explore as part of the project. Stepping down the learning ladder to acquire facts, principles and theories, then deciding when they have adequate information, becomes additional open-ended activities and learning opportunities. Instead of providing a fixed set of readings and methods, the instructors' task is to facilitate the students' search for relevant theory and information.

Based on the exploration of the present situation, the students are prepared to move up the learning ladder to the creative step of visioning desired futures in order to provide direction for action. Whereas the lower levels of the learning ladder are often de-contextualized, the importance of values and ethics increases as the students move upwards. The necessity for increased contact with stakeholders "out there" also increases as they move up the learning ladder. In the upper steps of the learning ladder, when students collaborate with non-university stakeholders, the expectations of methodological and theoretical rigor increases. This is so because the stakeholders that the students interact with must make decisions in much more multidimensional and complex situations than most academics want to deal with, and they have to do it in a way that is defensible to stakeholders whose well-being and life-support depend on the quality of the decisions being made.

At the same time students are moving on the external ladder, they also step up and down on an *internal learning ladder*. Their exploration in the *outer world* of the municipal cases becomes coupled with an exploration of their individual *inner worlds*. Lower-order learning occurs with the memorizing of facts and theories, including topics often taught in traditional lectures in the university. As they dig more deeply into systems, connecting components and creating future alternatives, there is need for more contextualizing of the experience and dealing with ethics and values, and thus a need to explore their own feelings about the systems and the people on farms and in communities where they are interacting. While instructors

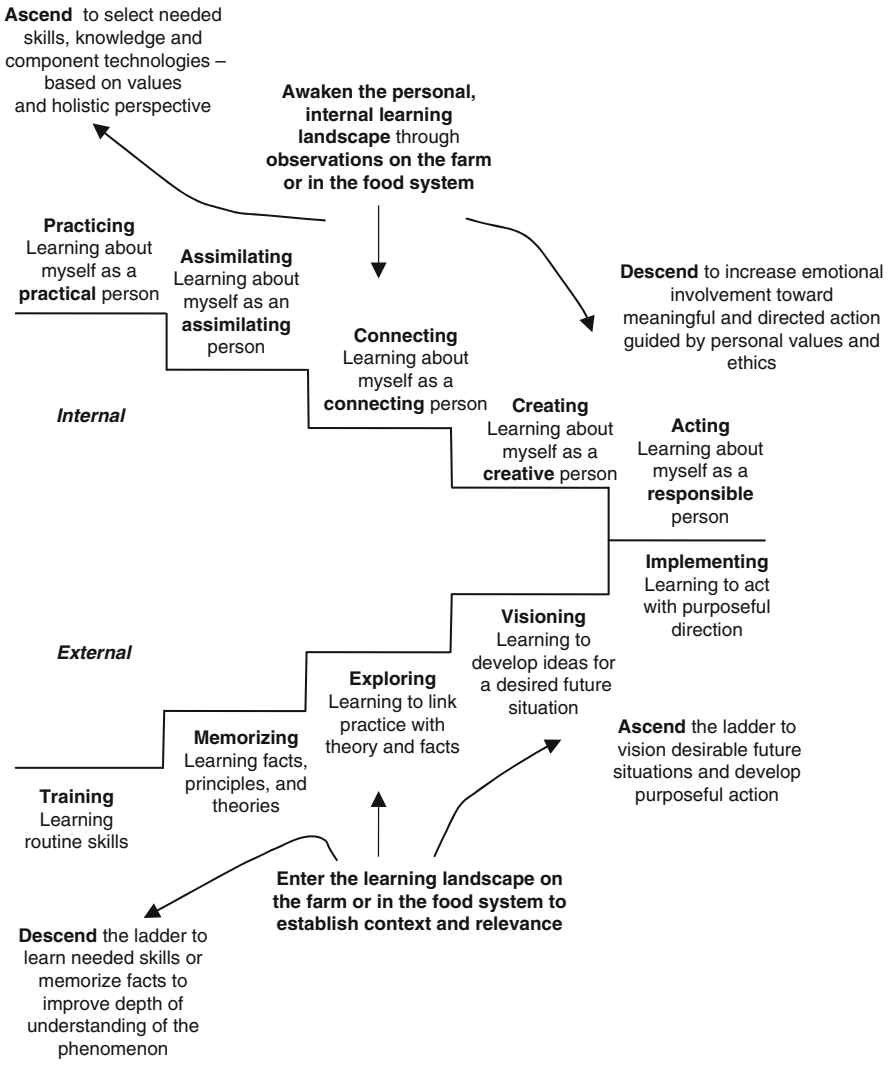


**Fig. 7** The dual learning ladder (Adapted from Lieblein et al. 2007)

can observe and evaluate the client documents and team presentations to assess progress on the external learning ladder, our abilities to understand changes in students' internal learning are enhanced by observation, individual interviews, and reading the individual learner documents. Understanding student learning and how to assess success in the agroecology course is a work in progress.

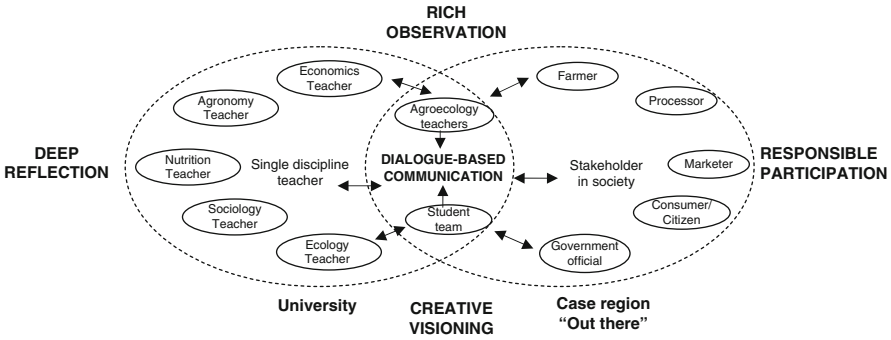


**Fig. 8** Students learning agroecological skills through collaboration with stakeholders in society (Adapted from Lieblein et al. 2012)

## *7.3 Students Collaborating with Stakeholders in Action-Oriented Learning*

One of the main challenges in developing stakeholder-oriented education at universities is that the students have to become "citizens of two worlds" in their learning process, the theoretical world of the university and the practical world of the municipality (Fig. 8). Students are generally not used to being able to both interact with stakeholders "out there" and to integrate those experiences with deep, theoretical reflections often generated in the classroom and in discussions on campus. According to Levin and Ravn (2007), the task of the action-oriented teacher is to nurture the ability for empathic engagement on one side and in parallel to facilitate reflective capacity of the students in both situations.

The positions of university and non-university stakeholders in the educational landscape are illustrated in Fig. 8, where we identify these actors and their interactions in a middle ground called "dialogue based communication". *Deep reflection* is the skill of consciously connecting theoretical aspects in agroecology and personal development to the improvement of situations which the students meet in collaborating with the stakeholders in the case regions. *Rich observation* is the skill of carefully examining situations with which the students are confronted. Communication with stakeholders plays a key role here, but the rich observation still has the intention of an unbiased examination. *Creative visioning* is the skill of transcending the mere repetition of existing stakeholder activities. The skill of creativity implies articulating new and innovative ways of approaching problems and challenges experienced by the stakeholders. The "results" of these "creations" might be presented in the client documents and if possible be developed in close collaboration with stakeholders. *Responsible participation* is the skill of participating in the case work, not as a distant researcher, but rather with personal commitment and dedication, requiring

the development of empathic engagement (Levin and Ravn 2007). *Dialogue-based communication* is the core competency of performing a two-way communication. The dialogue takes place between students and stakeholders in the field, between students and teachers, and among the students themselves; there is also prior communication between teachers and key clients in the field. Learning to actively listen is at the core of dialogue-based communication.

Our task as agroecology educators and researchers is to establish a "mid-field" where the stakeholders outside of a university can meet with students and agroecology teachers/researchers. In this mid-field, they can learn from each other as they collaborate on improving unique and complex situations "out there". During this activity, the students have the opportunity to develop what we see as key agroecological skills: deep reflection, rich observation, creativity, responsible participation, and dialogue-based communication. If students do not have opportunity to receive training in these skills during their formal education, including their multiple and complex interrelationships with other actors in the system, such skills are hard to develop later.

In 2010, three international workshops were conducted using the model presented in Fig. 8 to develop a shared understanding of a new working model for agroecology education, and further to identify key challenges and ideas for how university researchers and teachers can collaborate to meet these challenges. The workshops were held in Nødebø, Denmark (Lieblein et al. 2010a), Ames, Iowa, USA (Lieblein et al. 2010b), and Madrid, Spain (Lieblein and Francis 2010). The key challenges that were identified encompassed institutional, methodological, logistical, and individual issues:

- In what ways do we develop scientific rigor in agroecology education?
- How can we identify, develop and assess the key competencies for agroecologists?
- How can we establish criteria and working plans for involving stakeholders?
- How do we stimulate innovation and systems thinking?
- How can we cultivate the improved competencies that agroecology teachers need?
- In what ways can we create a balance between theory and action?
- How can we deal with financial and logistical issues?
- How do we change the educational policy and establish increased institutional support?

These questions are among the core challenges that the Nordic, European and United States agroecology learning communities presently work with in the quest to find creative strategies for education.

Collaborating with stakeholders in society as an integral part of a university course or program serves four main purposes. First, it enables learning about complex topics, a learning that cannot be substituted by merely reading or listening. Second, it supports the connecting of university and society. Third, the real-life flare of such activities provides the students with enthusiasm and energy to delve back into theoretical activities. Fourth, the process builds social relevance, inspiration for students, and civic engagement that is not found in conventional courses or curricula. Action oriented education in agroecology provides a unique platform for this type of learning.

## 8 Successful Models of Experiential Systems Learning

For more than a decade, teams of instructors in agroecology in the Nordic Region and in the U.S. Midwest have been exploring innovative learning models that move students onto farms and into communities to experience the challenges faced by clients in the field. Another more recent program has been initiated at ISARA-Lyon in France, as one component of an autumn semester in agroecology, and another started in the U.S. Pacific Northwest. Several underlying premises guide the design of these learning landscapes:

- Students take responsibility for learning, and work as interdisciplinary teams in their projects
- Instructors plan objectives, schedules of activities, and overall goals and then mentor the learning process
- Students build consensus and develop their own strategies on how to interview clients and analyze results
- Students vision the future and derive potential scenarios, rather than providing solutions to clients
- Results are presented to clients for their consideration and feedback, and to other students and instructors.

Student evaluations of how they have met the stated learning objectives have been highly favorable in Norway, France, and the U.S. Midwest and Pacific Northwest and each of the courses continues to attract a full complement of students each year. In all learning environments, core faculty instructors guide the process, and invited specialists present several key topics. Details of the three types of experience are described in the following sections, and educational results have been published (e.g. Wezel et al. 2008; Lieblein et al. 2005b, 2007; Wiedenhoeft 2004).

### *8.1 Agroecology M.Sc. Program in Norway*

Through years of teaching courses in organic farming, soil microbiology, horticulture, crops and forage production, we had observed that students identified more closely with the information content of lessons when they were directly involved in hands-on learning, whether in the laboratory or in the field. More valuable yet were those exercises in the field when students interacted directly with farmers and other experts in agriculture and food systems, and when they were involved in structured learning activities that invoked the multiple senses of seeing, hearing, smelling, feeling, and tasting the context of the farm. For students with practical farm experience this was a comfort zone of sorts, and a confirmation of their prior knowledge which they could relate to the new material being introduced. For students without such experience, being on the farm inspired curiosity about where food came from and how it reached their urban tables. For everyone it provided a real world context into which they could insert their previous knowledge and a practical situation into which new information could be incorporated. As Dewey (1897) insisted, the only

path to real learning is to incorporate new knowledge into the store of prior experiences. Our observations seemed to bear this out.

Based on this classroom and field experience, the inspiration for the planning and components of the Agroecology M.Sc. in Norway began with three short courses of 1-week duration that were organized for Nordic doctoral candidates during 1995–1997. Since these courses formed the foundation for the M.Sc. program, they are described in some detail. The first was *Research Methods in Ecological Agriculture* that provided background information on methods of analysis for integrated production systems, then we organized small student teams to focus on individual case study farms where they walked transects, interviewed farmers, inventoried and observed infrastructure, and learned what the farmers' goals were for the future. Although students explored some aspects of markets and adding value to raw products on-farm or nearby, the principal emphasis was on understanding the structure and function of the farm in terms of production and economics, while learning about the environmental and social context in which it was embedded. During the week students and teachers lived together on an organic dairy farm and became familiar with the working operations of the dairy and the vegetable production on this 90-ha farm. An evaluation of this course and the two that followed were published by Lieblein et al. (1999).

In 1996, the scope of another course *Systems Research in Ecological Agriculture* was expanded to embrace the functions of the farm as an integrated unit and as part of the rural landscape and watershed. We also began to incorporate some aspects of its integration into the social fabric of the nearby community. Students again were prepared through readings on systems thinking and analysis, along with background on the history and agriculture of the host region in Norway. Student teams visited farms and discussed their operations with the farmers, but this time with a broader focus that moved beyond the farm gate to consider the farm's place in the local landscape and the broader issues of local and regional markets. Logistics and requirements were similar to the prior course.

A third Ph.D. course, *From Farming Systems to Food Systems*, focused on the entire food chain, at the local level more appropriately called a "food web". The structure of the week-long course was similar to the previous 2 years, but this time students put the farm interview questions and their discussion of possible scenarios into a food systems context. Still focused on the integrated management system on the farm, choice of enterprises and types of technologies, and how farmers could better meet their personal and family goals, the students identified a number of key driving forces from both the environmental situation and the social and economic contexts that strongly influenced decisions on the farm.

In studying their project farms, it was useful for the students to distinguish between the commonly used metaphor of a food-chain as a series of linear, connected steps in the movement of food, and what is known in biology as a food-web. In the context of food systems, the chain metaphor refers to how natural internal resources and purchased inputs are combined on the farm for primary production of products that then enter the larger food system. Products go through steps in processing, packaging, and marketing to the consumer, and waste at each step of the

process is lost from the system, or "chain". There is a one-way movement of food, and continuing the chain metaphor the system is only as strong as its weakest link. There is minimal redundancy in the path that food takes, and the system is susceptible to interruption for economic, weather, or political reasons, especially in a globalized system. There is cost added at each step in the process and perhaps some value, and the accrual of this value is increasingly going to corporations ever more distant from the farm and local community. These three courses provided the foundation for the Agroecology M.Sc. Program described in other sections.

## *8.2 Agroecology Summer Course in the U.S. Midwest*

*Agroecosystems Analysis,* a summer travel course in the U.S. Midwest, incorporates visits to farms and associated enterprises with practical on-farm interviews with farmers and examinations of current production within their present complex economic, environmental, and social realities (Wiedenhoeft et al. 2003). The structured learning environment is designed for students to decide on their own team process to meet several key outcomes from the course, developing:

- Capacity to define and describe the key properties of agroecosystems, both their structures and functions, and use this information to design alternative systems;
- Investigative frameworks for analyzing the origins, impacts and sustainability of agricultural practices used on farms within the region as well as their economic implications;
- Meaningful experiences in defining, assessing and interpreting factors that contribute to improved environmental and social sustainability of agroecosystems and communities; and
- An ability to interact in a meaningful way with farmers, teachers, and other students who share expertise and interest in agroecosystems and their sustainability.

Prior to convening the group for the field portion of the class, readings from Rickerl and Francis (2004), descriptions of four frameworks for agroecosytem analysis, and information about the landscape of the region and specific farm sites are provided to students *via* the class website. Students are required to submit a narrative describing a framework for agroecosystem analysis that they favor based on preliminary reading and reflection on the class objectives, and to list three to five key questions and issues that they think must be answered/considered during the field portion of the class.

During the week-long field experience, the class visits eight farms to interview farmers; then student teams conduct an interdisciplinary analysis, and evaluate and describe their perceptions of the functioning and successes of current agroecosystems (Wiedenhoeft et al. 2003). The framework for the analysis is team specific, depending on a consensus developed by each group. Each student team has time during travel, field visits, meals, and evening sessions to develop its unique framework for analysis, often a hybrid of the four frameworks in the pre-field readings or

a departure in a new direction. During often heated team discussions, students must resolve differences in worldviews, experiences, and prior levels and types of knowledge. Students decide as a team what questions to ask farmers in the interviews and what key observations they need to make while visiting the farms. During the process the teachers assume the role of catalysts, mentors, and co-learning participants in the course. We have observed that students are very impressed when they see teachers taking seriously the role of learners, absorbed in keeping notes on each farm, and catalyzing discussions in the vans during travel between sites. At the end of each day we convene a large group discussion about the day's farm visits, and each of the evening sessions is led by one of the student groups and employs innovative ways to stimulate group interaction and sharing of the day's experiences. We have learned that a group of 30 people visiting the same farm and hearing the same farmer often comes away with a rather wide divergence of observations, and the evening sessions provide a forum for sharing the multiple meanings gained from common experience.

The class explores agroecosystems within the four-state region of southwestern Minnesota, northwestern Iowa, southeastern South Dakota, and northeastern Nebraska. During the farm visits, farmers serve as teachers to help guide learning about food production, economics, environmental concerns, and rural community viability. Farms are chosen based on diversity in size of operation, potential to provide a cross-section of farms typical to the region, communication skills of the farmer, and goals of the farm families. The farms selected represent different agroecosystems, landscapes, management philosophies, soil types and topography in the four-state area. Examples of the types of farms and landscape activities that we often visit include organic farms with diversified enterprises, large farms using conventional practices and growing commodity crops, family-scale integrated crop/livestock systems, and industrial-scale swine and dairy production. In addition, we visit diversified vegetable and flower production on small farms, where the major marketing is direct to consumers or through farmers markets.

The farmers are prepared to summarize their operations and provide insight on their world views and their attitudes toward the part of the farming and food system they manage. In addition, they are ready and willing to answer questions from the course participants. During the visits the teams explore production, economic, environmental, and social dimensions of each farm. Typically we spend between 2 and 4 hours with each farmer or agribusiness entrepreneur. Often they will include other members of their family or participants in the operation in order to help answer questions. We compensate each farmer with a modest honorarium, because we respect their time and knowledge.

The students spend substantial time in small groups after the visits, applying their agroecosystem analysis frameworks in order to determine their assessment of the sustainability of each farm. At the end of the field portion of the class, results are presented during oral team presentations that include analysis across all farms. Each team leads a 40 minutes presentation/discussion/activity based on the analyses and interpretations that the team made during the week. It is expected that a significant part of the presentation time will engage all the students and faculty in

discussion and other forms of constructive learning activity around the team's report. It is during this time that students receive feedback from other students and faculty facilitators. This feedback and their own reflections/evaluations are then used to prepare a written project report. Each year the individual teams develop and use widely different types of analyses, models, and results. There are no final and "right" answers, but students must clearly articulate their evaluation and analysis and provide rationale for their choices of methods.

The course is founded on the concept of community learning. At the beginning of the field portion, activities are planned that begin the community building process. We design a learning landscape that will help the students and teachers become better acquainted with one another. Based on documentation provided by students before the course, the instructors place students in groups of three to five, making sure that each group has students from different institutions and majors, with gender balance and an attempt at compatibility and potential synergism. Our objective is to maximize learning by forming groups with members who have a wide range of experiences and backgrounds, and thus expect some emergent learning properties from each mix of students.

Daily evaluation/reflection is a critical piece in the process, and many students find the structured reflection an innovation they have not experienced before. A one-page evaluation includes questions about what was learned from the day's activities, what could have been learned, and how the process of farm visits could be improved. Using a double-sheet carbon copy form, students can hand in the originals and keep a copy each day for themselves. These pages serve as useful reminders of daily activities, supplementing their notes from the field, and become invaluable when they write a final reflection. Faculty review the evaluation sheets each evening so that we can adjust programs and improve the learning environment in response to student observations. A summary of their evaluations is often posted each day so students can read what others have learned from the previous day.

Student teams work for 1 month following the intense week of farm visits to complete their team's project document, which reflects feedback from students and instructors during the oral presentations. In addition, at the end of the course students are required to complete a Learner Document, which is an opportunity to reflect on the process of personal learning during the course. The learner document should include reflections on the educational process of the course, on the student's participation in teams, and on their overall response to study in this type of learning landscape. The following questions are provided to guide the reflections:

- What were your impressions and reactions to the lectures, to the large-group discussions, and to the field trips and conversations with farmers?
- How were the group dynamics when your team discussed choosing key questions for farmers, when you summarized results after the farm visits, when you discussed what had been learned, and when you searched for consensus on conclusions about each farm and how to present them?
- What did you learn about your own role in a group/team activity?
- What did you learn about your own learning style?

The questions are intended to stimulate thinking and reflection, but not to limit the scope of the document. From these learner documents we have gleaned substantial insight about what is effective and what can be improved in the course. Although the schedule is grueling, often from 7 a.m. until well after 10 p.m. including the team meetings, there appears to be consensus that the investment of time and energy is valuable and appreciated. We have dropped some of the farms and added new ones in response to student feedback. We have also adjusted the schedule at times to help meet their learning needs. The learner documents as well as personal interviews were used to conduct an in-depth evaluation of the course over a period of 10 years (Harms et al. 2009). On more than one occasion a student has remarked in the evaluation that, "I have learned more in the week of intensive farm visits and team work than I often learn in an entire semester on campus." Although the veracity of this comment is difficult to assess, at least it appears that the experience is perceived as highly valuable as a part of the overall university learning experience.

## *8.3 Experiential Learning in Field Excursions in Southern France*

The autumn semester "Agroecology" at ISARA, Lyon, France, has the goal for students "to learn project management and expand on application of agroecological science in real-world situations". There are five modules in this semester that were described by Dr. Alex Wezel (Personal communication, May 2011, and http://www.isara.fr/Description%20English%20Autumn%20semester%20Agroecology%20at%20ISARA-Lyon.pdf):

- Agriculture and landscape management in a particular agricultural region
- Agroecological cropping practices
- World agroecosystems and agricultural use
- Management of agroecosystems: implications from policies, global change and nature conservation
- Group project management

In the initial module, the students "will learn to put together theoretical knowledge and past experiences to work in farming and food systems" (from program website). For an orientation into the landscape, the economic and ecological context of southern France, the students dedicate a week-long excursion in groups to investigate agricultural and environmental issues in one region in southern France. In preparation, there are lectures and discussions about methods for landscape analysis, evaluation of production systems, environmental indicators, and interview techniques. The student groups initially meet key stakeholders to gain background on the natural environment, production potentials and opportunities, and economic viability of agriculture in the region. Then as groups they explore the region to discover constraints and future potentials of the livestock and cropping systems, as well as landscape management for ecosystem services. One of the unique methods

used in agroecosystems analysis is driving transects across the region in cars, and making inventories of different crop and livestock land uses in the region. The results of this type of student research are remarkably similar to published data taken from GIS analysis of the same region (Wezel et al. 2008). They also investigate potentials for adding value to resources through agritourism, for conflicts and competition for land, water and other natural resources, and for adjusting agriculture and land use policies to promote rural development. Results of the field observations, analysis and evaluation are presented to the entire student group and evaluated by the instructors. In the beginning, students were mostly from France, but presently the number of foreign students has increased significantly. Thus, field working groups are enriched by the prior experiences of a number of students from other countries, yet the increasing number of foreign students poses a language challenge. As the agroecology semester in France is completely in English, many foreign students do not speak French (which is not a pre-requisite for the semester). Thus, certain topics during the 1-week excursion are less suitable because almost all interviews with key stakeholders have to be translated, with a certain loss of information and large time investment. To overcome this problem, late afternoon or evening meetings to discuss the interviews are held in the group with one of the instructors. The course continues to attract substantial interest from students in France and from outside.

## *8.4 Experiential Travel Course in the U.S. Pacific Northwest*

*Field Analysis of Sustainable Food Systems* was developed collaboratively between Washington State University and the University of Idaho. This course was modeled closely after the framework developed for the Midwest *Agroecosystems Analysis* course (Sect. 8.2) and extends the student experience and analysis to well beyond the farm gate, explicitly including distribution and retail venues, farm-worker housing, and waste management. The course is taught by a multi-disciplinary faculty team, typically including at least one sociologist in addition to one or more natural/agricultural scientists. A graduate-level offering is also conjointly available with additional requirements. A number of students historically have been distance degree students who are studying while out in the world in the workplace and their participation provides additional maturity and enrichment for more traditional campus-based students. When space and funding have been possible, we have also accepted participation by post-baccalaureate agricultural professionals in the field immersion component of the course – for their professional development, as well as to further enrich the academic student experience. Instructors emphasize the value of each student's existing knowledge and background experiences coming into the course, and encourage the students to contribute their expertise as appropriate.

As in the Midwest course, there is a week-long immersion field experience preceded by a set of common readings and a written assignment, and followed by group activities/presentations on the last day of the field experience and subsequent

written group report and individual Learner Document. After the initial years of offering the course during the summer, we moved the travel component of the course to the week of our universities' spring break (mid-March), in order to address student concerns such as conflicts with summer jobs and higher tuition in summer. This shift greatly increased academic student participation and led to the course becoming required as a part of WSU's *Graduate Certificate in Sustainable Agriculture*. Because of the extreme variety in climate and agricultural systems across Washington and Idaho (the region contains ten of the 13 worldwide soil orders described in Soil Taxonomy), we have chosen to move the course to different regions over the years – from the maritime seed crop-fresh vegetable-residual dairy systems of the far northwest, to the Mediterranean dryland wheat and residual cattle systems along the Washington/Idaho border, with tree fruit and vegetable processing operations in the irrigated desert of the Columbia Basin in between.

The learning goal and objectives are provided in the course syllabus (http://css.wsu.edu/graduate_studies/grad_cert_sustainable_ag.html). Course goal: develop and enhance our understanding of the components, connections, and changes occurring in our food systems, especially with respect to the environmental, economic, and social aspects of sustainability and community well-being. Course learning objectives: direct interaction with farmers, food site managers, agricultural professionals, faculty and other students who share expertise and interest in food systems and sustainability. Upon completion of this course students will have:

- Worked with an investigative framework for analyzing the origin, impact and sustainability of agricultural, processing and marketing practices used on farms and in the food systems of the region
- Explored ways to define, assess and interpret factors that contribute to greater sustainability of agricultural and food systems
- Developed an understanding of the factors that go into decision-making at multiple scales

During the initial meetings, time is spent: (a) getting to know each other, (b) grounding participants in the natural resources (especially climate, water, soils) of the particular study area, and (c) providing additional grounding in the social science procedures, requirements and etiquette important for successful site visits. Site hosts have been told that our group is studying food systems from farm to table, and is particularly interested in the types of relationships and decisions they need to make in their enterprise(s). As in the Midwest course, the students determine the lines of questioning and observation they will use, with instructor emphasis on breadth of observations possible, and on the importance of using solid social science methods, including maintaining confidentiality and respectful rapport with all site hosts. Students are members of two groups in a jigsaw fashion; first and foremost they have been assigned to a multi-disciplinary group who will work together as a team throughout the week and in their final presentations and document (as in the Midwest course). Within these groups, the students decide who will represent their group in each of the four Filter areas (environmental, social, economic or production). In this way, each student contributes to the production of a complete set of notes, which are then available to all. In most years, the afternoon of the

second day is spent visiting retail food outlets, including a large grocery store and a food cooperative or other natural food store. These visits serve the practical purpose of allowing students to shop for food for the week, since our dormitory/cabin–type housing for the week typically requires that we cook and eat our meals together. However, and importantly, they also set the stage to consider the ultimate *retail consumer role* in food systems and issues of sustainability. The store managers meet with the students, describe their operations, provide a tour of facilities and answer the students' questions.

On each of the subsequent days leading up to the final presentation, students and instructors visit three or four sites, spending about 2 hours at each. Examples of sites include a family-sized dairy with biogas digester, an immigrant flower farm doing direct marketing, a pasture-based organic dairy, a small-scale fruit farm with processing and direct sales, a grain elevator as well as a food cooperative, and other diverse production and marketing operations in the study area.

Deep reflection is designed into the course through written evaluations as well as the large and small group discussions held each evening. Day 1 and 7 evaluations are lengthy and designed primarily to capture before and after perspectives. The remaining days' evaluations are a single page, and include the following open-ended questions:

- What were the most important insights and/or "learnings" I gleaned from today? What became more clear?
- What new questions or considerations did today's activities raise for me?
- How and to what extent did today's activities help me recognize and understand (1) agricultural networks and systems, (2) the interplay among environmental, socioeconomic, and policy factors that influence sustainable food production and delivery choices, and (3) examples that demonstrate how this interplay affects the success of a farm, ranch or other agricultural enterprise?

Similar to the Midwest course, student comments often stated that they felt they had "learned more in this 1 week than in any of my other classes" (or "…in the rest of my college career"). Over the years of offering the course, almost all of the quantitative responses (five point scale) were five ('very high') regarding several questions about learning, including: amount of overall learning, learning about influences on sustainable food production and delivery systems, learning about the interplay between environmental, social and economic factors affecting food systems, learning how food systems contexts affect individual farm success, and learning about their own roles in food systems and their own values with respect to food systems. This positive student evaluation compels us to offer the course each year.

## 9 Challenges and Opportunities for Experiential Learning in Universities and Colleges

"If you want to truly understand something, try to change it" (Lewin 1948). This quote from Kurt Lewin, father of social psychology and an expert on change theory, serves as an appropriate introduction to discussion of the challenges facing

those who want to change education. Experiential education based on theory as defined in Sect. 2 and demonstrated with a number of examples above should find a welcome home in universities and colleges, in spite of their general conservatism. These are among the principal places in society where creative learning should happen, places that provide an experience where students are liberated from the working world for a period of intense interaction and exploration together with other students and with teachers who are prepared to guide this search. Such an idealistic and creative scenario is tempered, of course, by long-standing traditions in our various types of higher education venues. Student and faculty initiatives and potential for moving very far beyond the accepted norm and curriculum may be suppressed by lack of budget, conventional organizational structure, narrow disciplines and fixed graduation requirements, and even the inertia, comfort, and complacency sometimes generated by the tenure system. Here we explore the differences that may be found between the Land Grant Universities (United States model) and national agricultural universities (Europe) generally focused on research but also entrusted to design and deliver agricultural education, and small liberal arts colleges that have more flexibility and integration. We present these as extremes, for purpose of illustration, recognizing that most institutions and individual degree programs will fall on a spectrum in between. The discussion provides a platform to examine the potentials of experiential learning in a wide range of situations, and an opportunity to survey a number of innovative places where new models are being tested.

Through this section we examine the current and potential roles of higher education to bridge theory with experience and action, the unique structural potentials in facilities and programs that are conducive to fostering the experiential learning process, and the differences among agricultural universities and liberal arts colleges in their propensity to promote transdisciplinary learning and preparation of students to become lifelong learners as well as thoughtful and educated members of society. As suggested a number of times in this review, we need to prepare these learners to deal with an increasingly complex, unpredictable, and resource-limited future where food will be at a premium, and where our ability to envision and implement strategies for equitable access to food and other resources will in large part determine our long-term survival as a species.

## *9.1 Students in Higher Education as a Unique Audience*

We meet students in our courses at an impressionable time of their lives and development. Although we often lament their previous educational experiences as overly structured, divided into disciplines without a substantial systems perspective, and focused on memorization rather than problem solving, there is great potential at the college level to break out of these patterns through experiential learning. Over the past decade we have established highly participatory learning workshops and courses, and found that students quickly adapt to a situation where they are encouraged to bring forward their past experiences and to build on those with new information and insight. According to Dewey (1897), this is the only way that real education takes place.

An example comes from a workshop experience in Estonia a decade ago when students came to a 1-week course for Ph.D. students, expecting to encounter 40 hours of sustainable agriculture lectures with some limited time for discussion. Imagine their surprise when we dedicated 2 hours the first day to their preparing and presenting personal biographies of their past experiences as well as expectations from the class and what they hoped to contribute. It was especially heartening to observe students from Eastern Block European countries who had only experienced top-down academia blooming like flowers from the bud as they shared their past expertise and hopes for the course. After 2 days there were spirited discussions and frequent questions, at times to a teacher cadre that was not prepared for such challenges.

We face the same situation in the full-time Agroecology M.Sc. course each autumn semester in Norway. It takes some time to convince students that they in fact 'own the agenda' and must take responsibility for learning. We expect a creative project report, based on working visits to farms and communities, with potential future scenarios for their clients to improve the current situation. Students at first are dismayed to hear that the instructors don't have the correct answers that they should be clever enough to discover, but rather we are pursuing an open-ended case together as co-learners and seeking ways for their clients to solve their own challenges (Francis et al. 2009). We empower the students and provide some guidance through this complex learning landscape, but as mentors and co-explorers rather than as authority figures.

One of our goals in experiential learning is to catalyze a process where students examine their assumptions about food systems, natural resources, and the future, and we do this by exposing them to real world situations that are complex, uncertain, and dependent on multiple factors. These situations present a series of what Batie (2008) terms 'wicked problems', those for which there may be multiple solutions and are not easily resolved with the tools available in any single discipline, and which may be viewed differently by multiple stakeholders. This is why students need to carefully look at their background of prior information, learn the importance of context and complexity, and be able to see situations through new eyes.

The college experience provides unique potential to stretch beyond prior experiences and to prepare to meet the challenges of the real world. Most students are away from home for the first time, sorting out large questions about religion, ethics, and world views in addition to expanding their knowledge and skill sets. It is in this new environment that students are able to stretch their wings, to test ideas and attitudes against those of their peers, and take advantage of the college or university environment to learn and grow. We provide several contrasting models of structure of higher education institutions in Sect. 10, including a future learning university designed to promote the process.

## *9.2 Colleges and Universities as Unique Environments*

Our colleges and universities present students with unique environments and multiple opportunities to explore learning in an experiential manner. One good place to start

is with food and the dining experience. In the United States, students often are required to live on campus and to pay for a meal plan to ensure that they are adequately nourished in this first adventure away from home. Here is an opportunity for food and nutrition education, but one that is too often missed. When budgets are limited, food service goals are to feed as many students as possible with lowest cost ingredients. Expensive labor dictates that pre-prepared foods form the bulk of the diet, and students are not involved in the process of planning and choice. The dining halls may in fact closely resemble an industrial model, confined animal feeding operation with efficiency and low cost being the only guiding principles. Likewise, there are few places that have a rational recycling program to put waste food, napkins, and other organic materials into a visible composting system that returns those nutrients to the land. Virtually none has capability of recycling human feces and urine back into the production process, due to lack of technologies, restrictive rules, and a social revulsion to even the idea of cycling human "wastes". Of course these are all resources that should find their way back into the food-web, and we lose an opportunity for learning when we do not explore all the possible strategies to involve people in the food – consumption – waste management process. More creative systems for food service and resource recycling could add value to the overall education experience, and provide models for students to pursue in the future.

The building structures on campus including classrooms and laboratories present opportunities for demonstration to students and visitors. When we herd a large group of students into a traditional lecture hall to hear the pronouncements of an authority figure, a professor of agronomy or entomology, we are perpetuating a 1,000 year tradition that started with the organized church. All focus is on the professor (high priest) on a raised platform or behind a podium, there is domination by one-way transfer of information, and little opportunity for questions or discussion or even thinking. This is a frequent method of "teaching" in large universities. There are valuable alternatives, and some of the newer classrooms are smaller with movable chairs and tables rather than the fixed rows of chairs with flip-up writing desks. The flexibility of these facilities is more conducive to discussion and small group learning. In contrast to large class size and lectures, many liberal arts colleges have smaller enrollments in basic courses and thus more opportunity for student group learning and more faculty – student interaction. To be sure, there are exceptions to each of these models in both types of learning organizations, and to the extent possible with limited budgets, most instructors try to adapt their circumstances to promote learning in smaller groups.

An example of a missed learning opportunity was the recent remodeling of the Agronomy and Horticulture Department building at the University of Nebraska, a 1950s vintage structure that needed updated windows, air circulation, accessibility, and asbestos removal. In response to suggestions for a green roof, solar panels and awnings on the south exterior, wind machine on the roof, and a green wall to purify water in the courtyard, those in charge of design in the Buildings and Grounds Department declared that each of the proposals was not cost effective, represented an untested technology, and was difficult to specify in their call for proposals from contractors. The resulting newly designed structure did meet LEED standards

thanks to energy efficient windows and recycling of concrete, but fell far short of what could have been a wonderful demonstration of living in an energy-scarce future. The proposed alternative, albeit designed for the long-term future, would have been a dramatic demonstration to students each day and to visitors to campus that the university was on the cutting edge of energy efficiency.

In contrast, the Adam Joseph Lewis Center for Environmental Studies building at Oberlin College in Ohio, dedicated in 2000, is a testament to college and community joint planning for a facility that has become a landmark in the educational community for its comprehensive design and efficient energy use. This building is for both demonstration and education, and students are exposed to innovative and contemporary thinking about environmental design every time they enter the building. Almost as impressive as a visit in person is to go to the website and see real-time monitoring of energy production and use (Lewis Center 2011; http://www.oberlin.edu/ajlc/ajlcHome.html).

Another example is the Sustainable and Environmental Studies program at the Berea College campus in Kentucky, where well-designed ecological machines purify wastewater and recycle it back into the system. This is a central feature of their ecovillage on campus, where 50 apartments accommodate students with children, a learning laboratory, and state-of-the-art energy saving and recycling. Their goals for the ecovillage include 75% reduction in energy use, 75% reduction in water use, and 50% waste reduction through recycling, reuse, and composting, using the latest in green design (Berea College 2011; http://www.berea.edu/sens/ecovillage/default.asp).

These latter two examples demonstrate what is possible through creative planning, vigorous search for funding, and aggressive implementation of green design as an integral part of the education strategy. Both are found on campuses of relatively small, liberal arts colleges.

What students learn as they enter these classroom buildings or live in an ecovillage could be called a “co-curriculum” that is available in parallel with scheduled classes and other college activities. When we consider that full-time students spend perhaps 15–20 h per week in class and laboratory sessions, there are many more of their waking hours spent in study, with friends, in exercise, or in casual activities. The more of this time that can be spent learning, including social and environmental learning, the more valuable the total experience. When the campus environment can be designed to extend learning beyond the classroom and laboratory, the potentials for learning are increased.

Structured learning may be extended by providing students with employment on campus. Many institutions employ students in grounds and maintenance activities, including part-time work in gardens and in snow removal in northern climates. Research projects employ students in a number of support roles, and those students may use some of their on-the-job experiences in developing a thesis. Teaching assistants are often paid to prepare laboratory materials or help in grading routine exercises. Student farms and community supported agriculture marketing schemes employ students in many agricultural colleges and universities, with examples in Maine, Iowa, California, Washington, and other states. These farms are designed

for production, but especially for providing learning experiences for students. Berea College has a unique program in which most students pay for their tuition, fees, and housing by working at the college farm, the pottery factory, and the woodworking factory where they learn practical skills as well as support themselves and pay for education. Berea College, University of California at Santa Cruz, and Evergreen State College in Olympia, Washington have student farms, even though they are not agricultural institutions.

Many of the land grant universities (LGUs) in the United States began with 2-year degrees and a highly practical curriculum that included farm practice along with utilitarian courses addressing many technical aspects of farming and ranching as well as agricultural economics and a limited supporting liberal arts component. As programs were changed to 4-year B.Sc. degrees, more theory was introduced along with higher technology practices, and farm practice was gradually phased out. The LGUs today are viewed primarily as research universities, with additional focus on instruction and outreach through Cooperative Extension. Practical experience through student farms or internships is available but often considered an option for only students of agricultural science. Student managed farms on campus are seen as an add-on activity rather than integral to the mainstream of learning.

There are numerous experiential learning programs in agriculture and food at liberal arts colleges. Smaller non-land grant institutions appear to be more penetrable with creative ideas, yet from the administration's point of view may be more vulnerable to criticism. As with small business ventures, such as software start-up companies or highly diverse organic farms, small colleges can be more capable of responding to changes in technology or in the marketplace. To maintain student enrollment, they need to differentiate themselves from other institutions. The most creative energy seems to be found in small liberal arts schools with gardens, farms, local farmer talks, museum exhibits, and cooperative programs with their local communities. Their search for creative answers may be enhanced because they are not funded by the Morrill Act of nearly 150 years ago, nor the Hatch Act of 1887 that established experiment stations. The liberal arts view may tend to reveal linkages and complex interactions more readily than technical tracks in agricultural schools. Liberal arts colleges have an ability to be innovative and nimble in visioning and moving towards a different production and food system because they are small, historically grounded in a conversation about ethics and social transformation, and are not constrained by the broad land grant mission of research, teaching, and extension.

The structures of small schools allow for them to more easily become a laboratory, for example a dining hall as a place for learning and sharing. Although faced with the same rising costs and budgetary constraints that are found across higher education, these colleges are more apt to measure attaining their mission using multiple bottom lines, rather than only finding the most cost efficient method of accumulating the most credit hours, tuition payments, and numbers of graduates. We see the potentials of close linkages between the land grant universities and the liberal arts colleges as holding one key to design of broad and effective education in agriculture and food systems for the future. A current initiative is opening our agroecosystems analysis summer course, run for the past 13 years by three land

grant universities (Sect. 8.2), to students and faculty from liberal arts colleges in these states. We anticipate that the hybrid vigor thus created will be valuable for both groups. While the LGU instructors contribute their knowledge about integrated farming and food systems, the small college instructors and their students bring a fresh and creative perspective to the environmental and social dimensions such as integration with rural communities, rural-urban communication, and equitable distribution of benefits from the system.

## *9.3 Challenges to Experiential Learning*

There are numerous challenges facing agricultural universities as well as liberal arts colleges, challenges that relate to administrative structure, physical facilities, term schedules, established majors and degree requirements, accessibility of farms, and reward systems for faculty. Although it seems that these have been overcome in a number of situations, including the examples in Sect. 8, it is useful to enumerate challenges and some of the steps that have been taken to solve them. Just as ecological niches are unique in natural ecosystems, the situations and challenges in each university and college are specific to their history, location, stated mission, faculty, and student population. The issues listed are based on the authors' personal experiences as instructors or students in more than 25 such institutions and short-term experiences through seminars, sabbatical leaves, professional meetings, and working visits to scores of additional sites. The insight from several ENOAT (European Network Organic Agriculture and Agroecology Teachers) meetings has also informed design of the educational programs, for example Lieblein and Francis (2010). The list is not inclusive, but represents some of the most apparent issues.

*Emphasis on Research* – Although more of a challenge in land grant or national universities with a primary research mission, any college or university with split appointments runs the risk of sacrificing teaching excellence while pursuing the grant support agenda of major research institutions. Although teaching is a compelling responsibility – students will appear for class at 9 a.m. on Monday, Wednesday, and Friday whether the instructor is prepared or not – if there is a publication deadline for a journal special issue, a book chapter nearly done, or a grant proposal that needs to go out the door, these activities may take priority over teaching preparations. The situation has become more complicated due to the steady erosion of state and federal formula funding for research and growing reliance on grants from state, federal, and private sources. It is a rare situation where a promotion and tenure committee considers teaching evaluations more important or even equal to the number of research publications. This is not a constraint for most liberal arts colleges where teaching is the full-time responsibility.

*Time for Preparation* – For those who have planned and implemented experiential learning exercises and projects, there is little doubt that this is more time consuming than preparing and presenting lectures. A well-structured experiential learning

session or project needs clear learning goals, discovery activities that tap into prior experience and incorporate new knowledge or skills, involvement of students with clients on farms or in the community, and integral evaluation and reflection. This requires substantial advance planning. Sufficient time ahead is needed for preparation by both instructor and student in order to maximize the learning experiences; prior background reading, web searching, student team meetings, decisions on what questions to ask clients, setting up schedules, and reflecting on the project all take time. It is easy to see why instructors resort to lectures or to carefully bounded exercises in classroom or laboratory, either in LGUs or in liberal arts colleges.

*Logistics and Timing for Experiential Activities* – The logistics of setting up visits to clients, arranging transportation, scheduling activities that do not conflict with other courses and orientation for outside-of-class learning also consume time and resources. It is often useful to find well-run farms and opportunities for hands-on experiences very near to the campus. Yet, students who are taking three to five courses per semester or quarter have difficulty scheduling a half or full day to be away from campus, much less an entire week if travel and extended stays are needed. This constraint has been overcome at the Norwegian University of Life Sciences by having students enroll in a single course in Agroecology for the entire autumn semester; at Evergreen State College in Washington, United States, all students enroll in a one full-time program each quarter. This avoids conflicts, since the single class is the only academic activity for each student. There still can be conflicts with other organizational involvement, athletics, jobs, or volunteer positions that require students to be on or near campus. One option is bringing clients to campus in order to interact with students in class or laboratory; it is time effective in that one person travels rather than an entire class, but such an experience often loses much of the flavor of the context of the farm or community in which the activity is embedded.

Timing of farming systems operations presents another challenge. The school year normally runs from September (nearing harvest season in the northern hemisphere) through May (planting season). It is not possible to have students follow the logical sequence of farming activities during a school year because it does not coincide with the farming year. The logical solution is to use internships where students can apprentice on farms and be able to follow the entire cropping season, although some adjustments may have to be made to the school year to accommodate this learning experience. Livestock operations present a better opportunity, due to year-round activities on the farm, and greenhouse operations may fit the school year better. These challenges are similar in research universities and liberal arts colleges.

*Administrative and legal issues* – Some of the challenges to implementing farm experiences on campus are common to European and United States university settings. These include multiple demands on teachers' time, lack of facilities or support, and legal matters such as liability insurance. When there is a student farm or at least a plot of land dedicated to learning activities it may fall on the instructors to do more than just teach and supervise students in the field. If this is not part of the routine college or university activity, there may be minimal support from the buildings and grounds people, whose time may also be limited due to budget constraints.

Many college farming activities are constrained by use of older equipment that is affordable, as compared to what is currently in use on commercial farms. This could actually be an advantage, as students learn to make do with what is available, a useful skill if they intend to start farming on their own on a small scale. If the administration and the promotion/tenure committee are not convinced of the importance of the practical and experiential activities afforded to students, an involved faculty member may be at a professional disadvantage compared to a colleague who can quickly turn experiments around in the laboratory and move these results into the publication stream, while teaching a specialized methods course in the lab. A liberal arts college may present challenges if a majority of teachers and decision makers do not consider the agricultural and food systems activity a part of their mission. On the other hand, if teaching is the major objective, the college may be more supportive of experiential activities and their supervision by faculty than in a research university that is primarily driven by grant success and research publications. It often comes down to commitment by the individual instructor, and it is not surprising that junior faculty members may be cautious to embark on what they consider most important before reaching tenure.

In some countries such as the United States, the legal climate is such that liability for students while at the university becomes a major issue. At the University of Nebraska, a daily additional insurance premium must be paid for each student who embarks on a field trip in a university vehicle. This also covers liability during their activities in the field, but there are uncertain areas such as when students drive their own vehicles to a university-sponsored event off campus, coverage if they are operating farm equipment, and who is responsible for their actions while on a field trip. Most universities carry an umbrella policy that covers their faculty involved in such activities, including athletics, except in cases of proven negligence. It is an unfortunate reality that all these factors must be taken into consideration before an instructor embarks on planning any learning activity that is outside the normal pattern of education on campus.

## *9.4 Potential to Expand Experiential Learning in Universities and Colleges*

We observe a high level of motivation among students for practical and relevant learning activities, and offering well-organized programs including experiential learning could be useful for recruiting students in today's competitive higher education environment. There is potential for future collaboration between the research universities and liberal arts colleges. The former have the discipline-specific technical expertise, soil and plant testing laboratories, and solid interactions with farmers through extension programs. They have students with practical farm experience, willing to share this with others. The latter have motivated students, often seeking internships and technical guidance, and may provide motivation and energy for socially-viable projects with farmers and with communities. Some talented undergraduate liberal

arts students may develop a broad base and understanding of ecology, new ways of thinking about agriculture, ethnographic skills that enable them to talk with important innovators in farming, and questions about where food and agriculture best fit into tomorrow's society. Many are motivated by a craving for right relationships with the land and with both our natural and social community. They can raise questions that are less often our focus in the large research-oriented universities, about issues such as global climate change, peak oil, food versus fuel, and whether "feeding the world" is really the right question.

In the United States land grant system we may have become too fixated on the stereotype of who is a farmer. Although one conventional farmer may be providing enough commodity crops or livestock for feeding more than 100 people, there are many more people involved in the food system. It would be useful to interview food systems people to learn what their visions are for future systems. Our students could be learning more about who brings food onto our campuses, working with the cooks on a daily basis, and learning about health and safety regulations. Students can explore where their food is coming from and why, and learn about the challenges of ordering from multiple purveyors, industrial food delivery systems, and local farmers. Young people are quick to judge but also quick to understand and propose different solutions. We often talk of today's students as our future, but they are also our present. In terms of food systems, we must redesign education so that students are not just consumers of education but co-creators of their education, much as we are redefining the "consumer" as a "co-producer" within the CSA model. We need skills in soil science but we also need skills in interviewing, graphic arts, business, ethics and more. This is easier in small schools where faculty across disciplines can meet and may not be beholden to departmental commitments over collaborative engagement. Small schools tend to be more dependent on their town community, and intimate relationships may lead to creative educational opportunities.

A number of innovative programs are showing that experiential learning can be used with a wide range of audiences, allowing a new dimension of outreach from our colleges and universities. Numerous undergraduate service learning courses have students working directly with elementary school children in their schools or surroundings to plant gardens, take field trips to see farms or forests, or identify insects and reptiles. Instructors can help students seek out these opportunities or structure them into courses on campus, yet many of us are not well trained in this type of learning. Better use of school farms, setting up more internships, and using apprentices in a structured program with clear learning objectives provide several options. Often these practical learning activities may be more easily structured into an inter-term short period, or during school vacations, although such experiential learning may have to be linked to summer jobs essential to many students to help pay for advanced education.

In the Norway Agroecology M.Sc. program students move out onto farms and into communities. Although working at this local scale, they continuously seek additional focus at the regional, national, and global scales, in order to fully understand boundaries and importance of food system design within and beyond the farm gate. This requires ethnographic skills, and includes using farmers' and other clients'

words in describing and understanding their total experience. Then it is valuable for them to evaluate the gap between what clients say and what the university instructors say and their different assumptions. Another outcome is for students to have a better understanding of how smart and talented farmers are, while simultaneously being limited in their choices due to policy. Farmers are good at farming to the policy, particularly in the United States and the European Union.

## 10 Experiential Learning in Agroecology Learning Landscapes: Back to the Future

While we are intent on designing new learning environments, using the latest tools in communications technology and involving students in taking responsibility for their education, it is humbling and useful to reflect on how many generations of our species depended on experiential learning within the family and the village since agriculture began some 10,000 years BCE. Even without written language our ancestors passed on information about what plants were safe to collect and to plant, and methods of cultivation under the specific circumstances of each production environment. Knowledge and skills were passed on from one generation to the next, without written record, and small innovations accumulated across the centuries. We could extrapolate this learning process to imagine how hands-on learning led to the industrial revolution and eventually to computers and space flight. It may be more than happenstance that some of the most creative minds in the early computer age honed their skills in workshops in a garage or basement, and not in the laboratories of academia. How does this observation contribute to our design of future learning?

It is also intriguing to think about how people have prioritized challenges over the millennia, and how our early experiences as a species may have predisposed us to deal with some challenges better than others. Anthropologists explain that we are hard-wired to react to threats such as a bear at the mouth of the cave, or a child about to touch a hot burner on the stove, or an intrepid youngster riding a bicycle with no hands. We deal with those challenges well, and we react quickly to assure safety of our loved ones. It is more difficult to react to subtle threats that we cannot perceive first-hand with our available senses, such as dissolved pesticides in a waterway, gradual global warming, or unchecked human population increase and growing disparities between rich and poor. All affect our personal well-being and the resilience of our species in the long term, but we seem less well prepared to handle these subtle challenges. Here is where the integration of theory with knowledge, of literature with practice and common sense, and of book knowledge with hands-on experience dealing with challenges in the real world collectively introduce useful perspectives for future education.

Agroecology as a transdisciplinary study of the ecology of farming and food systems provides an integration of useful biological and social science methods to handle complex future situations that are often undefined, complex, ambiguous, and unpredictable. Thus we advocate a blending of science with practice, and integrating

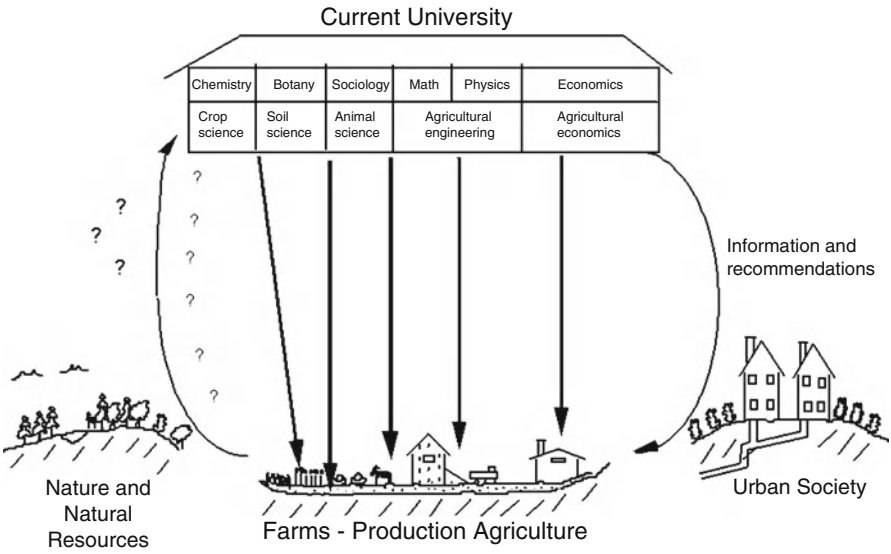


**Fig. 9** Schematic description of a current agricultural university and connections of research and education specialists to individual enterprises and specialized farms (From Lieblein et al. 2000)

the important results of a century of discipline-specific research with the experiential knowledge accumulated by farmers in their unique production systems well-suited to divergent ecological niches. In this conclusion, we offer some future visions of how institutions could be organized and experiential education implemented to help assure a sustainable and equitable future food supply while maintaining an environment and a society in which we would like to live.

## *10.1 Reflections on Current Experiential Learning*

In contrast to the institutional organization that is optimum for what has been presented above to foster experiential learning, the structure of conventional universities and colleges and the interactions among their instructors, researchers, and outreach specialists could be illustrated as shown in Fig. 9. The diagram shows the university classroom/laboratory building and the connections its people make with the stakeholders "out there" (from Lieblein et al. 2000). The physical infrastructure of most universities could be depicted as a monolithic building, clearly divided into cells or sections by traditional academic departments within which we teach and research. Students take most courses within their department or major, although "breadth requirements" force us to grudgingly send students to other departments to acquire additional specialized knowledge about other fields. If the individual faculty reward system depends on accumulation of student credit hours taught, it is not to

our advantage to send students to other departments. One joke on the university campus is that departments are primarily connected through the plumbing system. To be sure, there are large exceptions to this stereotype of the university and its teaching function. There are interdisciplinary majors, general education requirements, and individual advisors who carefully counsel students to take a range of courses in multiple departments that will enhance their education and prepare them better for the job market in the future. The extreme case is presented to provide a traditional standard for comparison.

To expand on an explanation of this traditional model, part of the problem is our assumption and mind-set that the world is only built up of atoms, coupled with a scientific worldview of the universe as a natural machine, and until recently a lack of coherent science on system scales larger than organisms to convince us to think otherwise. In contrast, many systems thinkers now explore alternative scientific explanations and study the world as a complex interactive system impacted by unpredictable events and dependent on many emergent systems properties. In the nexus of natural systems and agriculture, there is a background of scientific, integrated theories and examples that could be useful for a systemic approach to farming and food systems (e.g. Prigogine and Stengers 1984; Odum 1982). Odum and Odum (2006) called this a 'General Systems Theory', with reference to the phenomenon in the universe called 'self-organization', a theory that local ordered structures are formed at the cost of increasing 'disorder' or increasing entropy to the surrounding environment. The theory has been demonstrated in studies on different types of systems, both natural ecosystems and integrated human-managed agroecosystems (Able 2003). Recent books and articles on self-organization in biology and ecology, and their interactions with social sciences, may be explored for more details (e.g. Ostrom 2009; Olsson et al. 2004).

Moving into the landscape "out there" we can observe three domains of interest: the natural environment, the farming sector, and the urban setting where most people live today. These are drawn as separate domains in Fig. 9, because to some extent we have categorized and dealt with them as unique and disconnected entities, although they all are dealing with and impacting food in multiple ways. Until recently, most courses in departments of natural resources were focused on the environment *per se*, with little interest in production activities and how farming could be made less harmful to nature and the environment. Ecology and study of natural systems as a discipline diverged from production agriculture in the first decades of the twentieth century. Moving across the landscape, farms and production agriculture are the domain of disciplines such as agronomy, horticulture, entomology, plant pathology, animal science, agricultural engineering, and agricultural economics. Finally, activities and inhabitants of the urban society are studied and taught in departments of sociology and anthropology. The crossovers and linkages between and among these departments and their instructors, while obviously important to us today, until recently have not often been connected in academic tradition and instruction.

In communication with stakeholders in the larger society, we have obvious interaction with students, those we herd onto campus and subject to 4 years of specialized training, and hopefully to some education. Outreach in programs of extension,

evening courses, and publications has been formulated in terms of information and recommendations, and the communication has generally been in a mode of one-way transfer. This information has come from specialized departments, and targeted to answer very specific, reductionist questions about small components of the overall natural resource, food production, and food consumption system. The building shown and one-way transfer of information that we call "education" represent the not-too-distant past, and one that many educators have worked hard to change. Both the structure and function of the university resemble in many ways those of the classical church, and the large lecture hall with all seats facing forward and attention given to the authority figure up front, usually male, are not unlike the structural patterns found in the cathedral.

Most modern educators would dismiss this depiction of the university as out of date, and quickly bring up the important exceptions of team teaching and research as well as cross-department courses, but the model is presented to demonstrate how far we have come in some programs, at the very least for comparison with more enlightened models presented later in this section.

## *10.2 Relevant Lessons from History*

Our ancestors certainly made little distinction between the natural environment, their food gathering and hunting areas, and the places they lived. In a demanding environment where survival depended on a wide range of skills, they lived across this continuum in a highly integrated way. There was considerable specialization among tasks, some related to gender and others to special skills, but in a way these people were all generalists who could make do with the resources at hand or on what could be acquired by trading. While few in today's society in any part of the world would advocate return to such a difficult life style, there may be lessons to be learned from this resilient culture that are useful to our design of tomorrow's learning landscape using principles of ecology.

Early university researchers and instructors were also generalists. Those dedicated to agricultural botany, and many branches of science, originally came from the clergy, often among the few people in society who were educated outside of the local community and with language skills that allowed them to acquire accumulated knowledge from the scarce books available. Key names in our scientific history such as Darwin and Mendel come quickly to mind. Early botanists who were interested in plants looked carefully at species in the natural environment as well as agricultural fields. The founders of our departments of botany and plant pathology over a century ago were well versed in the interconnections and systemic nature of the agricultural process, although they had neither the tools nor the language we have to study and describe it today. Much of the early learning was through apprenticeships, where students accompanied their mentors for long trips to the field for observation and analysis. One could argue that our capacity for careful observation, critical sorting of useful information, and holistic analysis has declined as we moved away from study of whole plants and animals imbedded in

their natural or cultivated environment and into the laboratory where ever more sophisticated – and expensive – equipment has enticed us to "grind and find" in our search for gene sequences, cellular mechanisms, and biochemical details related to life. Evidence shows that much of our graduate education has been skewed toward the reductionist end of the spatial spectrum (Langer et al. 2007).

As we design holistic and experiential educational experiences for students in agroecology, it is useful to reflect on the long-term history of learning as summarized in the examples of "primitive societies" described above. As we recognize agroecosystems as human activity systems rather than merely collections of crops and animals in separate enterprises, and how their success is highly impacted by management decisions, the search for alternatives begins to bring in more of the social science literature and other experience. We hear agronomists discussing human capital, and even some discussing other traditional societies such as Ladakh before the road to India was completed, where people did well in a high-altitude, and generally inhospitable climate with limited quality of soil resources (Norberg-Hodge 1991). All human needs for food, shelter, clothing and others were secured with about 20 hours of labor per adult per week, averaged through the year. Much of the rest of the time was spent in community, building relationships and human capital, a way for society to survive under what many of us would consider marginal natural circumstances. Bushmen of the Kalahari and Sami in northern Finland, primarily without written language, also spend about 20 hours per week to provide all necessities, and the balance of time is spent in community (Sahlins 1976). Are there lessons from this part of human history, and even current practice in some corners of the globe that can help inform our design of future learning landscapes?

An important foundational principle for development of future learning environments is the recognition that different ways of knowing, both from the academic tradition and from practical experience of farmers, are important to appreciate and to integrate into student learning. The vital role of experience and incorporating prior knowledge and practical learning into the approach to new topics is essentially similar to the literature of John Dewey from over a century ago. Taking this to an extreme, he argued that the only way real learning could occur is to incorporate new information into prior experience. In a sense, we are going "back to the future" in revisiting the principles espoused by Dewey, and re-thinking how we reorient learning situations to better validate prior knowledge and bring information into the context of the audience, be those students or other stakeholders with whom we work. A part of this learning is an immersion in real world situations, both on farms and in food systems, and there is a certain parallel to Kurt Hahn's initiatives in Outward Bound where students are given large challenges and have to develop their own tools to embrace them. The social consciousness of Paulo Freire and concern for equity in farming and food systems as part of a long-term, sustainable society provides another foundational element to the program. Finally, the Kolb learning cycle is invoked to conceptualize and organize the learning process, another connection of the course activities to education theory. In this overall process, students then can better internalize new information, and complete the program better prepared to envision and put into practice what they have learned through systems action education.

## *10.3 Emerging Theories of Experiential Learning*

Systems action education (SAE) has been described in Sect. 3 as a strategy for recognizing emerging challenges, addressing new focus areas such as the bioeconomy, adaptive governance, and other important dimensions of a future curriculum that lead to capacities for creative inquiry and taking responsible action. One important dimension of meeting the challenges of maintaining global life support systems is helping students to recognize problems at broader spatial scales and over longer time spans than is apparent to the average observer. Among the priorities in helping students navigate an increasingly complex and unpredictable farming landscape and food system foodscape is providing the tools and developing the perspectives that will prepare them to deal with challenging problems such as those inherent in an emerging bioeconomy. Future production systems must do more than provide higher yields with ever more scarce resources, and have to be designed to provide multiple outputs and especially vital ecosystem services on which the human population depends. Policy makers and planners will face ethical decisions such as using commodity crops for food versus fuel, and allocating scarce land resources to agriculture, to other human activities or to ecosystem services. These could also be called more precisely 'life-support functions' such as regulating $CO_2$ concentrations in the atmosphere, preserving genetic diversity and general biodiversity, and maintaining hydrological cycles on which we depend. Locations for food production will likely evolve toward more focus on land close to where people live, as we adapt to foods available in season, reduce food miles (i.e., total distribution miles from origin to destination), and use scarce energy for needs more critical than long-term transport of foods. Peri-urban and urban food production are likely to grow in importance to improve food quality, increase access, and improve food security which is sometimes called food autonomy or food sovereignty, terms related to current food equity challenges.

Questions about political and economic systems that recognize the value of ownership and access of local resources related to food by a wider sector of the population can be addressed through the systemic methods provided in agroecology, when this is broadly interpreted as the ecology of food systems. A combination of biophysical and social science methods of research as embodied in the agroecologists' "tool kit" can help students recognize and study complex issues in the natural resource-dependent human activity system we call farming. Social resilience to climatic as well as political and economic changes can be related to the structure of agriculture, and thoughtful research into local versus global food systems as well as farm size and stability and viability of rural communities are all a part of societal stability. We have found that immersing students in the farm and rural landscape, including communities, provides a learning experience that allows them to examine broad and systemic challenges. Combining theory from the classroom with personal observation through collaborative work with stakeholders in the field builds practical skills for dealing with a wide range of unexpected challenges in the future.

Conscious focus on the steps of Kolb's learning cycle can inform our design of learning environments to guide students on a rational path through complex

challenges of allocating scarce resources, meeting multiple demands of society, and creating a future that is desirable for humans and most other species. *Deep reflection* by students on the goals and direction of current decision makers in the food system must reveal stakeholders' underlying motivations, concerns, and world views that lead to choices that will determine the long-term sustainability of food, and this includes sorting out and evaluating multiple sources of information. Who says that "the U.S. farmer has a moral obligation to feed the world?" Or is this a myth perpetuated by superficially well-meaning large land owners and input-supplying corporations that stand to increase market share and/or profits through perpetuating the industrial model of agriculture? *Rich observation* skills enhance student capacities to collect relevant information on "coupled human-natural systems" and guide them in exploring the *ecotones* between disciplines, crucial systems components across spatial and temporal scales, and resilience of biodiverse local food systems as compared to larger scale and predominant industrial systems. *Future visioning* skills provide a valuable tool to help students look beyond current reality and plan for a desirable and equitable future, one that will meet the needs of multiple stakeholders with often competing demands. *Responsible participation* and *focus on action* move learning out of the theoretical domain of conventional university education and into the forefront of contemporary concerns of farmers and community members with regard to food systems. The open-ended cases used in agroecology courses provide a learning strategy that immerses students in the complexity, uncertainty, and risky reality of present resource and food systems.

Incorporating a learning strategy that builds a systemic point of view into the study of farming and food situations makes explicit the numerous factors that interact and impact success and stability of the system in each unique situation. When prior experience in a given discipline or personal bias obscures the objective observation and analysis of food systems, it is unlikely that future scientists and development specialists will be capable of evaluating the full range of potential alternatives. A systematic and logical approach to researching systems, and not jumping to conclusions or solutions, is a vital component of the process we encourage in agroecology projects in the field. Using multiple criteria to evaluate current systems as well as potential scenarios for the future enhances the agroecologists' capacity for responsible action in totally new situations. Students need to develop and practice communication skills that enhance their capacity to deal with a range of stakeholders in the field and to understand in depth their motivations and needs. These are among the goals of systems action education as applied in our design of curricula, classes, and activities in the agroecology program.

## *10.4 Broadening Education to Embrace Integrated Systems*

In the simplest terms, education in the complexities of integrated systems requires a quantum leap in thinking above the study of individual enterprises, simple crop or animal interactions with fertility level or feed supply, or costs of production from a

single field on the farm. Likewise, recognizing the primacy of importance of management decisions in these human activity systems helps students understand the complexity of multiple goals of stakeholders, including goals of farmers, processors, marketers and consumers even in the simplest of local food systems. Most of the focus of research and education in traditional agricultural and natural resource disciplines has been on components of systems, with a goal of understanding simple cause and effect, linear relationships to inform the design of learning. For example, we have well-understood methods of measurement and tools for statistical analysis of maize responses to fertilizer rate applications, animal performance using different feed rations, and economic decisions made by farmers in response to changes in commodity prices. These ideas and skills are easy to teach. We can quickly train students to take soil samples and run chemical analyses, formulate and mix feed rations and weigh animals, and calculate production costs and crop sales to determine net income from a field or farm. It requires higher order skills to interpret soil test results, compare crop yield responses and grain quality using chemical fertilizer versus compost versus green manure, or to decide on limited financial input allocation among different production factors. To effectively address the complexities of farming and food systems, it is not only essential to deal with a much wider array of variables, but to embrace the multiplicity of interactions inherent in these systems and how these operate in the context of each unique situation.

When the human dimension is added to the equation, and we seek ways to better learn about the multiple human + production biology + economics + environmental influences on agriculture and food systems, it is essential that we view whole systems as more and different from a sum of the components. It is not possible to study and comprehend these interactions and complexities without using the methods and analytical tools of both biological and social sciences. This is where agroecology as an emerging "discipline" provides a platform for creatively combining these methods, and where we can create co-learning environments or landscapes that mobilize the energies and ideas of instructors, students, and stakeholders to better understand systems complexity. The importance of stakeholders' involvement, explored in Sect. 7, and expanding their role from passive providers of case study information and a place to solve problems to one of full participants in the learning teams, is essential to success of the open case approach to learning.

As a final rationalization for the importance of studying whole systems rather than focusing on individual components, singular attention to factors one at a time often obscures vital interactions, complementarities and types of competitions that are essential to understanding system function. Ways to uncover emergent properties thus revealed, methods of establishing criteria for weighting individual factors, and capacities to view and understand whole systems can all be developed as part of the learning environment, and students move out from the program with the capacity to address higher order questions. How do we recognize and measure resource productivity, range and stability of incomes, resilience and sustainability of the system under changing conditions, and equity in the distribution of benefits across society? We see this as only possible if we embrace, together with students and stakeholders,

the complexity of systems, the importance of webs of interactions rather than food or value chains with simple cause and effect relationships, and the concepts of long-term food system performance and how we can manage them to better the human condition.

## *10.5 Future Potentials of Distance and Blended Learning*

Many of us as instructors are immigrants into the community of electronic communicators, while most of our students are natives in this environment. Just as we learned from lectures, library assignments, and graded writing activities, today's learners are more active in electronic environments that bring them information from the web, authority from multiple sources of ideas, and social networking through cell phones, Facebook™, Twitter™, and especially verbal communication. How do we design learning landscapes that reflect both the methods that are understood by tomorrow's students as well as reflect the knowledge and values that we deem important for the long-term future? One solution is to seek activities, courses, and curricula that encompass the idea of blended learning, based on multiple means of information acquisition, processing and discussion, and synthesis into meaningful communications among students and between students and instructors.

On-line accessibility of courses and other learning activities is one resource-efficient option to reach a wide audience, and this popular strategy has become a part of the course offerings of many universities. Several activities that depend on this technology and teaching approach were described in Sect. 5. Case studies on-line as part of a distance course provide the opportunity to visit farms and meet farmers in a new environment, and to work with other students on teams to understand those farming systems and how to improve them.

We currently conduct field studies with students using different models in Norway, the United States, France, and Sweden. Student exposure and interactions with stakeholders range from farm visits of 2–4 hours to extensive 2 week visits to farms and communities. In some ways, many instructors feel that it is impossible to replace this type of intense experience on farms, where students invoke the senses of seeing, hearing, smelling, tasting, and feeling the environment of crops and animals, with a virtual experience using videos, photos, recorded interviews, and even real-time conversations with the farmer through Skype™ or other communications media. Although we may be right, our students may have different capabilities to gain these same experiences through different means or use of their senses in ways scarcely imaginable by an older generation. Among the capacities we hope to develop in our agroecology graduates is the social learning needed for tomorrow's working environment, where team approaches, effective communication within the team and with stakeholders, and multiple disciplines will likely be the norm whether in academic, non-profit, government, or private employment. Although it is important to embrace the values and some wisdom from the past, it is essential to put this into the context of the future where our students are going to develop new agendas for involvement and achieve responsible actions.

## *10.6 Building Capacities for Effective Collaboration*

In many ways, the most effective way to learn about effective collaboration in a potential future working situation is to practice that same type of collaboration during the study years. There is value in some preparation, such as learning theory and elements of communication plus role play to practice interview techniques in a safe environment, but there is no substitute for learning with stakeholders in the field. In addition to practice in communication with stakeholders, it is important to develop the skills and attitudes that will promote effective work in teams. Group focus on clear objectives, personal integrity in dealing with colleagues, and a strong work ethic all contribute to successful team activities. Although many of the qualities needed are a product of common sense, the opportunity to observe others in diverse situations and to personally practice to hone these collaboration skills are indispensable.

The new Ph.D. program in agroecology and capacity-building now in the planning stage includes among the learning goals the effective management of people and organizations. Beyond the typical skills expected in such a study program, such as organizing budgets, working project teams, and personnel management, it is important to learn how to operate up and down the administrative hierarchy, deal with uncertain economic situations, and adjust to often changing political realities. Appreciation of the strengths of people and ideas coming from multiple disciplines is important but not sufficient to catalyze effective teams of diverse people and specialties. Understanding some of the complexity of whole systems and where they fit into the overall scheme of things is vitally important. This is one essential perspective that an effective leader, project coordinator, or administrator needs to develop to be ready for effective collaboration with colleagues and with stakeholders.

To help people move beyond "monocultural thinking" and simple solutions to problems that are based entirely on assumptions from prior experiences may require moving past the methods that have been successful in other times and circumstances. In a future characterized by resource scarcity, an increasing human population, and increasingly unstable geo-political interactions it will be necessary to think beyond current models and devise new types of thinking about resource allocation, equity of benefits, and neoclassical strategies to approach challenges. An educational environment that can effectively prepare people to deal with complexity, uncertainty and risk, and multiple criteria for evaluating farming and food systems will be the most useful for tomorrow's graduates.

## *10.7 Stakeholder Involvement in Future Learning Landscapes*

Our mental conversion from considering the collaborators "out there" as clients eagerly awaiting our ideas and counsel to fully participating members of the research and education team will take some shifting of attitudes. In a classical educational environment, with the professor or extension specialist as the authority figure who brings most of the solutions to the table, both the university information provider

and the client are in their comfort zones and playing familiar roles. When these roles are redefined and the players expected to take on new or different responsibilities, it is not surprising that adjustments must be made in behavior, attitudes and activities. Professors who convert to a role as facilitator of learning may feel uncomfortable with the "demotion", and interpret this move from supreme source to catalyst for learning as resulting in a loss of status or authority. Likewise, a stakeholder who is used to being a passive recipient of information changing to become an equal in the teaching/learning continuum may feel inadequate or unprepared to take on this responsibility. In any case, the sharing of tasks and roles from a hierarchical framework to a rather flat arrangement of exploration and decision-making among equals needs to include serious discussion and negotiation to become successful. The basis for this discussion needs to be trust and honesty about expectations, a validation of the practical experience of farmers and the legitimacy of prior knowledge brought by students, and of course the recognition of years of training and education that is provided by the university specialist. Our experience in agroecology field activities has proven that this transformation of roles can work well.

As instructors we have found great value in recruiting "social trustee professionals" who are farmers or food system specialists who can share their experience in context with our students. These people bring both practical expertise in how they have designed and worked within farming and food systems and the credibility of people who have survived the rigor of the ups and downs of the farming and food economy. They can frankly discuss current challenges in food systems that prevent them from reaching their goals, because they live with those challenges on a daily basis. Their incomes and quality of life depend on making sound decisions in the context of their local conditions. They admit freely to our students that they do not have all the answers, and the interviewing and probing process by students often helps them to ask the right questions, perhaps in a potential future context that has not been considered, or bringing in new ideas from the students' experiences that will be useful in future farming systems.

Another advantage of close stakeholder participation is the potential for increased relevance of the project work and use of results by those who work with the students. An open-ended case (Francis et al. 2009) that will be useful to stakeholders needs up-to-date information and feedback from the field, something that cannot be achieved by a case that has all the background information stored and accessed in an asynchronous manner by students. Personal interviews with those most involved on the farm and in the community provide first-hand information, and collecting this on site enhances the student team understanding of the context from which questions have arisen and where any solutions will be applied. When stakeholders are directly involved with the design of scenarios, alternatives, and solutions they will obviously feel more ownership of both process and results, and thus may be more likely to adopt recommended changes. Lastly, when communities pay a portion of the team costs as we have observed for the past 3 years in Norway, there is a higher level of commitment from both the students and the stakeholders. These are all positive considerations that should be included in planning to work more closely with stakeholders in agroecology field project activity design.

## *10.8 Extending the Experiential Agroecology Model to Other Groups*

There are several ways to expand the opportunities for increasing student numbers and thus bring the chance to move experiential learning methods in agroecology to a larger student population. The obvious first alternative is to increase numbers of students in existing courses or study programs. Although this would increase student numbers and credit hours, the instructors in charge of current courses strongly feel that having more students in a given class would generally dilute the effectiveness of learning as their time is spread across more students. With a carefully planned and supervised experiential learning experience, much depends on the close involvement and continuing evaluation by one or more instructors. Doubling class size in a conventional lecture situation involves little additional preparation costs, although grading assignments would be directly proportional to student numbers. What is difficult is planning excursions with additional transportation needs and costs of overnights and meals if these are extended field experiences. There is more preparation time needed in contacting stakeholders, setting up schedules, meeting with teams, and doing some instructor and supervision travel in the field. What we have found to be a limitation in the Norway program is limited time to adequately supervise thesis planning and provide timely feedback on reports, questions about methods, and reading reports and thesis drafts. To offer a quality learning experience to each student and to conduct enough evaluation to monitor progress are both time consuming.

A more viable method of expanding student numbers is to initiate new programs. The U.S. Midwest agroecology summer course has been successful in catalyzing the new course in the U.S. Pacific Northwest, now in its fifth year at Washington State University. Likewise, the Norway course is one of the reasons there are classes offered in ISARA-Lyon, France, and a new M.Sc. 2-year program at the Swedish University of Agricultural Sciences (SLU) on the Alnarp campus in southern Sweden. The new courses offer a quantum leap in available student positions, and almost always involve new institutions and additional instructor interest. There are always challenges to new programs, and their sustainability often depends on grant funding and overload time dedication by involved instructors who strongly believe in the concept. Examples of fragility include the dependence of the Midwest course on grant funding, as we are now on our third grant and need to work on new sources each year. Another is the new course in Sweden that attracted a number of students from outside the European Union due to no tuition charges; a current change in national policy implements a tuition charge for anyone from outside the European Union, and this has impacted enrollment in the second year the program is offered. Such problems need to be overcome to provide a stable opportunity to students from all countries. It is likely that one of the most efficient investments in development aid would be scholarships for these kinds of programs, educating people whose preparation will have a high degree of relevance in developing countries.

A third strategy to broaden the impact of both experiential learning methods and the holistic strategies of inquiry in agroecology is to promote the infusion of these ideas into other courses, departments and curricula. This has been done in the U.S. Midwest course by inviting additional instructors to participate as part of the teaching team. One visitor followed through and started a similar course in the Pacific Northwest. Two other instructors from two states in the U.S. Northeast also participated in the course, and attempted without success to start their own travel course back home. Two instructors from Sweden and Denmark observed or studied the Norway model before initiating the new M.Sc. course in southern Sweden. It appears significant that the new course began on a small campus that was more accepting of innovation, rather than on the main campus of the university. As described by Kuhn (1970) in *The Structure of Scientific Revolution*, change most often starts on the margins and not in the mainstream, citing the reformation in northern Europe and changes in civil rights and the women's movement in the United States as examples. Our current example is the systems thinking that is infused in agroecology courses and programs, and the move toward experiential learning as a fundamental revolution in educational thinking. Yet, there are many challenges faced by those seeking change.

## *10.9 Converting Challenges into Opportunities*

"If you end up with a lemon, try making lemonade rather than cursing the bitterness of the fruit", says one popular cliché. How do we deal with conservative institutions that are relatively resistant to change, when our goal is to introduce content and processes of learning that differ substantially from the mainstream? It is useful to examine our own personal experiences in education, since we are all products to some degree of the conventional educational system. Many instructors in agroecology, among them most of the review authors, came from traditional disciplines in academia: agronomy, horticulture, soil biology, cereal chemistry, entomology, and weed science, while only one actually has an advanced degree in agroecology. Perhaps it was our dissatisfaction with the narrow confines of thinking and methods of our disciplines, as well as an exposure to farmers and food systems in a larger context that provided the incentive to look for alternatives? Several of the authors have embraced long-term assignments as students, researchers, or teachers in developing countries (Philippines, Sri Lanka, Colombia, Costa Rica, and Mexico among others). Several have worked with small farmers in a tropical context, and others with small farm systems in the United States and Europe. Most have some familiarity or are actually teaching courses in organic farming philosophy and methods. Some were involved in the early days of research and outreach under the umbrella of Farming Systems Research and Extension. Thus, we have for the most part started our academic careers with mainstream topics and departments, but have subsequently embraced a more holistic and systems-oriented view of the world and of farming and food systems. Does this provide any insight on how to communicate some of our passion for learning and systems with mainstream colleagues?

We note with interest that some of the important initiatives in agroecology come from outside of mainstream agricultural institutions: University of California at Santa Cruz, Evergreen State College in Washington, College of the Atlantic in Maine, and other small liberal arts colleges. Is there some quality in the broad, liberal education tradition that helps us to see things whole? It is relevant to observe that some Land Grant Universities in the United States are introducing more systems-oriented topics into courses at all levels of the undergraduate curriculum. Most of these universities have a required "capstone course" in each major that includes integration of information from the building block courses that have come before. The question persists whether this integration is broad enough, for example if agronomy and horticulture integrate the areas of soils, crops, and plant protection, while giving limited attention to economics, environmental impacts, and social or political viability of systems under study? Do many of us in mainstream production agriculture still consider many of these areas as externalities, as we pursue ever more sophisticated strategies for increasing crop yields using transgenic technologies, precision farming methods, and expensive chemical pesticide and fertilizer inputs from off the farm in *lieu* of focus on farming system design that make many of these technologies less needed?

It appears essential to consider innovations from wherever they come, from organic or sustainable farming projects, from other countries and cultures, from non-agricultural educational programs in small colleges, from social science disciplines including history and literature, and from involved stakeholders who are testing new systems in their own farms and communities. Perhaps our "breadth requirements" for undergraduate students in agriculture should include more courses in human nutrition, ecology of natural systems, political science, education and sociology, rather than staying within the disciplines that traditionally contribute to an industrialized production agriculture based primarily on fossil fuels. Most universities provide options for interdisciplinary studies and flexibility for choice of courses and undergraduate honors thesis projects, and we can explore the opportunities within our existing institutions and rules rather than investing too much energy trying to completely change the system in one large *coup*.

## *10.10 Institutions and Future Learning Landscapes*

Innovative options for designing institutions that could promote broad, transdisciplinary research and learning were published by Lieblein et al. (2000) and are shown here in two figures. Figure 10 suggests a structure for an *integrative university*, where there are porous walls between the basic science, mathematics, and economics departments, and they also have instructors, research projects, and team courses that interact closely with two large production-oriented units in animal and cropping systems and in economics and rural sociology. Some of the learning takes place off campus in natural resource, production, and food systems with students and instructors in teams, interacting with stakeholders working in the natural environment, on farms,

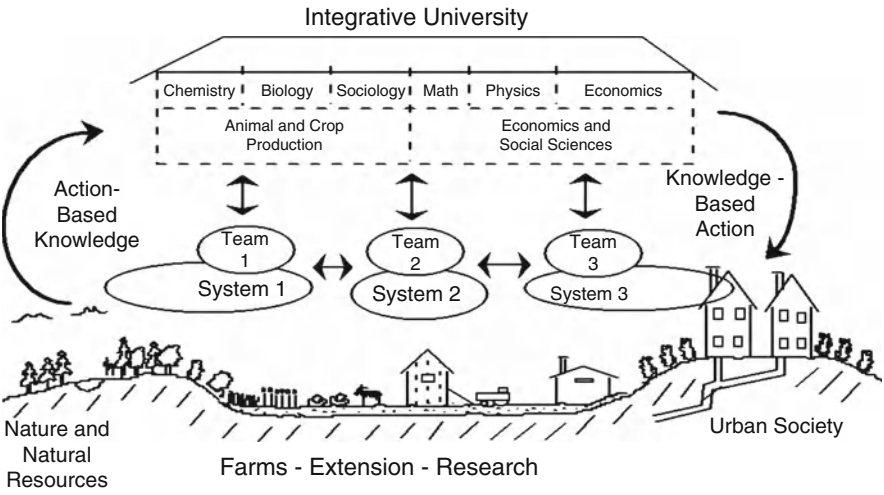


**Fig. 10** Schematic description of an integrative university with closer connections among courses, linkages and information exchange with farmers through systems, and closer relationships with natural resource and urban society contexts (From Lieblein et al. 2000)

and in communities. Ideas and recommendations for "knowledge-based action" move from university to stakeholders, and "action-based knowledge" moves from the teams and the stakeholders back into academia. The figure illustrates many of the concepts and practices of integration that have been detailed in previous sections.

A further elaboration of the principles is shown in the design of a *future active learning university* in Fig. 11 where the lines between university departments are blurred even more, and much of the applied technical research and education takes place entirely off campus. There are learning and research teams organized in different ecoregions and focused on solving challenges that are unique to each of those sites. One set of teams works in the natural resource – farming continuum, and another in the farming – food system – urban society sector, and the research and learning teams include students, instructors, and a wide range of stakeholders. Students move continually into and out of the campus environment, and at the time of graduation feel completely comfortable moving into a job in the larger society because they have spent time and already learned in the context of that society. Recommendations from the university are now termed "knowledge for action", while suggestions coming back into the university are called "knowledge from action". This is one potential way of operationalizing the concepts illustrated for university – stakeholder interaction as shown in Fig. 8, where dialogue-based communication is the intersection of activities of several university disciplines and various stakeholders, mediated and made functional by agroecology instructors and students who are focused on whole systems.

As described in Sect. 9, the challenges of organizing such programs are large, and often new ideas are difficult to put into action in our tightly organized and traditionally

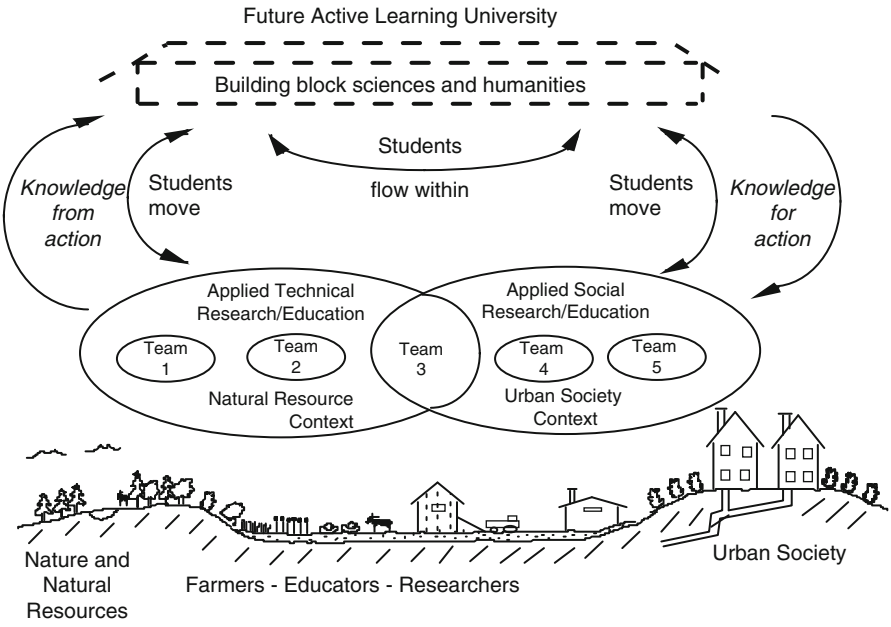


**Fig. 11** Schematic description of a future university for active learning and research, with student and faculty learning activities often in the farming and community environment, and close relationships with both natural resource and urban society contexts (From Lieblein et al. 2000)

focused universities where much of the power resides in the individual discipline-specific departments and with the individual professor's research project. There is also great strength in this same academic tradition and a wealth of information, research methods, and teaching experience that can be accessed in universities. The essential building blocks for sustainable and resilient production strategies are available, if these can be organized and mobilized to fit together into economically, environmentally, and socially viable systems that are unique to the resources and context of each place. While the pieces of a system and their configuration may be unique to location, there are certain organizing principles gained from ecology that can be used in the design process. The use of nature as a model for organizing strategies may be useful as we study the energy and material webs, the cycles of materials, and the ways that scarce available resources can be combined into viable farming and food systems that are sustainable and equitable for the future. Our challenge is to organize and implement activities in learning environments that can lead our students through this complex experience, and thus prepare them for a future that is quite different from the present. We owe our students no less than this ideal outcome in education: a set of skills, capacities, and attitudes to deal with the future.

**Acknowledgements** The authors gratefully recognize the diligent contributions of the book editors and three reviewers who have made important suggestions to improve this review.

## References

AAHEA (American Association for Higher Education & Accreditation) (n.d.) Service learning in the disciplines series. http://www.aahea.org/book-store.htm
Able T (2003) Understanding complex human ecosystems: the case of ecotourism in Bonaire. Conserv Ecol 7(3):10. http://www.ecologyandsociety.org/vol7/iss3/art10/inline.html. Accessed 23 June 2011
Al-Kodmany K (2000) Public participation: technology and democracy. J Archit Educ 53:220–228
Anderson JA (1988) Cognitive styles and multicultural populations. J Teach Educ 39(1):2–9
Argyris C, Schon D (1974) Theory in practice: increasing professional effectiveness. Wiley, New York
Argyris C, Putnam R, Smith DM (1985) Action science: concepts methods and skills for research and intervention. Jossey-Bass, San Francisco
Askew S, Carnell E (1998) Transforming learning: individual and global change. Cassell Publications, London
Auel J (1980) The clan of the cave bear. Crown Publishing/Random House, New York
Barker J (2001) The new business of paradigms. Star Thrower Publishing, Minneapolis
Basarab N (2002) Manifesto of transdisciplinarity. State University of New York Press, Albany
Batie S (2008) Sustainability science: statement of the Friiberg workshop on sustainability science. Am J Agric Econ 90(5):176–191
Bawden RJ (1991) Systems thinking and practice in agriculture. J Dairy Sci 74:2362–2373
Bawden RJ (2005) A commentary on three papers. Agric Hum Values 22:169–176
Bawden RJ (2006) Learning from the future: of systems, scenarios and strategies, Occasional paper 20. Strategic Development Institute, Champaign
Berea College (2011) Ecovillage at Berea College. http://www.berea.edu/sens/ecovillage/default.asp. Accessed 14 May 2012
Bawden RJ (2007) Knowing systems and the environment. In: Pretty J, Ball A, Benton T, Guivant J, Lee D, Orr D, Pfeffer M (eds) Sage handbook on environment and society. Sage Publications, Thousand Oaks
Beard C, Wilson JP (2002) The power of experiential learning: a handbook for trainers and educators. Kogan Page Ltd., London
Beck U (1992) Risk society: towards a new modernity. Sage Publications, New Delhi
Berkes F (2007) Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. Nat Hazards 41:283–295
Biggs R, Diebel MW, Gilroy R, Kamareinen AM, Karnis MS, Preston ND, Schmitz JE, Christopher J, Uejio K, Van De Bogart MC, Weidel BC, West PC, Zaks DPM, Carpenter SR (2010) Preparing for the future: teaching scenario planning at the graduate level. Front Ecol Environ 8:267–273
Bland B, Bell M (2007) A holon approach to agroecology. Int J Agric Sustain 5(4):280–294
Bostock D (2000) Aristotle's ethics. Oxford University Press, Oxford
Brint S (1994) In an age of experts. Princeton University Press, Princeton
Brooks-Harris JE, Stock-Ward SR (1999) Workshops: designing and facilitating experiential learning. Sage Publications, Thousand Oaks
Burbules NC, Berk R (1999) Critical thinking and critical pedagogy: relations, differences, and limits. In: Popkewitz TS, Fendler L (eds) Critical theories in education. Routledge Publishing, New York
Burby R (2003) Making plans that matter: citizen involvement and government action. J Am Plan Assoc 69:33–49
California State University – Hayward (2011) Distance learning degree: M.S. in education with an option in online teaching and learning. http://www.schoolaah.com/Distance_Learning/California_State_University_Hayward.html. Accessed 1 Mar 2011
Caporali F, Lieblein G, von Fragstein P, Francis C (2007) 1. Introduction: importance of integration, multidisciplinarity, transdisciplinary, and systems thinking in research and learning. In: Caporali F, Lieblein G, von Fragstein P, Francis C (eds) Teaching and research in agroecol-

ogy and organic farming: challenges and perspectives. Proceedings ENOAT Meeting, Pieve Tesino, Italy, 29 Aug–3 Sep 2007. pp 9–16. Available at. www.agroasis.org
Carver RL (1996) Theory for practice: a framework for thinking about experiential education. J Experiential Educ 19(1):8–13
Carver RL (1997) Theoretical underpinnings of service learning. Theory Pract 36(3):143–149
Checkland P (1981) Systems thinking, systems practice. Wiley, New York
Checkland P, Poulter J (2006) Learning for action. A short definitive account of soft systems methodology and its use for practitioners, teachers and students. Wiley, Chichester
Checkland P, Scholes J (1990) Soft systems methodology in action. Wiley, Chichester
Churchman CW (1979) The systems approach and its enemies. Basic Books, New York
Claus J, Ogden C (1999) Service learning for youth empowerment and social change. Peter Lang Publishing, New York
Conway GR (1985) Agroecosystems analysis. Agric Adm 20:31–55
Conway G (1986) Chapter 2: Concepts. In: Agroecosystem analysis for research and development. Winrock International Institute for Agricultural Development, Little Rock
Dewey J (1897) My pedagogic creed. Sch J LIV(3):77–80
Dewey J (ed) (1977) Experience and education. Collier Books, New York
Deyle RE, Slotterback CS (2009) Empirical analysis of mutual learning in consensual planning processes: an exploratory analysis of local mitigation planning in Florida. J Plan Educ Res 29(1):23–38
Dillon C, Granger D (1998) Guest editorial. Am J Distance Educ 12(1):2–6
Dodge B (1995) WebQuests: a technique for internet based learning. Distance Educ 1(2):10–13
Dyrdahl T, Karseth D (2006) Professional responsibility – an issue for higher education? High Educ 52:95–119
Englund T (2002) Higher education, democracy and citizenship – the democratic potential of the university. Stud Philos Educ 21:281–287
Foley JA, deFries R, Asner GP, Barford C, Bonan G, Carpenter SR, Chapin FS, Coe MT (2005) Global consequences of land use. Science 309:570–573
Folke C (2006) Resilience: the emergence of a perspective for social-ecological systems analyses. Global Environ Change 16:253–267
Forester J (1999) The deliberative practitioner: encouraging participatory planning processes. MIT Press, Cambridge, MA
Francis CA, Porter P (2011) Ecology in sustainable agriculture practices and systems. CRC Crit Rev Plant Sci 30(1, 2):64–73
Francis C, Lieblein G, Gliessman S, Breland TA, Creamer N, Harwood R, Salomonsson L, Helenius J, Rickerl D, Salvador R, Wiedenhoeft M, Simmons S, Allen P, Altieri M, Flora C, Poincelot R (2003) Agroecology: the ecology of food systems. J Sustain Agric 22(3):99–118
Francis CA, Lieblein G, Breland TA, Salomonsson L, Geber U, Sriskandarajah N, Langer V (2008) Transdisciplinary research for a sustainable agriculture and food sector. Agron J 100(3):771–776
Francis C, King J, Lieblein G, Breland TA, Salomonsson L, Sriskandarajah N, Porter P, Wiedenhoeft M (2009) Open-ended cases in agroecology: farming and food systems in the Nordic Region and the U.S. Midwest. J Agric Educ Ext 15(4):385–400
Francis CA, Jordan N, Porter P, Breland TA, Lieblein G, Salomonsson L, Sriskandarajah N, Wiedenhoeft M, DeHaan R, Braden I, Langer V (2011) Innovative education in agroecology: experiential learning for a sustainable agriculture. CRC Crit Rev Plant Sci 30(1, 2):226–237
Freire P (1973) Pedagogy of the oppressed (trans: Ramos MB). Continuum Press, New York
Gareau TP, Smith RG, Barbercheck ME, Mortensen DA (2010) Spider plots: a tool for participatory extension learning. J Ext 48(5):5–8
Gomez AA, Kelly DES, Syers JK, Coughlan KJ (1996) Measuring sustainability of agricultural systems at the farm level. In: Doran JW, Jones AJ (eds) Methods of assessing soil quality. Soil Science Society of America, Madison, pp 401–410
Green RE, et al. (54 additional authors) (2010) A draft sequence of the Neanderthal genome. Science 328(5979):710–722

Greenwood DJ, Levin M (2007) Introduction to action research: social research for social change. SAGE Publications, Thousand Oaks
Harms K, King J, Francis C (2009) Behavioral changes based on a course in agroecology: a mixed methods study. J Nat Res Life Sci Educ 38:183–194
Heemskerk M, Wilson K, Pavao-Zuckerman M (2003) Conceptual models as tools for communication across disciplines. Conserv Ecol 7(3):8.http://www.consecol.org/vol7/iss3/art8/ Accessed 12 July 2012
Henry AD (2009) The challenge of learning for sustainability: a prolegomenon to theory. Hum Ecol Rev 16:131–140
HIOBS (Hurricane Island Outward Bound School) (1990) Readings. Rockland, Maine, USA. http://www.outward-bound.org/docs/info/HIOBS.htm. Accessed 10 July 2011
Holman D, Pavlicka K, Thorpe R (1997) Rethinking Kolb's theory of experiential learning in management education. Management Learning. Sage Publications, Thousand Oaks
Holtz G, Brugnach M, Pahl-Wostl C (2008) Specifying "regime" – a frame-work for defining and describing regimes in transition research. Tech Forecast Soc Change 75:623–643
Hopkins RL (1994) Narrative schooling: experiential learning and the transformation of American education. Teachers College Press, New York
Husserl E (1913) Logical investigations (trans: Findlay JN, 1973), 2nd edn. Routledge Publications, London
Innes J (1992) Group processes and the social construction of growth management: Florida, Vermont, and New Jersey. J Am Plan Assoc 58:440–453
Ison R (ed) (2008) Systems thinking and practice for action research, 2nd edn. Sage Publications, London
Ison RL, Russell DB (eds) (2000) Agricultural extension and rural development: breaking out of traditions. Cambridge University Press, Cambridge
Ison R, Röling N, Watson D (2007) Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. Environ Sci Policy 10:499–511
Itin CM (1999) Reasserting the philosophy of experiential education as a vehicle for change in the 21st century. J Experiential Educ 22(2):91–98
James T (1995) Sketch of a moving spirit: Kurt Hahn. In: Warren K, Sakofs M, Hunt JS Jr (eds) The theory of experiential education, 3rd edn. Kendall/Hunt Publishing, Dubuque, pp 75–95
Jordan N, Warner KD (2010) Enhancing the multifunctionality of U.S. agriculture. BioScience 60:60–66
Jordan N, Andow DA, Mercer KL (2005) New concepts in agroecology: a service-learning course. J Nat Res Life Sci Educ 34:83–89
Jordan N, Boody G, Broussard W, Glover JD, Keeney D, McCown BH, McIsaac G, Muller M, Murray H, Neal J, Pansing C, Turner RE, Warner K, Wyse D (2007) Sustainable development of the agricultural bio-economy. Science 316:1570–1571
Jordan NR, Bawden RJ, Bergmann L (2008) Pedagogy for addressing the worldview challenge in sustainable development of agriculture. J Nat Res Life Sci Educ 37:92–99
Kaplan R, Kaplan S (1989) The experience of nature: a psychological perspective. Cambridge University Press, Cambridge
Kaplan R, Kaplan S, Ryan RL (1998) With people in mind: design and management of everyday nature. Island Press, Washington, DC
Katula RA, Threnhauser E (1999) Experiential education in the undergraduate curriculum. Commun Educ 48:238–255
Klosterman RE (1999) The what if? collaborative support system. Environ Plan B: Plan and Des 26:393–408
Kolb DA (1984) Experiential learning: experience as the source of learning and development. Prentice Hall, Upper Saddle River
Kuhn T (1970) The structure of scientific revolutions. University of Chicago Press, Chicago
Langer V, Rasmussen J, Francis C (2007) Spatial focus of M.Sc. and Ph.D. agricultural research in Denmark, U.S., and Canada. J Sustain Agric 30(2):29–39

Levin M, Ravn JE (2007) Involved in praxis and analysis at a distance. Syst Pract Action Res 20:1–13
Lewin K (1948) Resolving social conflicts. Harper Publisher, New York
Lewis Center (2011) Lewis Center at Oberliln College. http//:www.oberlin.edu/ajlc/ajlcHome.html. Accessed 14 May 2012
Lieblein G, Francis C (2007) Towards responsible action through agroecological education. Ital J Agron/Riv Agron 2:79–86
Lieblein G, Francis C (2010) Collaborating with stakeholders using an agroecology systems model. In: von Fragstein P, Francis C, Rembiałkowska E, Briz T (eds) Proceedings of ENOAT meeting, Madrid, Spain, 6–8 Sept, pp 41–62. www.agroasis.org. Accessed 10 June 2011
Lieblein G, Francis C, Salomonsson L, Sriskandarajah N (1999) Ecological agriculture research: increasing competence through Ph.D. courses. J Agric Educ Ext 6(1):31–46
Lieblein G, Francis C, King J (2000) Conceptual framework for structuring future agricultural colleges and universities. J Agric Educ Ext 6:213–222
Lieblein G, Moulton M, Waalen W, Breland TA, Francis C, Sriskandarajah N, Porter J, Helenius J, Salomonsson L, Langer V (2005a) Systems thinking and experiential learning: a Nordic net-based course in agroecology: integrating student learning and teacher collaboration. European J Open Distance Learning [EURODL] vol 1. http://eurodl.org/materials/contrib./2005/Lieblein.htm
Lieblein G, Østergaard E, Francis C (2005b) Becoming an agroecologist through action education. Int J Agric Sustain 2(3):147–153
Lieblein G, Breland TA, Ostergaard E, Salomonsson L, Francis C (2007) Educational perspectives in agroecology: steps on a dual learning ladder toward responsible action. NACTA J 51(1):37–44
Lieblein G, Breland TA, Salomonsson L, Sriskandarajah N, Francis C (2008) Educating tomorrow's agents of change for sustainable food systems: Nordic Agroecology M.Sc. Program. J Hunger Environ Nutr, Special Issue Sustain Food Syst 3(2):309–327
Lieblein G, Holm AS, Breland TA, Moulton M, Francis C, Salomonsson L, Cuadra M, Jensen ES, Herzon I, Langer V, Næve A (2010a) AGROASIS in the future – further development of Nordic collaboration. In: von Fragstein P, Francis C, Rembiałkowska E, Briz T (eds) Proceedings of ENOAT meeting, Madrid, Spain, 6–8 Sept, pp 41–62. www.agroasis.org. Accessed 10 July 2011
Lieblein G, Breland TA, Jordan N, Francis C, Bell M, Morse S, Wiedenhoeft M, Johnson B, Rickerl D (2010b) Improving experiential education in agroecology: Nordic/U.S. model. In: von Fragstein P, Francis C, Rembiałkowska E, Briz T (eds) Proceedings of ENOAT meeting, Madrid, Spain, 6–8 Sept, pp 27–41. www.agroasis.org. Accessed 10 June 2011
Lieblein G, Breland TA, Østergaard E, Francis C (2012) Agroecology education: action-oriented learning and research. J Agric Educ Ext 18(1):27–40
Liu JG, Dietz T, Carpenter SR, Folke C, Alberti M, Redman CL, Schneider SH, Ostrom E, Pell AN, Lubchenco J, Taylor WW, Ouyang ZY, Deadman P, Kratz T, Provencher W (2007) Coupled human and natural systems. Ambio 36(8):639–649
Mandarano LA (2008) Evaluating collaborative environmental planning outputs and outcomes: restoring and protecting habitat in New York–New Jersey Harbor Estuary Program. J Plan Educ Res 27:456–468
Margerum RD (2002) Evaluating collaborative planning: implications from an empirical analysis of growth management. J Am Plan Assoc 68:179–193
Maturana HR, Varela FJ (1988) The tree of knowledge: the biological roots of human understanding. New Science Library, Boston
Merriam SB (1987) Adult learning and theory building: a review. Adult Educ Q 37(4):187–198
Mezirow J (1996) Contemporary paradigms of learning. Adult Educ Q 46:158–172
Miettinen R (2000) The concept of experiential learning and John Dewey's theory of reflective thought and action. Int J Lifelong Educ 19(1):54–72
Mittelstrass J (1998) Die Häuser des Wissens. Wissenschaftstheoretische Studien. Suhrkamp, Frankfurt/Main, pp 29–48
Moncure S, Francis C (2011) Foundations of experiential education for agroecology. NACTA J 55(3):75–91

Moore MG, Kearsley G (2011) Distance education: a systems view of online learning, 3rd edn. Wadsworth Publications, Belmont
Nassauer JI, Opdam P (2008) Design in science: extending the landscape ecology paradigm. Landsc Ecol 23:633–644
NCPI (National Centre for Postsecondary Improvement) (2002) Beyond dead reckoning, research priorities for redirecting American higher education. http://www.stanford.edu/group/ncpi/unspecified/from_the_director.html. Accessed 12 July 2011
Norberg-Hodge H (1991) Ancient futures: learning from Ladakh. Sierra Club, San Francisco
Null JW (2000) Schwab, Bagley and Dewey: concerns for the theoretic and the practical. Educ Forum 65:42–51
Odum EP (1982) System ecology. Wiley, New York
Odum HT, Odum EC (2006) The prosperous way down. Energy 31(1):21–32
Olson RK (1998) Procedures for evaluating alternative farming systems: a case study for eastern Nebraska, vol 8, Extension education materials for sustainable agriculture. Center for Sustainable Agriculture System, University of Nebraska – Lincoln, Nebraska, pp 39–44
Olsson P, Folke C, Berkes F (2004) Adaptive co-management for building resilience in social-ecological systems. Environ Manag 34(1):75–90
Østergaard E, Lieblein G, Breland TA, Francis C (2010) Students learning agroecology: phenomenon-based education for responsible action. J Agric Educ Ext 16(1):23–37
Ostrom E (2009) A general framework for analyzing sustainability of social-ecological systems. Science 325(5939):419–422
Pahl-Wostl C (2007) The implications of complexity for integrated resources management. Environ Model Softw 22:570–579
Pahl-Wostl C, Hare M (2004) Processes of social learning in integrated resources management. J Community Appl Soc Psychol 14:193–206
Parker M (1991) Creating shared vision. Dialogue International Ltd., Cambridge
Perry WG (1970) Forms of intellectual and ethical development in the college years. Holt, Rinehart, Winston Publishing, New York
Pickett S, Cadenasso M, Grove J (2005) Biocomplexity in coupled natural–human systems: a multidimensional framework. Ecosystems 8:225–232
Pretty J (2003) Social capital and the collective management of resources. Science 302:1912–1914
Prigogine I, Stengers I (1984) Order out of chaos: man's new dialogue with nature. Heinemann Publishing, Oxford
Raffan J, Barrett MJ (1989) Sharing the path: reflections on journals from an expedition. J Experiential Educ 12(2):29–36
Ravetz J, Funtowicz S (1999) Post-normal science: an insight now maturing. Futures 31:641–646
Rickerl D, Francis C (eds) (2004) Agroecosystems analysis. Monograph 54. American Society of Agronomy, Madison
Robertson GP, Dale VH, Doering OC, Hamburg SP, Melillo JM, Wander MM, Parton WJ, Adler PR, Barney JN, Cruse RM, Duke CS, Fearnside PM, Follett RF, Gibbs HK, Goldemberg J, Mladenoff DJ, Ojima D, Palmer MW, Sharpley A, Wallace L, Weathers KC, Wiens JA, Wilhelm WW (2008) Agriculture – sustainable biofuels redux. Science 322:49–50
Rodriguez-Ulloa R, Paucar-Caceres A (2005) Soft system dynamics methodology (SSDM): combining soft systems methodology (SSM) and system dynamics (SD). Syst Pract Action Res 18:303–334
Röling N, Jiggins J (1998) The ecological knowledge system. In: Röling N, Wagemakers M (eds) Facilitating sustainable agriculture. Cambridge University Press, Cambridge
Sahlins M (1976) Culture and practical reason. University of Chicago Press, Chicago
Salem School (n.d.) The seven laws of Salem. http://www.salem-net.de/fileadmin/Kundendaten/pdf/PERSOENLICHKEITSENTWICKLUNG/Die_7_Salemer_Gesetze/7_Laws_of_Salem.pdf. Accessed 10 July 2011
Salner M (1986) Adult cognitive and epistemological development in systems education. Syst Res 3:225–232

Schively C (2007) A quantitative analysis of consensus building in local environmental review. J Plan Educ Res 27:82–98
Schön DA (1983) Reflective practitioner. Basic Books, New York
Schunk DH (2008) Learning theories: an educational perspective, 5th edn. Pearson Education, Upper Saddle River
Schunn CD, Crowley K, Okada T (1998) The growth of multidisciplinarity in the cognitive science society. Cogn Sci 22(1):107–130
Sieber S, Zander P, Verburg PH, Van Ittersum M (2010) Model-based systems to support impact assessment – methods, tools and applications. Ecol Model 221:2133–2135
Simmons S (1998) Case studies: reprinted articles from Journal of Natural Resources and Life Science Education (Simmons S, ed). American Society of Agronomy, Madison
Simonson M, Smaldino S, Albright M, Zvacek S (2012) Teaching and learning at a distance: foundations of distance education, 5th edn. Pearson, Allyn and Bacon, Boston
Sipos Y (2009) Non-traditional pedagogies. In: Advanced education: engaging head, hands and heart for environmental and educational benefit. Addressing Global Environmental Security through Innovative Educational Curricula. NATO Sci Peace Secur Ser C: Environ Secur III:155–164
Smith MK (2001) 'Kurt Hahn,' the encyclopedia of informal education. http://www.infed.org/thinkers/et-hahn.htm. Accessed 12 July 2011
Sriskandarajah N, Bawden RJ, Packham RG (1991) Systems agriculture: a paradigm for sustainability. Assoc Farming Sys Res/Ext Newsl 2:1–5
States' 4-H (2011) http://states4hexchange.org/. Accessed 3 July 2011
Stremba B (1989) Reflection: a process to learn about self through outdoor adventure. J Experiential Educ 12(2):7–9
Tallis H, Polasky S (2009) Mapping and valuing ecosystem services as an approach for conservation and natural resource management. Ann NY Acad Sci 1162:265–283
Toderi M, Powell N, Seddaiu G, Roggero PP, Gibbon D (2007) Combining social learning with agro-ecological research practice for more effective management of nitrate pollution. Environ Sci Policy 10:551–563
Tress B, Tress G (2003) Scenario visualisation for participatory landscape planning–a study from Denmark. Landsc Urban Plan 64:161–178
Trigg MK, Balliet BJ (1997) Finding community across boundaries: service learning in women's studies. In: Guarasci R, Cornwell GH (eds) Democratic education in an age of difference. Jossey-Bass Publishers, San Francisco
Turner BL, Lambin EF, Reenberg A (2007) The emergence of land change science for global environmental change and sustainability. PNAS 104:20666–20671
Van Mansvelt JD, van der Lubbe MJ (1999) Checklist for sustainable landscape management. Elsevier Publishing, Amsterdam
Veldkamp A, Van Altvorst AC, Eweg R, Jacobsen E, Van Kleef A, Van Latesteijn H, Mager S, Mommaas H, Smeets PJAM, Spanns L (2009) Triggering transitions towards sustainable development of the Dutch agricultural sector: TransForum's approach. Agron Sustain Dev 29:87–96
Vidal RV (2004) The vision conference: facilitating creative processes. Syst Pract Action Res 20(5):385–405
Voß JP, Bauknecht D, Kemp R (2006) Reflexive governance for sustainable development. Edward Elgar Publishing, Northampton
Warner KD (2006) Extending agroecology: grower participation in partnerships is key to social learning. Renew Agric Food Syst 21:84–94
West E (2004) Perry's legacy: models of epistemological development. J Adult Dev 11:61–70
Wezel A, David C (2011) Agroecology and the food system. In: Lichtfouse E (ed) Agroecology and strategies for climate change. Sustain Agric Rev 8:17–34.
Wezel A, Dubois P, Lagaise B, Boissière C (2008) Land use transects with cars – a potential tool for students to explore an agricultural region. In: Lieblein G, von Fragstein P, Francis C (eds) E-learning and experiential learning in organic agriculture and agroecology. Proceedings European Network Organic Agriculture Teachers (ENOAT), Nitra, Slovakia, pp 28–41. http://oe.confolio.org/apps/?config=AGROASIS#34.644. Accessed 24 June 2011

Wezel A, Bellon S, Dore T, Francis C, Vallod D, David C (2009) Agroecology as a science, a movement or a practice. Agron Sustain Dev 29(4):503–516
Wiedenhoeft MH (2004) Creating farm cycles. In: Agronomy Abstracts. American Society of Agronomy, Madison, Wisconsin, USA
Wiedenhoeft M, Simmons S, Salvador R, McAndrews G, Francis C, King J, Hole D (2003) Agroecosystems analysis from the grass roots: a multidimensional experiential learning course. J Nat Res Life Sci Educ 32:73–79
Wilson GA (2007) Multifunctional agriculture: a transition theory perspective. CABI Publishing, Cambridge
Wilson K, Morren GEB Jr (1990) Systems approaches for improvement in agriculture and resource management. Macmillan Publishers, New York

# International Shifts in Agricultural Debates and Practice: An Historical View of Analyses of Global Agriculture

**Shelley Feldman and Stephen Biggs**

**Abstract** This paper reviews the changing issues that shape understandings of agriculture, agroecology, rural landscapes, and food production over the course of the last 50 years. While we will highlight the specific changes that characterize the last two decades, we will situate current conditions and shifts against the longer backdrop of the post-World War II period. Providing a historical context for ongoing debates and practices will enable us to show how current debates respond to, challenge, extend, and at times, reproduce ideas and strategies of an earlier period. Thus, this review will have two interrelated goals: First, to outline the backdrop against which we can understand current shifts in agricultural debates and policy choices; and second, to show how these debates feature in contemporary understandings of the status of global agriculture.

We will suggest that while there has been continued growth in scientific expertise and specialization in the agricultural sciences, an expansion of the kinds of technology and innovation that characterize agricultural production, and broad changes in production and trade relations, food crises continue to pose a challenge to national and global agricultural policies.[1] We also will suggest that despite significant changes in crop production, consumption, and exchange notwithstanding, there has been a decline in open policy debates both across and within disciplinary boundaries.

[1] We view this challenge as both an epistemic one – how we understand and interpret food crises, and a response to policy choices (Feldman and Biggs 2012). For historical accounts of food crises and famines see Dreze and Sen (2002), Greenough (1980, 1982), and Sen (1981).

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W.B. Campbell and S.L. Ortíz (eds.), *Integrating Agriculture, Conservation and Ecotourism: Societal Influences*, Issues in Agroecology – Present Status and Future Prospectus 2,
DOI 10.1007/978-94-007-4485-1_2, 

In some cases, this decline recalls an old debate about the relationship between science and policy, but also about the role of politics and policy choices and the different interests that constitute policy implementation and practice in relation to agricultural production choices. These, as we will show, help to explain the re-emergence, even if framed by a new discursive formation, of public-private partnerships over the past two decades and their link to questions of equity, sustainability, and climate change.

We suggest, too, that by not fully appreciating the long history of debate and analyses in the broad field of rural production and practice, land relations, and the relationships between non-farm and farm livelihoods, current food crises appear as unexpected or surprising rather than in relation to the policy choices that currently shape agricultural production and policy implementation. We thus examine some of the debates of the earlier period for what they can contribute to understanding these crises, current agricultural production practices and policy choices, global poverty, various forms of inequality, including that between individuals and households as well as between states, and food security and ecological sustainability. This means that our discussion is selective and does not seek to address all of the important issues within the broad arena of international shifts in agricultural debates and practice.

The arguments to follow will be based largely on secondary material. These materials include an understanding of global agricultural policy through analyses of the documents that guide global food production choices. Such choices are outlined by the contributions of the major international organizations including the Food and Agriculture Organization (FAO), the World Bank, the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), the United Nations Environment Program (UNEP), the Consultative Group on International Agricultural Research (CGIAR), and the global assessments that either directly address agriculture or one or more of its critical attributes. We also will examine meso- and micro-studies and policy documents that address the prospects and effects of such policy choices on the lived experiences of food producers and food consumers, and the ongoing debates that shape understanding food sovereignty, climate change, environmental degradation, equity and ecological sustainability.

**Keywords** Green and Gene Revolutions • Rural development • Global science assessments • Rural inequality • Rural and agricultural planning • Policy discourses • Policy practice • CGIAR • International agriculture • Food production • Gender relations • Global food crises • Food sovereignty • Global agriculture and food debates • Hunger and malnutrition • Bilateral and multilateral aid relations

## 1 Introduction: Drawing on the Past, Imagining the Future

In a review of the evolving themes and ideas that animate how we understand rural development, Ellis and Biggs (2001) periodize knowledge production and development practice to highlight the salience of linking narratives we hold about rural

development to how these narratives are articulated in policy formation and project implementation. Their approach provides a template for understanding shifts in agricultural debates and practices since both *rural* and *agricultural* are often used as synonymous concepts. Importantly, the shared meanings associated with the terms rural and agricultural are neither fixed nor neatly distinguishable temporally. Rather, the terms, and the development narratives of which they are a part, may overlap and sometimes even compete with each other. Together, they circulate and are popularized in ways that hold promise in helping to illuminate international shifts in agricultural debates and practice. For instance, as we will show, the overlapping meaning of rural and agricultural has been slowly changing in ways that signal important shifts in how we understand and value rural livelihoods and in what is included in the diversity of forms of agricultural production and relations of farm, off-farm, and non-farm work characterizing changing rural communities and landscapes.

Prior to the mid-1970s, for instance, when a large majority of people from countries in the South[2] depended on agriculture for subsistence, there was only scant research and policy attention focused on non-farm rural production and rural industrialization, as these latter sources of primary employment were significant for only a small proportion of rural households. Most rural dwellers, in fact, were peasant producers and small-scale farmholders whose lives and livelihoods depended on agricultural production for daily subsistence even if they were involved in other wage earning or in-kind labor exchanges. As a case in point, the agricultural population of West Africa fell from 80% of the total population in 1961 to less than 50% in 2005, with broad variation across the region. Today, in contrast, the rural environment is no longer primarily centered in agricultural production, and urban areas in parts of Africa continue to be used for peri-urban agriculture and livestock farming (OECD 2007). Such population shifts and complex agricultural settings signal important changes in the agricultural landscape and the key themes and foci of agricultural research and rural policy formation.

To capture these broad shifts in people's lives and the narratives that are deployed to both guide agricultural change and respond to it, we engage an historical template.[3] Such a template (see Fig. 1) marks key concepts that can assist in clarifying the kinds of changes that characterize shifts in agricultural production, the development policies that have shaped resource availability and strategies for growth and sustainability, and the kinds of projects and programs that have been used to promote particular production strategies.

As Fig. 1 suggests, central to the Green Revolution and rural development approaches of the 1960s was the assumption that farmers were rational economic agents in the neoclassical sense of the term.[4] This meant that while small-scale farmers had few resources, they were efficient in the ways that they used them, and

[2] We use the terms *countries from the South* or *Southern countries* to reference what in other circumstances may be noted as developing countries, the Third World, or peripheral economies.

[3] We offer this template with the same cautionary concerns emphasized by Ellis and Biggs (2001).

[4] See Winkelmann (1976), Lipton (1968), Hopper (1965), and Schultz (1964).

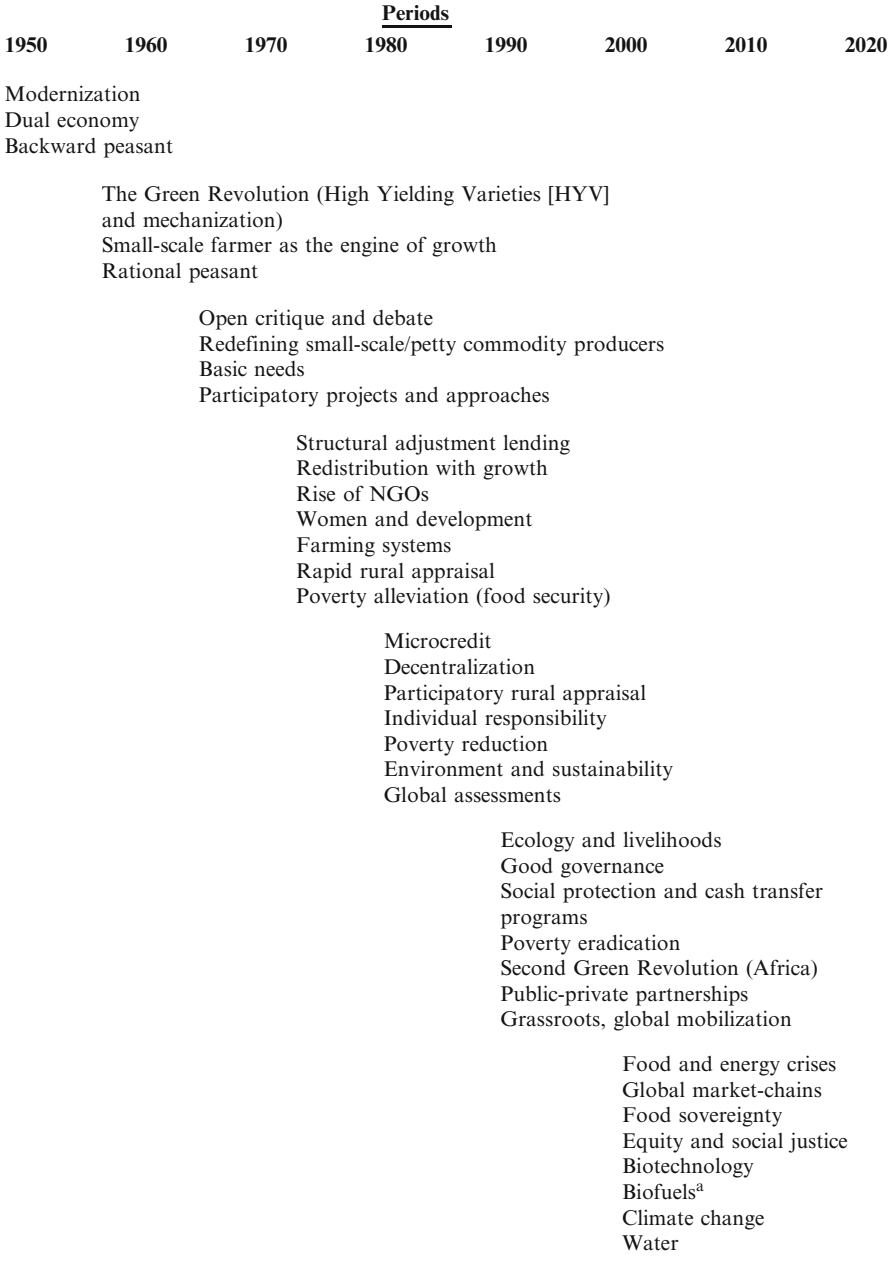


**Fig. 1** A history of discursive themes and concepts framing agricultural policies and practices ([a]See the special issue of the Journal of Peasant Studies, 37, 4 (October) 2010)

even if they were poor, they, like larger-scale farmers, responded to economic incentives. Therefore, policies used in the West to influence the level and composition of agricultural production could be used equally well in developing countries. This, in turn, meant that agricultural production could be modernized (read as *increased*) using subsidized inputs, guaranteed commodity prices, the transfer of modern technologies, including policies to make fertilizer and irrigation available at subsidized rates, and training and exposure to new ideas and production practices through the enhancement of extension services to producers. Such an approach to agriculture was a challenge to prior assumptions about "backward and 'lazy' peasants" who were resistant to change.

As a window on the animating strategies that held sway at the time, Leys' (1996: 7) assertion in relation to development could be read through the lens of agriculture: "It is not a great oversimplification to say that "development theory" (read as *agricultural policy formations*) was originally just theory (policy) about the best way for colonial, and then ex-colonial, states to accelerate national economic growth in this international environment. The goal of development was growth; the agent of development was the state and the means of development were these macroeconomic policies."

## 2 The Red and Green Revolutions

> These (new HYVs) and other developments in the field of agriculture contain the makings of a new revolution. It is not a violent Red Revolution like that of the Soviets, nor is it a White Revolution like that of the Shah of Iran. I call it the Green Revolution.
>
> William S. Gaud, USAID 1968

In the context of the Cold War, efforts by the United States to win the hearts and minds of newly emerging independent states and their people included using development assistance to enhance agricultural production and extend new production techniques and technologies to small-scale farmholders. This Green Revolution, as part of the effort to incorporate new nations into the American political orbit, was premised on the belief that, with new agricultural technologies, states would be able to secure their independence by substantially increasing food production per unit of labor and land and, in so doing, contribute to reducing poverty. The success of such a revolutionary goal had two critical components: the first, to build the resources and technologies that would support this revolutionary goal, and the second, to extend these resources and technologies to producers in the South.

These goals were part of the task of rethinking development assistance and were built on substantial investments by the Rockefeller and Ford Foundations in agricultural research, mainly for high-yielding varieties of grain crops. Research began in the post-war 1940s with research in Mexico (International Maize and Wheat Improvement Center, CIMMYT) to develop disease resistant high-yield varieties of wheat, and subsequently, in 1962 in the Philippines, with the establishment of the

International Rice Research Institute (IRRI) at Los Banos. IRRI's focus was rice, a staple of Asian diets that was produced by 80% of those eating rice in the region. It was assumed that new HYV rice varieties would have an enormous impact on countries where yields were low, including India, Thailand, Pakistan, the Philippines, Cambodia, and Laos. The development of these new varieties was part of a package of inputs that would depend on three critical institutional changes.

The first change was recognition that relations between the advanced and, in the language of the time, developing countries, would be long-term, since it was known that the new varieties depended on attendant inputs, such as fertilizer, that was not produced in countries of the South but rather in the West. This dependence in turn created the need for loans to states to enable them to import fertilizer with development assistance that financed a significant proportion of these resources. As Gaud (1968) of the Agency for International Development (A.I.D.) would note, by 1968, India was "using the equivalent of one-fifth of its foreign exchange earnings to import fertilizer and raw materials to produce the stuff (food crops) … [and] A.I.D. will finance $200 million worth of fertilizer on a loan basis." Gaud would go on to state that by 1980, "the world demand for fertilizer will probably increase two and one-half times or more [and]… is rapidly becoming the largest single element in the A.I.D. program." Gaud's claims, made in efforts to secure United States Congressional support for international development, highlight the key role of development assistance, its integral relationship to the Green Revolution, and the benefits that would accrue to dependent and developed countries alike, relationships that entail support for American companies to establish fertilizer plants in countries that expand their food production using the Green Revolution strategy.[5] As we will show, such partnerships across countries and constituencies would undergird food production strategies over the next 50 years, even as particular foci or interventions would change during this period.[6] This strategic understanding of the nexus that sustains international development also, and importantly, presages current interests in public-private partnerships that may differ from earlier articulations of the interests and relations that characterize the Green Revolution, but similarly serve as important indicators of the long history of thinking about the development of a global agriculture that supports the private sector, and the issues, problems, and prospects identified in relation to its production worldwide.

The second change necessary for the successful implementation of the Green Revolution strategy entailed the building of adequate infrastructure to support the

[5] As Gaud would also share in his address: the implementation of this strategy "is why the program which A.I.D. has proposed to Congress for FY 1969 emphasizes Development Loans and Alliance Loans to finance exports of American fertilizer: $200 million to India, $60 million to Pakistan, and lesser amounts to Brazil, Chile, Morocco, Tunisia, Indonesia, and Laos, among others."

[6] During the 1960s, development assistance was tied to policy reform. USAID, for instance, pressed Southern countries to expand their investments in agriculture, "introduce price incentives and other measures which favor and stimulate food production, …shift fertilizer manufacture and distribution from public channels to more efficient private outlets, and …liberalize import quotas on raw materials for fertilizer production." Such policy reforms are increasingly made a condition for receiving both food aid and A.I.D. program loans (Gaud 1968).

institutionalization of Green Revolution technologies and capacities in particular countries. Such capacity-building depended not only on increased access to and use of fertilizer, but also on the development of irrigation facilities, market infrastructure, an attitude that was able to risk "an untried and expensive investment" in the production of rice, and an increased dependence on farm credit (Gaud 1968). What was central to this effort was a focus on small-scale farmers who would need to be trained in new technologies and the use of new seed varieties and their production that, as Leaf (n.d.) would proclaim, "was not only a technological or agricultural revolution but a full-scale social revolution, a true democratic alternative to the centralizing "Red Revolution" promoted during the same period by the Soviet Union." Importantly, and what was not part of the discourse at the time, was the loss of knowledge, biodiversity, and skills that would accompany establishing a general or universally applicable commercial agricultural production environment based on the development of new seed varieties and new requirements for their use.

Carrying out this institutional reform required a third change; massive public sector investment and intervention, complemented by foundation support such as Ford and Rockefeller, but also support from such institutions as the Agricultural Development Council (ADC)[7] whose aim was to support the social sciences (primarily agricultural economists) by strengthening the capacity of young scholars to respond to the economic and human problems of agriculture and rural development in Asia. Through fellowships for graduate education, the ADC trained a generation of researchers and academics to meet the broad challenges related to food production which would bring this new knowledge to bear on national policy formation in their respective countries. In part, this led to a devalorization of local forms of knowledge and an erosion of support for "traditional" practices, skills, and crop varieties. This initiative complemented parallel efforts to support the land grant mission of selected United States institutions of higher education and to transfer the Land Grant institutional model to the Indian subcontinent. Together, these institutional supports helped to solidify a policy environment that was initially to build a highly protected subsidized agricultural sector with provisions for cheap energy, water, inputs and guaranteed support prices for major food crops.

The success of this strategy also required the setting up of social safety nets and government ration shops in South Asia since the economic strategy that framed the institutional reforms that would enable realizing the goals of the Green Revolution was recognized to strengthen better-off farmers and regions through large subsidies for irrigation, transportation, the building of regional markets, and public sector research capacity. This meant that less well-off farmers would need alternative supports to meet their production and consumption needs. It also was recognized that there was every likelihood of increased inequality among classes of

[7] The ADC, established by John D. Rockefeller III, was initially known as the Council on Economic and Cultural Affairs, Inc. (1953–1963). In 1985, the ADC merged with two other Rockefeller-related agricultural programs, the Winrock International Livestock Research and Training Center and the Rockefeller Foundation's International Agricultural Development Service to create the Winrock International Institute for Agricultural Development.

farm households as the returns to successful large-scale farmers would increase disproportionately, and more rapidly, than returns to labor, even if total employment demand was envisioned to increase.

Ideally, this strategy was premised on a "trickle down" notion of benefits, as increased food production among large-scale producers was expected to reduce costs and make staple foods available more cheaply to poor and under-subsistence farmers. Among smaller-scale producers, the extension of fertilizer, seeds, credit and irrigation supports would be made available through marketing and distribution cooperatives or other forms of decentralized distribution which could serve as sites to disperse new technologies (seeds, fertilizers, and pesticides), offer training and extension services, and along with local government offices and large-scale farmers, provide land to locate "demonstration plots" to showcase the potential of the new Green Revolution strategy for development. For the landless and those who were unable to engage in this new form of production, they would benefit from the increased demand for labor that the implementation of such a strategy would require and also benefit from cheaper market prices for food.

This Norman Bourlaug[8]-inspired Green Revolution was thus envisioned as a win-win opportunity for development assistance as it would nurture long-term development of the agricultural sector, contribute to decreasing local hunger, and contribute to reducing rural poverty in countries of the South, while simultaneously providing access to new sites of production and new markets for American industry. Together, this strategy responds to the presumed Malthusian threat of overpopulation and food shortages, since it assumes that without such changes in agricultural production, countries would be unable to meet the growing demand for food crops.[9]

## *2.1 Open Debates: Critiques of the Green Revolution*

A hallmark of the early years of the Green Revolution and its institutionalization in various parts of Asia was the openness of debate and exchange among biological scientists. This openness included not only debates within disciplinary boundaries, which is not particularly unusual among agricultural scientists, but soon incorporated the challenges posed by the social science community, particularly by agricultural economists whose interests highlighted the social and economic benefits and costs of the introduction of new agricultural practices for farmers and farm households. These debates also included members of the CGIAR Centers

[8] Norman Borlaug was a plant pathologist whose research on genetic mutation in plants and specific attention to crop varieties for regions of climatic extremes contributed to increases in wheat and rice production, especially in Mexico, Pakistan and India. He was awarded the Nobel Peace Prize in 1970 and often is credited as the father of the Green Revolution.

[9] This Malthusian logic was not limited to justifying agricultural policy reform but also served as the ground for population control policies of the United States and western European countries that also were central to western development assistance.

such as the International Rice Research Institute, the International Maize and Wheat Improvement Center, and the International Potato Center (Centro Internacional de la Papa, CIP) who had economists on staff and would eventually also hire anthropologists and gender specialists. The internal as well as cross-institution based discussions of the Green Revolution generally reconfirmed some of the assumptions held by researchers but, in other cases, assumptions and the behavior and choices of farmers opened to scrutiny some of the contradictions and complexities revealed in the production of rice and wheat HYVs.[10]

The Comilla model for agricultural change in light of the Green Revolution is a noteworthy example to share, primarily because it became the site for the diffusion of innovation through extension and training, and served as a key strategic intervention for enabling small-scale farmer access to new technologies. The Comilla cooperative model was an approach to rural development that began in 1959 at the Pakistan Academy for Rural Development (renamed in 1971 the Bangladesh Academy for Rural Development). Founded with United States technical assistance under the guidance of Akhter Hameed Khan, the Academy was a response to the failure of the Village Agricultural and Industrial Development (V-AID) program that emphasized the participation of village producers in programs to enhance productive agriculture. Central to the work of the Academy was combining the development of local infrastructure in combination with program maintenance and management by users that offered a form of cooperative capitalism that was able to include relatively small-scale and medium-sized farm households (Feldman and McCarthy 1984b; Raper 1970, Khan 1973).

The Comilla Project also included the development of a women's program to engage women in both family planning, a traditional rationale for including women in development initiatives, and as critical participants in household food production systems and beyond their roles in programs about nutrition and food preparation. Predating the emphasis on participation, credit and training, the Comilla program served as a model for the Integrated Rural Development Programs (IRDP)[11] that were reproduced in numerous countries of the South with World Bank and bilateral support from North America and Europe. This is but one example of what might be called epistemic openness that characterized the learning and exchange that attended to the early years of the Green Revolution, even if debate gave only limited attention to the contradictions posed by capitalizing agriculture which, while extensive in selected journals,[12] did not often engage biological and physical agricultural scientists.

[10] The CGIAR held its inaugural meeting on 19 May 1971 with 19 industrialized country governments, the Asian Development Bank, FAO, Inter-American Development Bank, International Development Research Center, UNDP, the World Bank, and the Ford, W.K. Kellogg, and Rockefeller Foundations. IRRI and CIMMYT were founding members, and IFPRI joined in 1979. In 2009, CGIAR had 65 members (http://www.cgiar.org/who/members/index.html).

[11] Integrated rural development schemes revived an earlier mode of intervention, community development, which took as its starting point a holistic understanding of agriculture to include employment, health, nutrition, sanitation, family planning, informal education and skill development, as well as extension activities to promote knowledge about agriculture and new production practices.

[12] See, for example, such journals as the *Journal of Peasant Studies*, *Economic and Political Weekly*, and *Development and Change*.

The Comilla cooperative approach which began in East Pakistan, now Bangladesh, was a critical site for debate at the time. As Bose (1974) would note, the extension of new technology through a system of farmer service cooperatives led to the conclusion that it was possible to overcome large farm biases in the distribution of new agricultural resources. It was believed that cooperatives could help promote small farmer adoption of new technologies and thus help to avoid the adverse distribution effects that were already associated with the Green Revolution. The early success of this initiative – through the cooperativization of resource distribution to provide small-scale farmers with access to Green Revolution technologies and practices, led the Bangladesh Government to note that the new approach also would "reduce rural poverty and promote equality of income distribution" (Planning Commission 1973, in Bose 1974: 21). This was based on the assumption that both direct benefits in terms of increased yields to producers, and indirect benefits in the form of increased opportunities for wage work and low food prices for agricultural laborers would help to reduce poverty and promote equality of income. As we have already noted, income inequality may indeed increase, but the security of income could, in theory, reduce extreme poverty even though, as Cain (1983: 149) would remind us, "[a]n appreciable worsening of the current distribution of land is likely to render the wage employment created through agricultural growth wholly inadequate."

Importantly, however, the Comilla cooperatives were not introduced in response to landlessness[13] since the focus of attention was on crop production and the target population was small- and medium-scaled farmers.[14] In a country like Bangladesh, with high rates of land-poor or under-subsistence producers, it was assumed that they could benefit from the diffusion of new agricultural technologies as these were expected to raise per-acre labor requirements brought about by the intensification of production from one, to as many as three crops per year. As Huq would report, an acre of high-yielding rice varieties under irrigated conditions is estimated to require between 30% and 90% more labor than the native varieties, although it would be significantly lower since not all land across all seasons is planted in HYV rice (in Bose 1974, footnote 21). Moreover, and crucially, the increased use of family labor will far outweigh the increased use of agricultural wage labor (Bose 1974: 27).[15] Thus, while the Green Revolution was focused on

[13] Landlessness, it was argued at the time, was primarily a response to increasing population.

[14] Interestingly, data on farm size usually did not go above 7 or more acres in Bangladesh, indicating a curiously low large-scale threshold. But the data also indicates the relatively small number of agricultural producers who actually owned what, in other parts of South Asia, would be considered small- and medium-scaled farms. Moreover, it would not be until the 1980s, and disillusionment with the development models of the time, that questions of landlessness and the meeting of basic needs would emerge. Noteworthy, is that the initial focus for agricultural intervention and extension was the farmer (read as *male*) rather than the farm household and the different contributions of each of its members. Women's agricultural labor, whether in production or processing, would not be recognized until the late 1970s.

[15] This insight is central to understanding the resources that would eventually support the development of the IRDP Women's Program but also early recognition of the importance of women in agricultural production (Feldman and McCarthy 1984a; Feldman et al. 1980; Harriss 1977; McCarthy 1977, 1978, 1980, 1981).

farm households rather than agricultural laboring households, it was already recognized that there would be significant and presumed positive consequences for labor. Extremely suggestive at the time are the words of Akhter Hameed Khan, the visionary behind the Comilla approach:

> [Comilla] was by no means a panacea for the misery of the landless. Nor was it … an attempt at [the] redistribution of incomes. … In fact, better drainage, link roads and irrigation substantially enhanced the value of land and its rent. The unearned increment of the landowners was a hundred times more than the wages earned by the labourers (Khan 1973, in Bose footnote 22).

Clearly, this signals increases in income inequality among rural dwellers, even as efforts to enhance production contributed to raising the returns and incomes of some rural households. While the focus was on differences among small-, medium-, and larger-scale producers, research did focus on what might be viewed as the unintended consequences of the Green Revolution for the livelihoods of others, including the increased pressure on women who would bear part of the increased demand for labor attendant to the introduction of HYV production.[16]

To be sure, many (Khan 1971, 1973, 1979; Blair 1978; Bose 1974) recognized that the Comilla approach was not without its problems – dominant groups eclipsing the benefits of small-scale producers, an increased dependence on new technologies and credit without sufficient resources to sustain the full complement of those required by the introduction of the Green Revolution, and greater income inequality across social groups. Some of these concerns were framed in terms of the specificity of Bangladesh and the need to transform the institutional environment in order to bring it in line with the needs of the Green Revolution, but debate about these constraints would reveal their consequences for other contexts as well. As Bose (1974: 28) would make clear,

> Within the technological limitations set by climatic conditions, the spread of the Green Revolution will be determined largely by the development of appropriate organizations of farmers and effective policies for the mobilization and distribution of resources. The organizational form of the Comilla system would come in handy in this regard. If the political will and administrative capacity can be mustered to remove some of the major deficiencies of the Comilla system - to broaden membership and democratize the organization of the co-operative and to ensure financial discipline - and to adopt progressive taxation on agricultural income or land, the prospects of the Green Revolution would be much better than otherwise. These, in addition to some special measures to help the rural poor, would make possible a more equitable pattern of rural development than elsewhere in South Asia.

What Bose' conclusion suggests is that in some countries the constraints imposed by, for example, climate change, are inherent limitations and not something to be addressed by those who envision the Green Revolution as a vehicle to develop and expand agricultural production. For others excited by the prospects of such development, the negative consequences associated with the Comilla approach are technical and

[16] While a focous on women was not sufficiently sustained in the debates that ensued, what is clear is that proletarianization, increased landlessness, and increased demands for wage labor without the probability of such laborers ever earning enough to join the ranks of the small-scale farmer were significant foci of debates on the larger Green Revolution (Glaeser 1987; Pearse 1977, 1980b; Cleaver 1972).

managerial and assumed to be resolved by changes in implementation and training or political will. To be sure, some constraints are indeed technical and managerial and can be resolved by improvements in organizational capacity and technical knowledge. But, what this conclusion does not address are the effects of institutionalizing the extension of capitalist relations and commercial agriculture and what these changes could portend for the environment, communities, and producers. For this, it is suggestive to turn to the work of critics who have identified the ecological costs of this new system, its transformation of rural economies, social relations, and production regimes, as well as the socioeconomic constraints that may indeed be better managed and, in some cases, even overcome, with a technical or organizational fix. Crucially, these critics also identify the contradictions posed by this new system that are not likely to respond to such fixes, since they are inherent attributes of the strategy itself (Oasa 1987; Pearse 1977; Cleaver 1972).

In an important volume that takes as its point of departure an essay by Oasa (1987) that reviewed the Consultative Group on International Agricultural Research (CGIAR), Glaeser (1987: 1–9) continued critical debate about the Green Revolution. Two issues framed his critique: The first responded to the dependence of the Green Revolution on the availability of particular growing conditions: irrigation facilities, intensive use of fertilizers, and monocultures for the use of machinery and equipment, pest control with chemical pesticides, as well as favorable soils and sufficient resources to purchase necessary inputs. The second examined the framework that set the ground for the first, that is, what the expansion of commercial agriculture might mean for both producers and countries. What is most significant for the argument here is the importance of critical debate in these essays and the conclusions that were drawn from these exchanges. Oasa's challenge reaffirmed the CGIAR focus on specific commodities and cropping system research, but also recommended that "the international centres reassess priority areas within the context of stronger national programmes," and "the possibility of phasing out work on some of the existing commodities, thus releasing resources for other work" (CGIAR 1981 in Oasa 1987: 19).[17]

Also identified as a concern of the Green Revolution was Pearse' (1977 in Oasa 1987: 20) recognition that "the main principles of the strategy adopted for introducing the technology are inadequate for the development needs of the mainly rural countries concerned and harbor a potential for increased pauperization and social conflict." What is noteworthy in Pearse' conclusion is the link he draws between technical and social conditions and consequences and his early appreciation for the potential conflict between the institutionalization of the HYV package of inputs, and the long-term interests of a majority of rural producers. This tension also was expressed in the connection drawn between broad-based development goals that focused on economic growth and its agricultural parallel, the Green Revolution strategy.

[17] Oasa (1987: 19) also points out the importance of the attention to unstable environments (less fertile and more acidic soils, rainfall versus irrigation, and a dominance of 'small, resource-poor farmer[s]) which yielded cumulative rather than incremental change'.

This strategy was adopted in order to increase food production, and, significantly, it was recognized early on that poverty reduction would not automatically follow from this growth. Said differently, pauperization and social conflict were not assumed as untended consequences of the commercialization of agriculture and the deployment of new technologies, but, rather, were understood as the very conditions of its institutionalization. As Oasa (1987: 22) would remark at the time, these processes of impoverishment would extend, but also create, new social relations and practices that would unfold simultaneously with "the internationalization of science-based agricultural research."[18]

Also animating Glaeser's (1987: 3) concerns were the negative environmental "side" effects (negative externalities) and health hazards that attend to intensive fertilization[19] (excess nitrogen which causes eutrophication of freshwater streams and lakes), the health consequences of the inappropriate use of pesticides, and the amount of energy necessary for the production of nitrogen-based fertilizer required to operate new agricultural machinery. His conclusion is the need for a viable alternative, an *ecodevelopment* strategy able to orient toward filling the basic needs of the poor, promoting agriculture, and striving for environmental compatibility in production methods (Glaeser 1987: 5).[20] What Glaeser's account offers is a window on the issues that would be central to debates 25 years later.

As we build toward understanding agricultural production as it is presently undertaken and imagined to change, our argument will emphasize three key themes that emerge from these early debates. The first is the foresight of these debates in the immediate post-Green Revolution moment that highlights issues that are critical today – environmental sustainability, social and livelihood sustainability, food security and sovereignty, poverty reduction, the equitable distribution of resources, and rising inequality and growing tensions between social classes. The second is the significance of ongoing debate and discussion that were part of the CGIAR institutional environment, but also engaged academics and scientists not employed by member institutions of the CGIAR. These exchanges proved invaluable in helping agricultural institutions and researchers address complex problems that arose with the spread of Green Revolution technologies and practices, and were part of an intellectual context that valued and productively debated different interpretations, claims, and research findings. For example, in the challenge posed by those who noted that the Centers were not adequately accounting for unstable environments in the development of HYV irrigation dependent agriculture, the CGIAR developed the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) site in India to address issues that emerge in arid regions. In other cases, however, where the issues were not of a technical or managerial kind,

[18] See also Byres (1981) for the link between new technological and class formation in India.

[19] By the late 1970s, Dahlberg (1979: 81 in Oasa 1987: 2) had already noted that "applications of fertilizer have reached a point of diminishing returns." Oasa also acknowledges the extinction of valuable germplasm with the introduction of crop monocultures.

[20] This brief summary is critical precisely because it highlights the long horizon that has shaped current debates on sustainability, eco-development, equity, and justice.

new interventions proved more problematic, if not impossible, to implement or, in some cases, even to acknowledge.

The third theme, and critical for the discussion to follow, is the distinction Oasa (1987) draws between understanding and "careful[ly] scrutiny[izing]" policy statements that address the core of Green Revolution policy, and "those minor deficiencies or shortcomings that could otherwise be attributed to faulty implementation of policy."[21] What Oasa (1987) reveals explicitly here is that, "the general misery of the poor tends to increase, and class lines and conflicts tend to sharpen as a result of *inherent contradictions*[22] in [Consultative Group] CG[23] policies and the politically neutral stance that the Group has adopted …" where the latter is generally explained as problems to be managed by the inadequacies of individual states. For Oasa (1987: 16 *italics added*) this *inherent contradiction* is "the social organization of capitalist agriculture" and the widening social polarities that attend to this organizational form and its social relations of production. This is important because, as Oasa acknowledges, "it is not happenstance that research's assessment is incomplete [because] it is a politically bound assessment and one that corresponds to a 'neutral' relationship with the state" (Ibid). Critical to this understanding is recognition that science practice embodies political interests in ways that shape both research findings and policy intervention (Jasanoff 1987).

Three other issues are important to highlight from these debates that are especially useful for the discussion to follow. One is that the debate engaged researchers not only within and across disciplines, but also from different epistemic communities and interest groups. Such an engagement provided productive opportunities for learning, even as ongoing political differences may have contributed to constraining the institutionalization of alternative practices, given the interests of the large donors in the post-liberation of many countries in the global South. Second, the logic of agricultural interventions were understood to address improvements in the production of food and, in some meaningful way, could be understood as separable from other sectors of the economy. As deployed at the time, justifications

[21] This distinction is important because it can be used to set the parameters of intellectual debate. The distinction is especially important in understanding how and why various constituencies have either engaged or ignored the IAASTD Reports.

[22] To respond to these contradictions it is noteworthy that Akhter Hamid Khan, the founder of the Comilla approach, used the term 'cooperative capitalism' to describe the effort. As Khan has noted, "cooperation did not extend to the mobilization of the latent productive resources… or to any kind of pooling of private productive resources for joint productive activities"… See also Feldman and McCarthy (1984b) and Khan (1979: 413).

[23] The Consultative Group on International Agricultural Research (CGIAR) is a global partnership that unites organizations engaged in research for sustainable development with the funders of this work. The funders include developing and industrialized country governments, foundations, and international and regional organizations. The work they support is carried out by 15 members of the Consortium of International Agricultural Research Centers, in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia, and the private sector (see website http://www.cgiar.org/who/index.html, Who we are) (accessed October 30, 2011).

for improved agriculture built on the Malthusian assumption of population growth increasing more rapidly than food production, thus supporting the need to intervene in ways that were presumed to increase food production but also to generate programs that would control population growth. As evident today, such an assumption was, and continues to be, contentious, since it avoids questions of distribution and the ecological costs of supporting particular production regimes. The result is that crises of sustainability are either underestimated or ignored, as are inequalities in food access, the uneven development of food quality, and the twin outcomes of under-consumption and obesity. The third theme is the substantive recognition that the Green Revolution was a class project that presumed a trickle-down notion of change that would, in the long-term, improve the conditions of the poor by increasing the availability of staple commodities. Proponents of the Green Revolution were not preoccupied with the rising incomes and security of large-scale producers or, eventually, of corporate agriculture, since it was presumed, overall, that everyone would benefit, however unevenly.

In sum, the period 1960 through much of the 1970s was an important watershed in extending the Green Revolution to parts of Asia and, in a more limited way, to other parts of the world. Research on the extension of new agricultural practices, the introduction of new technologies, and the transformation of social relations in rural communities was part of an ongoing engagement of CGIAR researchers, national research institutions, and the academy that would eventually lead to the commercialization and industrialization of agricultural production, the erosion of strategies to realize national food self-sufficiency, and growing landlessness and continuing poverty and inequality. The Comilla approach – and there are others – provided a particular arena for sustained debate and questioning that drew the attention of government bureaucrats, academics, policy personnel, and farmers. In some very important ways, the period witnessed sustained debate on the agricultural, environmental, ecological, social, and human security impacts of the Green Revolution. Recognizing these contributions, we argue, can prove informative for our understanding of agriculture over the last two decades.

## 3 The 1980s Turn: Toward a More Holistic Approach

The early 1980s continued critical engagement with the ideas and implementation of the Green Revolution that held center stage in the 1970s. What emerged as a complement and eventual focus of these debates was the rise of nongovernmental organizations (NGOs) and the challenges they posed to a top-down approach to agricultural development and, as we shall see, for a relatively narrow focus on production agriculture. NGOs drew attention to the limits of agricultural policy discourses and introduced a focus on micro-enterprises, micro-credit, gender training, and the social and environmental impacts of rural projects on rural people and places. New agricultural approaches by donors also gained significance during this period. For example, farming systems research and participatory

approaches to agriculture flourished – innovations of the demonstration plots[24] and cooperatives – and generated a host of partnerships between academic researchers, national agricultural institutes, and international donor support (FAO 1992; Gilbert et al. 1980; Norman 1978). The challenge they raised was how to serve the majority of small-scale farmers, how to build integrated and holistic approaches to farming systems, and how to appreciate the need for site-specific research teams (Chambers and Jiggins 1987; Norman 1978) while not challenging their commitment to improving yields on all farms.[25]

In practice this meant that the challenge facing agricultural science was how to enable resource-poor farmers to produce more. The transfer-of-technology (TOT) model of agricultural research continued to be central to this effort and part of the professionalism of agricultural scientists. In the TOT model, scientists largely determined research priorities, developed technologies in controlled conditions, and then handed them over to agricultural extension services within countries to transfer the new technologies to farmers. Although strong structures and incentives sustained this approach to enhance the productive capacity of small-scale farmers, many now recognize its problematic fit with the complex and diverse needs and conditions of hundreds of millions of resource-poor farm families. In response to this problematic fit, the TOT model has been adapted and extended through multidisciplinary Farming Systems Research (FSR) and on-farm trials that, under a Training and Visit (T&V) scheme, became the dominant World Bank approach at this time. While both the TOT and FSR approaches retained decision-making for agricultural reform in the hands of scientists, farmers were acknowledged as providing the information to be processed and analyzed by professional scientists in order to identify what might be good for small-scale producers.[26] But, here too, the contradictions that were unfolding in the implementation of these approaches – sustained poverty and inequality in access to resources among producers – were not addressed in analyses of these initiatives.

During this period as well, research within the CGIAR Centers and the practices that attended to the farming systems approach, had a pro-poor and, importantly, a gender orientation (Feldstein and Jiggins 1994; Feldstein and Poats 1989; Feldstein et al. 1988; Poats et al. 1988). There also was a growing interest in rural non-farm

[24] The idea of demonstrating new varieties and new fertilizers go back to the late 1950s when FAO had a program to introduce fertilizer use in developing countries. Many HYV wheat varieties spread from these on-farm demonstrations because the improved yields were better than local varieties, under any input conditions. This success led Mexican wheat varieties to be viewed as "magic bullets," but the history of rice is very different.

[25] It also was a way to incorporate producers, however small, within the field of industrial agriculture and not address the contradictions identified by Oasa (1987).

[26] A missing element in the TOT approach were methods that encouraged and enabled resource-poor farmers themselves to meet and work out what they needed and wanted. By the 1980s, this concern recognized that many types of partnerships could support agricultural research systems and that "participation" and "participatory research" could take many forms. One classification had four modes: contract, consultative, collaborative and collegiate (Biggs 1989). Other classification systems also emerged at the time (White 1996; Pretty 1995).

economic activities, particularly among those focused on Intermediate and Appropriate Technology Organizations, and in rural small-scale enterprises (Haggblade et al. 1990). These shifts resulted in complementing investments in agriculture with micro-enterprise development and NGO investments in non-farm activities, including those for women (handicrafts using agricultural commodities) that were driven by government programs with World Bank and bilateral support. Such investments paralleled those in agriculture as they increased credit access, but also indebtedness, and helped to capitalize the rural economy. This capitalization led to women losing forms of income earning as, for example, with the mechanization of rice processing, since the employment generated in rice mills was given almost exclusively to men. The introduction of rice mills, moreover, worked against some small-scale farm households given the costs of transport and a loss of access to the by-products of rice milling, such as rice bran, which provided animal feed in traditional farming systems contexts (Harriss 1977) and to employment especially for poor women who were able to secure work as household laborers during the rice processing season (McCarthy 1980, 1981). The contradiction here is that farming systems were envisioned to include some relations in the farming system, but also to exclude other aspects of production, with particularly negative consequences for the loss of ownership and control of resources among some small-scale under-subsistence agricultural producing households. These gender questions were central to debates within the CGIAR institutions, but especially outside them.[27]

As well, the major reviews of farming systems, and participatory projects generally, acknowledged the significance of institutional, economic, and political contexts as central to understanding how and why pro-poor goals were necessary and how such goals could be realized. One of these studies was undertaken by a CGIAR center (ISNAR) to assess the outcomes of pro-poor farming systems research projects in more than 30 locations in nine countries. The Overseas Development Institute, London, had a number of networks concerned with agriculture, irrigation, and forestry and their publically available discussion documents dealt directly with theory and contemporary practice in these areas. Other bilateral and multilateral agencies were similarly attentive or provided resources to assess issues related to small-scale farmer households. As Norman (1978: 813) summarized it at the time,

> Over the last two or three decades our thinking has evolved through four successive states: (a) believing the extractive philosophy of colonial times; (b) knowing what was best for the LDCs, resulting in transfer of technology from the high income countries; (c) developing technology within the LDCs…and, recently, (d) supplementing this "top-down" approach, but not replacing it, by a "bottom-up" approach which provides a foundation for the so-called farming systems approach.

Importantly, the focus on farming systems could readily make invisible the multiple roles of foreign assistance during this period. What is evident, especially in Latin and Central America, for instance, is that it is precisely during this period that United States geopolitical interventions were coupled with the dominant neoliberal

[27] They were also important in discussions of Food for Works programs and in advocating for NGO extensions of non-farm activities.

policy regime that was deployed to actively undermine peasant movements as well as state-sponsored agrarian reform programs (Boyer 2010). But, for purposes of the present discussion, what is critical is that even as debate created an important space to air ideas and challenges to the Green Revolution as an agricultural development strategy, in its implementation, and in its effects, the basic tenets of the shift to industrial agriculture were generally left intact, as was the power attached to who and how decisions were made, and toward what end or for whose benefit.

The focus on social context, however, was not limited only to administrative concerns, such as those that were shaped directly by particular forms of donor support, but also highlighted the way local contexts posed specific structural constraints for producers that limited their returns to labor. Johnson (1996), for example, in a study of Honduran maize producers, cautioned about the importance of accounting for relations of production and exchange if the benefits of state sponsored programs were to enhance the security of the poor and sustain and improve their productive capacities in the long term. Others played a critical role in situating agriculture in a broader macro-economic and trade policy framework – features that were largely absent or assumed by the agricultural growth linkage model that was promoted earlier (Stewart et al. 1992; Stewart 1987). Important to emphasize from these discussions is its implicit challenge to universal claims or a one-size-fits-all approach to agricultural change.

Paralleling an interest in more holistic approaches to meet the needs of a range of rural producers, NGOs also began to work in partnership with an increasingly interested donor community. For the latter, the partnership was premised on their need to extend their reach to rural communities where NGOs had already begun to establish strong ties and build rural infrastructural capacity.[28] Thus, what had begun earlier as a contentious relationship between donors and NGOs turned into a relation of mutual benefit, even with some costs for some NGOs. For NGOs who partner with donors, partnerships make available resources for program development and extension and provide employment for a host of urban educated youth who, at the time of NGO expansion and slowly growing urban employment found few alternative employment opportunities.[29] For donors, the partnership provided access to communities heretofore unreachable so that NGOs became the most efficient vehicle for access to the rural poor.[30] But with the institutionalization of NGOs[31] as partners in the development project, a number of changes transformed both their

[28] This process also entailed the cooptation of opposition through the institutionalization of civil society into increasingly formalized organizations that would, over time, become dependent on the resources available to them. These new dependencies served to structure new programs to meet the needs of donors. See the large literature on this process that we are unable to elaborate here; e.g. the journal *Development in Practice*.

[29] This was a period when under- and unemployment among educated youth had begun to expand significantly.

[30] Here it is important to distinguish between the poor and the ultra- or very poor who generally do not gain access to a majority of national and international NGO initiatives.

[31] Feldman (2003), Eade (2000), Pieterse (1997), Hadenius and Uggla (1996), Elliot (1987).

form and content, as well as the general character of agricultural production and development processes generally. These changes include a growing NGO dependence on foreign assistance for both large and small civil society organizations,[32] a new cadre of employees with the creation of a constituency of young professionals, and a curtailment of the openness and risk-taking that characterized early NGO efforts whose initial impulse was more characteristic of social movements than of formal organizations. But, important for this discussion is that these changes made evident the critical role of rural NGOs in meeting the training and credit needs of non-farm rural workers.

Such collaborative efforts also began to focus broadly on the agricultural context, that is, less on agricultural production *per se* and more on the conditions that shaped the capacities of producers and laborers, including examining non-farm activities, particularly among the poor. This signals an important shift in agricultural debates and practice. Such a shift drew attention to the complex relations that shaped rural life, where households and multiple and complex forms of income earning – including but also extending an earlier focus on share-cropping and other forms of land lease, rent, and grabbing arrangements – characterize rural labor relations and social sustenance.[33] While issues of land reform and land security, such as titling, continued to be of concern, the non-farm sector grew in importance and focus, solidifying the costs of land consolidation, insufficient employment generation in agriculture, and declining security among small agricultural producers (Deere and León de Leal 2001a, b; Griffin 1974, see also Agarwal 1994, 2003).

The 1980s also witnessed critical discussions of the theory and practice of the "agricultural growth linkage model" that underpinned the Green Revolution policy rhetoric (Hart 1993; Hazell and Ramasamy 1991; Ranis and Stewart 1987; Harriss and Harriss 1984). The model presumed that agriculture could serve as an engine for broad-based rural economic growth (Johnston and Clark 1982; Johnston and Mellor 1961). This opened to scrutiny the tensions identified by those who highlighted the shift from small-scale farm production to agricultural wage labor that accompanied increasing landlessness, or what might be called distress sales and sharecropping on one's own land, a practice by those able to hold on to their landed property, but unable to secure the resources necessary for sustained production.

Discussions of the Integrated Rural Development Programs (IRDPs) that had been such a major part of agricultural and rural development programs in the 1970s and early 1980s also came under critical review. One finding was the entrenchment and collaboration between large land owners and the rural bureaucratic elite which led to talking more directly about rural power structures (Lewis and Hossain 2008; BRAC 1980). Together, the interests they fostered led to their control of inputs and

[32] Both national and international NGOs are implicated in this shift, although small and usually nationally organized NGOs have either been excluded from access to donor resources or have chosen to remain independent from them.

[33] See also Farrington and Bebbington (1993), and Edwards and Hulme (1992) who identify the difficulties that attend to implementing pro-poor agendas and partnering with government and the private sector.

resources within the agricultural sector, often precluding small-scale farmer access to these and other resources. Such power differentials were expressed in forms of corruption and violence for the control of landed property, including land grabs by local elites and, in some areas, by government bureaucrats. Also, with donor support, the IRDP was extended across many regions of the South and, in some cases, encouraged stand-alone district level plans and programs. As findings suggest, such stand-alone programs, representing varied bilateral funding streams, were often highly bureaucratic with few linkages to national economic and trade relationships and resulted in a balkanization of agricultural development in some countries (Birgegard 1988; Conyers et al. 1988). In India, the IRDPs tended to be more concerned with the distribution of rural credit (Dreze 1990), while in Bangladesh the centralized planning of the rural women's cooperatives led to inappropriate extension of resources, training, services, and inputs in some districts (Feldman et al. 1980) and the lack of adequate monitoring to secure credit repayment among male cooperative members, particularly from the largest landowners where repayment rates were extremely low.

Significant too, during this period was the work of the Women in Development (WID), Women and Development (WAD), and Gender and Development (GAD)[34] movements that drew important linkages between the sexual division of labor and women's subordination, attention to the peasant household as a critical analytic unit, and the importance of including intra-household gender relations as well as non-wage work in measuring rural women's workload (Agarwal 1997; Sen 1990). Together, these contributions provided a way to make women's work visible, but also to show how the reproduction of the peasant household crucially depended on the contributions of female household members as domestic as well as farm laborers, whether for subsistence or for sale (Dixon-Mueller and Anker 1988; Dixon 1982). At this time, too, it was women's work in crop processing, livestock and poultry rearing, and as off-farm laborers that became a cornerstone of debates on the multiple income-generating activities that characterized social subsistence among peasant households.

In brief, the 1980s saw the salience of NGOs in the development process, first as social movements challenging those who supported processes that entailed the commercialization of agriculture at the cost of the lives and livelihoods of small-scale producer households and, subsequently, as partners in development. Other areas of discussion and debate addressed increased landlessness in the absence of alternative sources of remuneration sufficient to meet household needs, and the growing participation of women in paid and in-kind labor exchanges, including as sources of cheap labor in food for works programs. These shifts dealt a deathblow to any ideology that sustained the notion of a male breadwinner or a family wage.

[34] This is not the place to appreciate and critique their contributions, but each movement played a key role in raising issues that sought to transform agricultural relations of both production and consumption in ways that were attentive to women and the poor. These movements also were instrumental in working to secure women's access to land as well as to non-farm resources and formal employment.

In some countries, this led to an enormous expansion in credit available to rural dwellers, from micro-enterprise development to women's credit through such emergent institutions as the Grameen Bank[35] in Bangladesh, and its replication elsewhere, that provided non-collateral loans to the poor, but primarily to women. Also important was the rise of skills training and literacy to rural women, programs that proved crucial for their participation in emerging industrial sectors, including garment manufacturing for export. This shift toward credit and independent entrepreneurship would become the cornerstone of the declining welfare state both as practice and as ideology.

As we can see, the introduction of the Green Revolution and the research and extension efforts that characterized its early years included ongoing debate and strategic interventions and changes. Not only did researchers examine the complex processes and the changing social and economic relations, costs, and benefits that we associate with the Green Revolution, but they also, and importantly, were part of wide debate on the contributions of modern agricultural production for expanding production and contributing to poverty reduction. Some critics – as often from within, as from outside the major agricultural institutions – helped to identify strategic changes in practice to enhance production and/or limit the negative consequences of the new HYV production. Critics were research scientists at development and agricultural institutes, the CGIAR, or the bilateral and multilateral donor community and they proved instrumental in suggesting strategic shifts in the practice and implementation of HYV production. While the institutionalization of some of the identified costs of the Green Revolution furthered rather than challenged efforts to industrialize agriculture, the practices we associate with the Green Revolution also were subject to challenges by civil society organizations and social movements who offered alternative approaches to agriculture and rural development. These critics were important in challenging what would eventually be referred to as a 'business as usual' approach to food production, agrarian reform, and the changing rural context. What is important to conclude from the exchange of ideas and practices during this period, however, was that it helped to center rural poverty and inequality, changes in land relations and control, and food security as public concerns that would eventually become central features of efforts by social movements to challenge the shift toward global industrial agriculture in the late 1990s.

In the following section we will argue that such open and broad debates have not been sustained in ways that inform the concerns of the 1990s onward; the end of the Cold War, the period of neoliberal reform, and the full implementation of structural adjustment programs. Rather, the openness and breadth of policy debates that addressed agriculture, food security, labor relations, and poverty reduction would narrow in ways that would try to bring debate in conformity with the "Washington Consensus," along with a deprioritization of the agricultural sector. This is so,

[35] The Grameen Bank is now part of a global phenomenon with micro-finance projects across world regions, including the United States. Micro-finance projects are often non-agricultural, can create new market dependencies, and often exclude the ultra-poor.

despite the fact that new areas of science have flourished and specializations have grown in a tradition of open discussion and debate. Paradoxically, recent debates in and among members of the academy, agricultural research institutes, and civil society organizations often pit one set of ideas against another, a polarization that, more often than not, leads to ignoring the critical issues that are being raised in the policy documents promoting the Green Revolution over the long term. Framing informed debate as an opposition rather than as productive engagement is most clearly expressed in the social movement activities that currently animate discussions of alternative agriculture and a failure of the substance of these debates to be openly addressed in policy arenas.[36]

## 4 The Changing Rural and Discursive Landscape of the 1990s and Moving Forward

The deprioritization of agriculture, the rise of export production in low-income countries, and a dependence on foreign currency earnings to meet debt repayment requirements led to significant changes in the focus of agricultural debates and practices within countries, and in the global institutions that support agriculture, including the World Bank, the Food and Agricultural Organization (FAO), and the International Food Policy Research Institute (IFPRI). In some countries, this led to discussions about denationalization of industries that supply inputs to agriculture in relation to agricultural policy proscriptions, the increasing importance of the non-farm sector and its varied expressions, the role of NGOs in their support of both agriculture and non-farm employment, and the place of new technologies in sustaining production. Also important was attention to the environment, agroecological practices, and natural resource management, a growing interest in eco-development, and concerns about new infrastructural needs such as dams, land reform, and strategies to ensure food security and in efforts to reduce poverty. Coterminous with these issues and recognized shifts was a more extensive and deep set of trade relations that, by this time, had already witnessed the institutionalization of structural adjustment programs that removed most state supports for small-scale agriculture. In short, the 1990s focused discussions in agriculture on the largely privatized distribution system that was part of the denationalization process, including for the production of agricultural inputs, a shift that was already intimated in the framing of USAID lending in 1968.

Broad shifts in the role of trade and markets and a growing role for the private sector, and away from a largely state subsidized and small-scale agriculture, are often discussed in the name of globalization or neoliberal reform. Agricultural liberalization

[36] As the experience of the IAASTD has shown, not all critical engagement between scientists of different views is discouraged, but it is noteworthy that the FAO and World Bank reports, subsequent to the IAASTD report, did not engage with its findings nor address its policy options.

refers most broadly to a series of policy changes that include the elimination of marketing boards and the strengthening of private markets for cash and non-cash crops; open-market prices paid to farmers for their produce; the withdrawal of subsidized agricultural inputs, particularly for fertilizer and water; and a shift away from state banks as financiers of crop production to commercial ones. For small and under-subsistence producers, financing agricultural production was increasingly supported through the decentralization of credit made available by a growing NGO sector where the latter would eventually extend non-collateral loans to producers, but not at subsidized rates. For large-scale producers with access to larger loans and more competitive rates, their repayment rates continue to be considerably lower than those extended by NGO programs.

Neoliberal reforms also included rethinking the strategy of import substitution and food self-sufficiency (which today finds its parallel in the food sovereignty movement) and toward greater interdependence on global production. This shift supported efforts to earn foreign currency to repay prior debt, but also reduced the production of crops for local consumption, and contributed to reducing crop diversity and introducing niche market, and high value crops that did not necessarily support local food needs as they were often grown primarily for export. Farmers able to compete in these exchanges contributed to furthering distinctions among producers while, in other cases, they sold land for more lucrative practices, particularly in peri-urban areas where land values were increasing dramatically and interest was expanding for the building of industrial establishment or housing units. While these sites extended urban sprawl and increased pollution, they also reduced land in production and for having agricultural crops locally available for a growing urban market.

Together, privatizing resources for agricultural inputs and for systems of distribution led to changes in the viability and security of many small-scale agricultural producers in the South.[37] It also led to recognition – by a growing NGO community as well as national programs – that peasant households could no longer be imagined, for the purpose of strategic planning and policy formation, as peasant producers in the narrow sense that were guided by sufficient returns from subsistence production to secure their social reproduction. Rather, small-scale producers were recognized as pursuing diversified livelihood strategies to secure their subsistence and that such strategies often included non-agricultural activities performed by multiple household members. Such recognition, interestingly, forced researchers to acknowledge that such engagements were not new, but rather that complex labor relations had always played a significant role in the reproduction of rural life. As noted earlier, the WID/WAD/GAD movements were important in shedding light on this multiplicity and led to a series of studies that were undertaken by independent researchers, policy advocates, and institutions of the CGIAR highlighting the work of women in agriculture and in paid and unpaid labor that was expended in reproducing the farm household.

[37] This is not to ignore a rise, particularly in Europe and North America, of niche market production of high-value, artisan crops for a small elite market.

What is new, however, is that women's unpaid as well as paid employment increased as the family wage, whether from subsistence agriculture or male labor force participation, was even less able to ensure a family's social and economic security. This provided the context for an increasingly individualized understanding of social reproduction, as each adult was assumed to hold responsibility for her own survival. Debates about women's access to credit and of strategies to empower women, in other words, are contradictory in their import as they signal important gains in relation to questions of equity and justice, but also feed a new development logic that moves away from the potential collective imaginings of earlier development approaches.

At the level of strategic policy and planning, these changes entailed a discursive shift away from an agrarian, peasant-centered perspective to a rurally-focused frame that was becoming central in transforming debates and shifts in and about agriculture. But, what is important for the analysis here is that globalization, specifically as expressed in contemporary agricultural debates, did not create these changes; rather, a globalization discourse gave these rural relations greater significance. Nor were non-farm livelihoods simply a response to globalization; instead, the importance of non-farm work was accentuated as increasing numbers of rural as well as urban, often migrant, households were recognized as dependent on multiple income earning streams to secure their subsistence. Globalization, in other words was also created through both discursive and substantive changes that came to make sense, even taken for granted, as the logic that shapes the end of the twentieth century planning and policy forecasts.

## *4.1 Land Reform, Titling, and Large-Scale Development Infrastructure*

Throughout the 1990s and 2000s, there was a decreased commitment to distributive land reform even though movements to support land titling continued, as did land transfers of both public and private land in some countries, a point we return to below.[38] As Berry (2011: 638) claims, "[i]t is widely believed in many policy circles that land reform, if it ever was an important aspect of policy in developing countries, is so no longer. It is not happening and there is no need for it to happen." Berry's claim challenges earlier demands for land reform[39] that were premised on a commitment to small-holder agriculture under the assumption of an inverse relationship between farm size and land productivity and the predominance of small-holder agriculture during the mid-twentieth century. However, Berry's claim also could be

[38] Also important about the distinction between land reform and agrarian reform is that for the latter to have substantive benefits for small-scale producers it would need to entail changes in access to credit, agricultural extension services, and policy reforms that would alter the conditions and relations of production.

[39] See Lipton (2009) for a complex and historically specific discussion of land reform debates and their changing political contexts, but also their continued significance for discussions of agrarian change today.

read as implicit support for land consolidation under the assumption that it would create increased wage employment to echo earlier Green Revolution interpretations. It also could be read as providing legitimacy for efforts to shift from small and medium-sized farms and local food systems to a global system of comparative advantage and industrial agricultural production.

Yet, Berry's claim also signals a shift from earlier assumptions that framed discussions in the agricultural sector and suggests that the commitment to small-holder production is no longer central to agricultural policy reform. Read against the current policy dialogue, the claim contributes to the discursive shift that promotes the privatization and industrialization of agriculture that is presumed to provide low-cost food to rural and urban workers. In his rendering, opposition to land reform supports a transformation of household food consumption practices with likely consequences for family nutrition and health. In fact, a key donor strategy in support of privatization was their land-titling program that, despite claims it would increase tenure security, actually provides an institutional environment that tends to privatize and individualize ownership in ways that likely undermine forms of collective ownership and traditional tenurial relations. As well, titling programs for women have indicated that for "the vast majority of women small-holders, landless agricultural laborers and those doing different forms of informal work, market mechanisms are not likely to provide a channel for inclusion" (Razavi 2009; Lastarria-Cornhiel 1997).

Said differently, a history of land expropriation, privatization, and voluntary land transfers, including distress land sales that often contribute to land consolidation, are processes entailed in land exchanges that do not lead to the redistribution effects that often are associated with the land reform discourses that were envisioned to empower the poor. While the centrality of land reform programs during this period declined in agriculture and development discourses and debates in most countries,[40] there has been a continued focus on proposals that introduce land ceilings or titling among owners (Deere and León de Leal 2001a, b). However, evidence of the effectiveness of land titling in reducing poverty and enhancing economic security is mixed, as land titles are embedded in complex relations of power and inequality that condition actual control of tenure. Moreover, the institutionalization of individualized titles can undermine forms of customary and collective land ownership making it more difficult to engage in multiple forms of production.[41]

[40] This summary is not meant to underestimate the broad range of property rights regimes that are part of arrangements among producers, paralleling the diversity of agroecologies (defined here as multiple approaches to agroecology) and livelihood relations.

[41] "Whitehead and Tsikata's (2003) comprehensive review of the gender and land literature for sub-Saharan Africa, namely that in 'the development of private property regimes of any kind, sub-Saharan African women tend to lose the rights they once had … either because their opportunities to buy land are very limited, or because local-level authorities practice gender discrimination' (2003: 79) is sobering [and has]…become even more important … given the extent to which policy documents across the political spectrum advocate a blanket policy mix of private property rights and land-titling not only as a mechanism to encourage capital investment and foster a more efficient land market, but also as a solution to women's weak and tenuous place within land tenure institutions" (World Bank 2003, in Razavi 2009: 213).

Moreover, the implementation of land reform and titling policies has often failed and is generally assumed to be in response to entrenched rural elite interests in collaboration with those of government bureaucrats. Today, land grabs by transnational firms and individual countries have become new features of contemporary debate and represent agreements between government bureaucrats, such as those between China and South Africa, or between sovereign governments and multinational corporations. Such land grabs will likely accelerate the development of industrial farming that produces for a world market, further marginalizing small-scale producers, and transforming forms of subsistence and production for local markets. Moreover, land grabs by urban real estate dealers remove land from productive agriculture, particularly in peri-urban areas, which contribute to altering urban diets and access to food.

Yet, while Berry may represent one aspect of current agricultural debates, and while discussions of land grabs reveal other sites of contestation, the commitment to small-scale production continues to be of interest to both local and global social movements that will become important in framing discussions of land ownership and property relations in the 2000s. These movements, as we will suggest, also inform debates over questions of food sovereignty and food quality, including debates over genetically modified crops and pesticide use (http://www.panna.org).

However, during the mid-1990s onward, new mechanical technologies for pumping water, cultivation, and harvesting spread rapidly in some regions. Distinctive to agricultural mechanization was the great diversity in the patterns of mechanization. For example, while dramatic pictures showed combined harvesters and large tractors plowing great tracts of land in Brazil, much of the intensification and growth of agriculture in South Asia has come about, not by the spread of large-scale equipment, but rather by the spread of small-scale diesel engines (up to 15 horse power), particularly low-cost Chinese engines used to power irrigation pumps, two wheel tractors, and a variety of harvesting and processing equipment. In Bangladesh and Sri Lanka, for example, with the introduction of small tractors, over 80% of the work of land preparation is now mechanized (Biggs et al. 2011). During this period as well, struggles over the privatization of water became a significant point of contention between government, the private sector, and the farm community. Like other agricultural resources extended to enhance production under the first Green Revolution strategy, the expansion of cheap irrigation water and energy, usually to large-scale commercial farmers but with some spread to others, previously benefited from subsidized rates. Along with the removal of subsidies, debates over water now emphasize its scarcity, the relationship between water and climate change, and concerns over water quality.

At this time as well, debates over large dam projects to serve the growing energy (and irrigation) needs of industry and a growing middle class would ensue as would tensions over the placement and building of new dams with particularly grave consequences for poorer rural households. The Narmada Dam and the Andolan (the movement against its construction) in India and the Three Gorges Dam in China are sites of long-term social movements that seek to secure land ownership for

producers, many of whom had lived for generations on the plots that were appropriated by the state for dam construction. In these cases, compensation to agricultural households was usually inadequate in terms of the amount and quality of land (generally uncleared and not ready for production) to those displaced by the project, and forced those whose land had been expropriated to resettle in areas often distant from their original holdings. In many cases this led to disenfranchisement, and the loss of family and kin networks that were especially important for sustaining production among small-scale producers. Discussions of refugees and resettlement thus became important aspects of debates about agriculture that also included the destruction of agricultural communities and rural social networks as well as the changing aspirations of usually the sons of small-scale agricultural families who no longer see a future in agriculture and seek instead to secure non-farm employment or migrate to emerging towns and global cities.

## *4.2 Rural Livelihoods, Off-Farm Work, and the Reshaping of the Rural Landscape*[42]

While historically the demand for labor in the food system has been in its production as owner cultivators, renters, sharecroppers, and family and wage laborers, trends that began in the 1970s continue to reveal the displacement of family farmers and farm laborers. This is so notwithstanding an expectation that with the implementation of Green Revolution technologies, increasing yields, and a growing number of crops produced each year, demands for primarily wage labor, but also family, and in-kind labor exchanges would rise dramatically, as would the demand for extension services and credit. Instead, labor-substituting practices have expanded which have further displaced small-scale family farms by larger agricultural holdings. Despite this displacement, agriculture still accounts for approximately 40% of the world's employment, even if most is at subsistence or below subsistence level, and the value of food production in 2000 remained at only about 3% of gross world product. Under these circumstances, the agricultural labor force "accounts for approximately 22% of the world's population, and 24% of GDP in countries with *per capita* incomes of less than $765, the low-income developing countries, as defined by the World Bank" (Halweil 2000, Millennium Ecosystem Assessment 2005, in Lang 2010: 93). While this characterizes the low wages and increasingly

[42] Rural poverty incidence in the Philippines, for example, is much more pronounced than urban poverty incidence, but the number of urban poor families also is increasing. The very high rural poverty incidence (47% of families in 2000) has remained virtually unchanged since 1988 (46.3% of families). The urban poverty incidence fell from 30.1% of families in 1988 to 19.9% in 2000. However, the absolute number or the magnitude of urban poor families grew by nearly 11% nationwide between 1997 and 2000 (Schelzig 2005: xiii). This example is important because it is replicated elsewhere and signals what we need to consider as we guestimate the opportunities to be garnered by a second green revolution.

part-time rather than full-time employment that is available to agricultural workers in the countries of the South, in industrialized Northern countries, agriculture faces a similar movement as new generations of farm families move out of agriculture and into non-farm rural employment or urban migration.[43]

The emergence of new policy dialogues that address the increasing role of non-farm work in relation to agriculture is noteworthy, particularly among agencies that have had limited prior collaboration such as the FAO and the International Labour Organization (ILO). The FAO commitment to reducing the number of those who are hungry and poor, and creating the sustainable management and use of natural resources – land, water, air, climate, and genetic resources, coupled with those of the International Fund for Agricultural Development (IFAD) to empower the poor from developing countries to achieve higher incomes and improved food security[44] have recently collaborated with the ILO to directly address issues of employment as part of how they envision the rural and agricultural economy (FAO/ILO/IFAD 2010).

Recognizing the complex relations that shape subsistence incomes among small and medium-sized producers acknowledges that accompanying the institutionalization of the Green Revolution were broad shifts in on-farm, off-farm, including sharecropping and agricultural wage labor, and non-farm work as constitutive of household livelihood strategies, a point noted in the 1970s, but now a key concern in agricultural research. An early publication that signaled the emergence of non-farm work as crucial to household survival strategies, and appreciated by the agricultural research community, was that of Chambers and Conway (1992). They argued that rural households, especially poor rural households, were always multi-tasking, and were never just concerned with crop production activities in a farm management sense. Instead, social sustenance depended on domestic activities, non-farm production activities such as food processing, whether paid or not, and also off-farm employment as laborers, whether daily or seasonal, who secure employment in near as well as far away places.[45] A recent UNRISD report on rural Latin America indicates that there is a feminization of agriculture because women are a growing part of seasonal laborers working in non-traditional agricultural exports and constitute the majority of workers employed in packing plants associated with these global industries, and, given migration patterns among male

[43] An emergent research interest has begun to examine a declining interest in remaining in agriculture among small and medium-sized farm families, especially during times of inter-generational transfer. When coupled with declines in the amount of productive agricultural land held by such producers, potential rural labor shortages, and low and insecure agricultural employment in some countries, these conditions may partially explain why aspirations among the children of farm families are showing increased reluctance to remain in agriculture. Also significant is that access to urban resources, increased education and training, and opportunities to imagine life without the expectations associated with farm production can create disinterest among those in a new generation of farmers in continuing to earn their primary income from agriculture.

[44] http://www.ifad.org/governance/index.htm

[45] Observation of their significance for policy planning has been well documented for many years in development circles. For example see Breman (1996), White (1980).

household members, are becoming key decision-makers in farming households (Deere 2005).

Crucial to understanding the shifts in rural, and particularly agricultural, production relations and their consequences for the debates and practices that characterize contemporary global agriculture are the research and policy initiatives that are centered on the role of women in agriculture, intra-household gender relations, and the changing relations of women's domestic labor and non-farm employment.[46] As we will elaborate below, this research has transformed what is known about rural family production relations, the place of NGOs as part of the complex of institutions that shape agricultural and non-farm interventions, the role of livestock and poultry rearing as part of the productive capacities of agricultural households, and the synergies that shape forms of production, including the indigenous knowledge that characterizes agricultural communities. Also raised by the debates and practices addressed by gender and development researchers in the 1980s and 1990s was attention to the importance of examining water and fuel collection practices and consumption needs, the place of forest products in agriculture, and the meanings that attend to resource ownership and the shift to measuring assets rather than land as an adequate gauge of household resources (Kelkar 2009; Doss et al. 2008).[47] These represent critical issues that are now presumed to be part of ongoing debates in global agriculture and will be explored in the next section.[48]

For example, in response to recognizing the complex relations that comprise household incomes and the invisible work of women, NGOs came to play an increasingly important role in the rural economy. They did so either to complement the contributions of state institutions, or, in some instances, as parastatals, by replacing the initiatives of national institutions where the latter had neither the capacity nor resources to meet a growing demand for non-farm employment, training, or education. As NGOs grew in prominence, they signaled the shift to the growing importance of public-private partnerships and the decentralization of input and resource distribution. Among small- and under-subsistence producing households, NGOs became important resources for education and training in agriculture, particularly in support of small-scale animal husbandry and poultry rearing for women in Asia, and also for training in non-agricultural activities for the rural poor. By the latter part of the decade, NGOs would also offer extensive urban programs, often for migrants who as individuals or families were forced out of agriculture and who brought with them few skills outside of agricultural production.

[46] There is an enormous literature in this broad field which is not appropriate to reproduce here given the purpose of this review.

[47] Exploring measures of wealth and assets was largely in response to feminist development research; also see Moser and Felton (2010), Schelzig (2005), Agarwal (1990, 1995) and Folbre (1986). For a different approach see Carter and Barrett (2006) and Haddad et al. (1997).

[48] See Fontana and Paciello (2009) effort to address gender relations in rural areas within the context of agriculture and non-farm employment.

Health care, nutrition, and education training, and means to subsidize poor families through cash-transfer programs were the core of their rural as well as urban programs that either built on or complemented donor support for national budget items in these areas (Ahmed and del Ninno 2002). Yet, importantly, these programs helped to acknowledge that the pattern of migration to which families were responding was permanent for individual households and unlikely to be reversed as a development strategy. In these ways, debates in agriculture became increasingly attentive to the importance of non-agricultural conditions and relations in shaping and understanding what, for some, continues to remain an autonomous economic sector. Ironically perhaps, some discussions of agriculture, primarily among agricultural economists continue to treat these issues as externalities, despite evidence to the contrary.

Moreover, while agricultural and rural development preoccupations remained focused "on the farm" and its changing relationship to non-farm activities, debates were increasingly attentive to other issues that were arising at a macro- and global scale that were transforming agricultural production over the longer-term. These included, among other things, environmental concerns that were highlighted by the work of the International Panel on Climate Change (IPCC), a policy document that would generate interest among those addressing agricultural issues, but also signal the salience of climate change well beyond the concerns of agricultural production. This broad view of climate change has served as an important vehicle for educating increasing numbers of people to explanations of agricultural production that attend to its embeddedness in complex social arrangements and institutions that are temporally and spatially specific, and also to some of the features of the industrial production of food crops that is best understood as similarly situated. This new knowledge, as we will elaborate below, has been important in mobilizing for alternative agricultural strategies and practices.

Of particular importance for understanding shifts in current agricultural debates is that the issues raised by the IPCC were beyond the analytical policy framework of the agricultural growth linkage model and the notion that the agricultural sector could be treated as a sector meaningfully "independent" of other sectors. This was because the IPCC acknowledged how agricultural producers were subsidized and protected, but not held accountable, for the rise of negative externalities associated with climate change and, in this way, showed the analytic interdependence of these processes, thereby making it increasingly difficult to explain agricultural processes as if they could be sectorally separate from other environmental, ecological, and social processes. Other macro- and global issues that arose during this period included the consequences that attend to the mining of groundwater,[49] the over-use

[49] An important article by Byerlee (1992), an economist close to the Green Revolution, lists many of the negative externalities arising from irrigation-based agricultural growth strategies in South India.

of fertilizers, and the negative effects of large dams for irrigation. While these issues, too, would become central to debates at the turn of the century, the prevailing neoliberal policies[50] at the time interpreted these concerns as minor problems that attend to structural adjustment policies that were assumed to work themselves out through global markets.

In this context, neoliberalism provided the political ideology that emphasized the importance of economic growth as the primary, if not sole goal of agricultural production strategies and presumed, in response to concerns raised by the emergent food movements, that social justice could be best realized by minimal government interference and free market forces. Arguably, the emergent crises (e.g., food and environmental) that have ensued over the past years would suggest otherwise and, as global social movements also would reveal, the most agregious cost of such policies – whether they referred to particular interventions such as the building of dams (Narmada Dam, India), or the industrial production of food (Battle in Seattle and Via Campesina) – would have long-term global consequences for economic security and ecological sustainability.[51] As Lang (2010: 95) frames it, "[t]he crisis in the 2005–8 was not a blip, but creeping normality." Recognizing a new normal moves toward addressing the ways in which the context and conditions of agricultural production have changed as have the costs and risks that may attend to a business as usual approach. It is precisely these concerns that feature in some of the debates between social movements and the global institutions – in relation to questions of research as well as policy options – toward the end of 1990 and into the twenty-first century. Yet, by assuming a new normal rather than interrogating the conditions of a globalized agriculture, we accept globalization as a natural state of affairs rather than a social process and product about which we can intervene through policy reform founded on evidence-based research.

[50] Neoliberalism, as it has shaped conversations about agriculture and agricultural change, can be said to have emerged in the early 1970s and has been part of both academic debates and a characteristic of contemporary life; witness Harvey's notion that we live in an "age of neoliberalism" (Harvey 2005). Neoliberalism can thus be said to serve as "the most powerful ideological and political project in global governance to arise in the wake of Keynesianism, a status conveyed by triumphalist phrases such as "the Washington consensus" and the "end of history". (McCarthy and Prudham 2004: 275).

[51] Important about the anti-globalization movement against the WTO Ministerial Conference held in Seattle in 1999 was its resonance among a broad array of actors that included farmers from across world communities, people concerned with the environmental and the ecological costs of global food production, and members of developing countries whose interests were felt to be inadequately represented at the meeting. Despite the coalescence of these interests and its continuation as part of a global food movement, some interpret the experience of Seattle as a technical problem of not adequately safeguarding and distancing opposition from the proceedings (Vidal 1999). See also the WTO History Project (http://depts.washington.edu/wtohist/).

# 5 Global Assessments

## *5.1 Poverty, Environment, and Climate Change Assessments*

Key global institutions, including various UN agencies, FAO and UNEP, IFPRI, and the World Bank also recognized these crises. This is suggested by the emergence in the late 1980s and early 1990s of global assessments that examined and suggested policy reforms in relation to environmental and global public goods.[52] The World Meteorological Organization/UNDP Ozone Assessment, for example, led to the Montreal Protocol in the late 1980s that was designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion. The Protocol was signed by 196 countries. Our Common Future, better known as the Brundtland Report (1987), of the United Nations World Commission on Environment and Development, helped to focus attention on global environmental and sustainability issues. Its substantive focus presages the issues that take center stage today in debates on agriculture. Gro Harlem Brundtland, as Chair of the Report,[53] noted at the time the eight themes that framed the initiative: To revive growth, change the quality of growth, conserve and enhance the resource base, ensure a stable level of population, reorient technology and management risks, integrate environment and economics in decision-making, reform international economic relations, and strengthen international cooperation.

Interestingly, too, in a keynote speech in 2007, Volker Hauff, Chair of the German Council on Sustainable Development, shared his ideas in a talk entitled, "Brundtland Report: A 20 Years Update." He restated the challenge posed by the earlier report: to meet "the needs of present generations without compromising the ability of future generations to meet their needs [as] was moulded by the Commission into the concept of sustainable development." This general principle, he suggests, confirms the significance of four key ideas: the notion of equity and justice within and between generations; the clear idea of developing a shared understanding of the long-term goals for human life on earth; the idea of new governance instruments and of building collective action; and the resoluteness with which we advocated the need for leadership and building trust with others.[54] Together, these documents reveal the longevity and continued salience of these ideas, since they recur in current debates about the needs, merits, and costs of the industrialization of global agriculture, even as they did not call for recasting the policy or research framework that constituted debate in the 1990s.

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[52] See Haas (1992) and others in the special edition of International Organization on international assessments and policy coordination.

[53] (http://www.regjeringen.no/upload/SMK/Vedlegg/Taler%20og%20artikler%20av%20tidligere%20statsministre/Gro%20Harlem%20Brundtland/1987/Address_at_Eighth_WCED_Meeting.pdf) (accessed April 12, 2011).

[54] (http://www.sd-network.eu/pdf/doc_berlin/ESB07_Plenary_Hauff.pdf) (accessed April 12, 2011).

Animating the Brundtland Report were the links between poverty, inequality, and environmental degradation, themes consistent with those undergirding the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), that was completed 25 years later, and to which we return below. What is critical to highlight here, however, is that while sustainable development continues to animate current discussions as well as popular rhetoric, we will show that the conditions and relationships that frame debates on the links between poverty, inequality, and environmental degradation have yet to move beyond, or take seriously, what is entailed in challenging what Robert Watson,[55] chair of the IAASTD, referred to as "business as usual," and what Oasa claimed were the inherent contradictions of capitalist agriculture (see also Pearse 1980b). Central to the discussion to follow is the salience of these debates for understanding ongoing crises within or related to agricultural production, but also the significance of ignoring the issues that frame such debates as some seek to promote the benefits of a new green revolution. In some ways, efforts to extend and sustain a new green revolution, especially in Africa and centered on modern gene technologies, is modeled on the ideal model and promise, rather than the practice, associated with the earlier revolution. Yet also, and crucially, calls for a second green revolution fail to address the social, environmental, and ecological conditions that acknowledge that the gene revolution is unfolding in a dramatically different global political economy than the conditions and relations that were influential in the 1960s.

## *5.2 Assessments as Planning and Policy Instruments*

Before elaborating on the significance and substantive focus of the assessments that have been carried out since 1987, it is important to consider the place of assessments as planning and policy instruments, as well as for what they suggest about the new thinking that characterizes notions of public goods. Global assessments are research and policy exercises that recast how to think about national planning given that individual nations or states are now envisioned to be part of a large public arena where borders and national boundaries no longer mark the singular space of responsibility.[56] Whether the referent is climate change, water and energy use, or land degradation, ozone depletion or carbon emissions, food shortages or famines, national space no longer provides the outer limit of understanding. With new "fluid borders," the flow of resources and capital, the costs of ecological changes, as well

[55] Interview with Watson, May 2010. See also numerous press releases about the IAASTD and his Testimony to the Financial Services Committee of the United States House of Representatives during 2008 and 2009.

[56] This conceptual shift moved the intellectual map from "underdevelopment" and a world system of first-, second-, and third-worlds, to a global arena. With this shift, the politics associated with colonialism and its contemporary features also have been displaced in popular debate.

as movements of people alter how we imagine and offer policy options in shaping agriculture's future.

This new global "unit of analysis" has become instantiated over time, but these early assessments helped to create a more complex understanding of production (initially idealized in the distinction between food self-sufficiency versus comparative advantage) and new arenas and forms of participation (from top-down state-driven initiatives to forms of collective action and grass-roots mobilization) in the policy-making process. To reflect some of these changes in the assessment process, it is noteworthy that early assessments generally built on the technical expertise of specialists who were drawn from a narrow band of institutions. Today, in contrast, assessments include multi-stakeholder participation that draws on the expertise of social as well as technical scientists who employ a global framework to assess individual national contexts, and explore relations between countries and between a growing global corporate sector and agricultural producers, including, among the latter, those who speak on their behalf (social movements and NGOs).[57]

Global assessments are part of this transition from nation-based models of agriculture to global models and future scenarios of world food production, but they also are important sites of contestation. One of the more controversial assessments during the 1990s was the World Commission on Dams' Report, Dams and Development: A New Framework for Decision-Making, which was completed in 2000. This was an ambitious study where the assessment involved scientists from civil society organizations, members of representative governments, and the corporate private sector, and served as an early experiment in multi-stakeholder exchange. The controversies concerning the environmental, economic and equity dimensions of dams were identified then, and continue today, as reflected in a recent review (Moore et al. 2010). What Moore et al. (2010: 8) suggest in their reflections on the initial document is that "[despite] the World Commission on Dams efforts to find mutual agreement about the development effectiveness of dams and to assemble a comprehensive knowledge base that remains unrivalled in its scope 10 years later, fundamental disagreements remain about the costs and benefits of large dams, and about who reaps the benefits and who suffers the burdens of the costs. The question remains: are dams a useful technology to advance sustainable development or a destructive technology that only in rare cases can be managed successfully to avoid social and environmental devastations and produce real economic benefits?" Their conclusion appreciates the role of assessments in analyses of changing agricultural production strategies: it is important to engage diverse perspectives across a range of topics; recognize the changing drivers of development, including climate change and its significance for the development of approaches to food production, water storage, and energy production, as well as the relationship among diverse technologies, whether these include groundwater and wetlands management, water harvesting, and renewable energies like solar, wind, and geothermal, or the use and effect of new technologies including tractors.

[57] See, for example, Via Compesina or the various NGOs that participated in the IAASTD.

Friedmann (1982), writing at the time of the inauguration of global assessments, draws our attention to the importance of examining agriculture as a global commodity – the framing of a global food regime – that offers a window on international relations, but also on national policy formation, new forms of agricultural production, and new food consumption practices. For Friedmann (1982: 248), a food regime is "a stable set of complementary state policies whose implicit coordination creates specific prices relative to other prices, a specific pattern of specialization and resulting patterns of consumption and trade." Three crucial processes constitute a food regime: (1) the commodification of food as a critical aspect of proletarianization and a key factor in global accumulation, (2) recognizing family farms and simple commodity producers as important contributors to the production of food for a world market, and (3) recognition that national structures initially contribute to the policies constituting an international economic order, but then are dominated by it, producing different effects within nations as well as among them. In this way, food production creates particular patterns of global integration and dependency, national policy environments and formations, divisions of labor, how and what people produce and eat around the world, and where accumulation and profit are centered.[58] Global assessments confirm this empirical shift to global planning and policy formation. As Friedmann notes, the essence of the United States food regime was a system of trade protections and farm subsidies that yielded agricultural surpluses that provided food aid, built on United States Public Law 480 (PL 480), that guided the flow of the grain trade by sending surplus agricultural commodities to poorer nations below market cost (Friedmann 1993, see also Gaud 1968).[59]

## *5.3 Poverty, Food, Environment, Climate Change, and Agricultural Assessments*

Assessments that highlight the global character of production and the problems that producers, whether large or small, face have continued through and after the turn of the century. The Millennium Ecosystem Assessment (MEA) was completed in 2005.

[58] This is an uneven and competitive arena where social movements are critical in creating and responding to the diverse demands of the corporate sector, aid policies, and producers. The WTO Ministerial Conference of 1999, held in Seattle, Washington, to launch a new millennial round of trade negotiations was quickly overshadowed by controversial street protest as part of the United States anti-globalization movement against the WTO, the World Bank and the International Monetary Fund. As Friedmann (2005) also notes, if food retailers and agro-food corporations consolidate, "the new food regime promises to shift the historical balance between public and private regulation, and to widen the gap between privileged and poor consumers as it deepens commodification and marginalizes existing peasants. Social movements are already regrouping and consolidation of the regime remains uncertain."

[59] Food aid was an important aspect of the debates at the time and was recognized to have contradictory consequences for producers and for global agriculture generally. See, for example, Clay (1986, 2003), Clay et al. (1998), Clay and Stokke (1991).

Its conclusions are critically important in understanding and planning for agricultural development in the coming years and include recognition that, over the past 50 years people "have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, freshwater, timber, fiber and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth."[60] The Assessment goes on to suggest that the "changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people…. [Moreover,]…the degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals" (Ibid.). Noteworthy about this report is that "the data and information that [were available to them were] generally related to either the characteristics of the ecological system or the characteristics of the social system, not to the all-important interactions between these systems" (Ibid. x).

The MEA process was rooted in a particular set of disciplines – the biological sciences, ecology, and economics – despite the experience and achievements of, for example, the Dams' Assessment which showcased the benefits of multi-stakeholder exchange. As the introduction to the Millennium Ecosystem Assessment makes clear, "the data and information that are available [for the assessment] are generally related to either the characteristics of the ecological system or the characteristics of the social system, not to the all-important interactions between these systems" (MEA 2005: x). To the extent that the MEA offered an epistemic challenge to earlier thinking, it was to invite cross-disciplinary exchange and thus served as an important precursor to the International Assessment of Agricultural Knowledge, Science and Technology for Development which would build on some of the findings and the organizational strategies used in the MEA.

Two other global activities that changed the landscape for the analysis of agriculture were the failure of the WTO negotiations to come to agreement, due mainly to the intransigence of the OECD countries to reduce the protections and the subsidies given to their agricultural and food industries. These interventions gave rise to two important reference points for food and agricultural analysis. First, they revealed that the neoliberal global market policies advocated by the World Bank were not universally implemented when lobbying and interest groups were sufficiently powerful to resist such measures. Also, the fear of food scarcity has led some countries to restrict exports of food gains, and similar to the OECD countries, while agreements to "free, open global markets" has been a policy to support, in the face of potential emergencies or, in the case of the OECD countries, powerful commercial interest groups, policy practice is determined not by principle but by a broad range of political and economic considerations where

[60] (http://www.millenniumassessment.org/en/About.aspx#2) (accessed April 12, 2011).

unequal power relations and participation in decision-making shaped how and which policies were implemented.[61]

The second activity was the establishment of the Millennium Development Goals in the early 2000s which identified the crises of hunger that continues to plague the lives of rural people across world regions,[62] despite, in some cases, national economic growth. For example, India's recent economic growth and global trading successes can be put in context against the undisputed figures that over 30% of Indian children are undernourished. Here it is evident that benefits of agricultural and, more remarkably, national economic growth have not trickled down as advocates of neoliberal theories often promise. Despite this disjuncture, the arrival of the MDGs has been significant precisely because they provide a reference point in international discourses for an agreed upon concern with poverty reduction.

These activities build on the increased public concern with food production and poverty reduction and the mobilization of people across world communities to address these concerns. Sometimes mobilization unites people who wish to collectively address specific issues and help to create synergies in recognition of shared interests that were not common or possible earlier. The World Social Forum, Via Campesina, and the Zapatista Army of National Liberation each raise issues that are of concern to those preoccupied with current food and agricultural practices and policy decisions. Like global assessments, global social movements alter the ways in which debate about agriculture and food unfold.

The World Social Forum (WSF) is an annual coming together of members of civil society organizations, usually in January at the time of the World Economic Forum in Davos, Switzerland. The Forum offers a vehicle for the democratic exchange of ideas, proposals, experiences, and activities. It represents a broad cross-section of people who are committed to issues of justice and equity, and concerned with social and ecological sustainability. Importantly, the WSF offers alternatives to the neoliberal assessment of the future of food production and consumption. Via Campesina and the Zapatista Army of National Liberation center their concerns within the broad landscape of agricultural production and highlight

[61] Social movements organized around questions of agriculture's future would expose the importance of participation in the decision-making process, as efforts to be heard were part of the strategic stance of the various global food movements, as was the role of the NGO community in their discussions with the World Bank and the establishment of the IAASTD process (Feldman et al. 2010).

[62] While the Millenium Development Goals (MDG) have important implications for agriculture, where it is estimated that 70% of the world's poorest live in rural areas, its primary focus is poverty reduction and thus is not essential to advancing our argument here. MDGs include: to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), malaria, and other diseases; ensure environmental sustainability; and develop a global partnership for development (http://reliefweb.int/sites/reliefweb.int/files/resources/F7FC8E4FA7224D3DC125717100507EE1-ifpri-gen-may06.pdf)

(http://www.ifpri.org/publication/agriculture-and-achieving-millennium-development-goals).

the significance of local resource control that can be achieved through agrarian changes, including land reform, to give producers control of productive resources. La Via Campesina also raises concerns about corporate-driven agriculture and transnational companies for what they contribute to the loss of resource control by local communities (Wield et al. 2010).[63] What is distinctive about these initiatives is that they give public voice to those who previously were excluded from participation in these debates by "bring[ing] together millions of peasants, small and medium-size farmers, landless people, women farmers, indigenous peoples, migrants and agricultural workers from around the world…[that, in their words, defends] small-scale sustainable agriculture as a way to promote social justice and dignity" (http://www.viacampesina.org/).

Important about identifying these debates are their similarities with the issues that were identified by scientists and reviewers writing during and in the wake of the Green Revolution, parts of which were revisited throughout the 1980s and 1990s, even as there was significantly less debate about these issues throughout this period. While there are shared conclusions about the costs of particular forms of agricultural production, shifts toward industrial agricultural production are often supported by Malthusian assumptions which continue to justify more intensive production based on the speculations and promises of new technologies and new relations of ownership, while less often addressing the ecological and equity issues that have plagued efforts to intensify production, the loss of soil fertility, dependence on increasingly limited water resources, and declines in biodiversity. Research by the institutions of the CGIAR may acknowledge these costs, but they nonetheless exclude them in the forecasting models they offer on agriculture's future (IFPRI 2010). Further, while rhetorical claims for sustainable development are championed in almost all recent proscriptive policy documents, there is only limited attention to agricultural practices that would contribute to sustainability. Instead, a focus on growing food needs and increased yields are privileged precisely because a declining

[63] As Wield et al. (2010: 343) suggest in their analysis of the development of agricultural biotechnology from a political economy perspective is "how its applications reflect corporate power and strategy … [and new] processes of industrial and technological restructuring and accumulation." They go on to conclude that the "commercialization of the first generation of GM crops has brought concentration and commodity-chain integration of seeds, chemicals and biotechnology. Agrochemical companies have invested into the seeds part of the plant commodity-chain, so capturing new intellectual property from the integration of GM seed and chemicals. …GM crops are increasingly important but the benefits so far are associated with a small group of (albeit important) crops, for a relatively small number of farmers, in a few, mostly large, producing countries…. [Despite this, they argue that] debate about the potential of GM to raise productivity in farming should not be deflected by the classic populist preoccupation with what is best for … the poorest farmers in the South." What they conclude is the need for "an urgent agenda of future work." The arguments outlined in this paper concur with this need for urgent, but also embedded analyses of current agricultural production and policy priorities. See also Woodhouse (2010) who raises questions about industrial agriculture with a focus on the sustainability of large-scale production; and Weis (2010) who addresses fossil fuel and labor crises in relation to industrial agricultural production.

land base precludes bringing more land into production, and competition by fuel crops, as well as climate changes, erosion, declines in soil fertility, and the loss of agricultural land to industry and housing has meant that land and other resources that can be used for agricultural production are continually being squeezed in ways that threaten a narrow commitment to growth.

## *5.4 Food and Agriculture Assessments and Debates*

The post-millennium period is characterised by the emergence of a number of international assessments and reports that focus directly on global agriculture and food. These have been accompanied, or followed, by reports and activities concerned with forecasting future food and agriculture scenarios to 2050. Animating these reports and scenario planning exercises is alarm at the rate of population growth: "Looking to the future … it is calculated that feeding a global population of just nine billion in 2050 will require a 70% increase in global food production" (IFAD 2010: 14).[64] The IFAD Report, like that of the World Bank Development Report on Agriculture, emphasizes the need for "greater and effective efforts … to address the concerns of poor rural people as food buyers" (Ibid. 14). This dual commitment – to increase agricultural production and to enhance the purchasing power of the poor – signals one of the key controversies framing contemporary agricultural debates, what is often proposed as the trade-off between enhancing small-farm sustainable production and industrializing agriculture through large-scale capital intensive methods using primarily wage labor in the production of cheap staple commodities that are affordable to the poor.

Despite this popular framing, discussions reveal the complex relations that are actually entailed in securing the lives and livelihoods of agricultural producers, and it is precisely this complexity that is underestimated in the above opposition. Ongoing debate, in other words, has yet to adequately open to scrutiny the possibilities of small-scale industrial, but unsustainable capital intensive production, or large-scale, sustainable practices that do not displace labor nor provide below-subsistence wages. In short, what debate has exposed, but has yet to fully resolve, is the diversity of rural social and ecological conditions, and the broad range of social and technical knowledge that shape contemporary agricultural production. It is this diversity that decision-making ought to address in the promotion of technologies and ideas by particular interests who seek and create markets for the extraction of rent.

To be sure, there are a range of arguments that are used by large NGOs and the aid industry, as well as scientific interest and commercial groups, to promote different agendas. What is interesting in comparing them is that they each make similar rhetorical claims about sustainability and poverty reduction. Where they differ is on

[64] See also the United Kingdom Government's Foresight Report, and various IPPRI and FAO reports.

the role of universal models to forecast global needs (IFPRI 2010), and approaches that are location specific and attentive to the different circumstances, conditions, and social relations at local levels (national or community) of production, policy planning, and implementation (McIntyre et al. 2009). Thus, it is not surprising that the new green revolution for Africa, like the food sovereignty movement, focuses on "small-holders," even as each may have a different rational for doing so.

As well, even as debate recognizes the greater complexity of contemporary agricultural relations and practices, and their link to the environment and labor markets, there is still little if any attention to the question of local diets, eating traditions, habits, and practices, or food quality and diversity. Nor is there adequate attention to the link between forms of production and nutrition, diet, or health care. The information generally available on nutrition, diet, and health care (a growing area of research) is their relationship to education and training rather than to the ways in which they also may be differently enabled by the relationship between forms of production and consumption.

One reason for these controversies, and the need to open up public debate about agriculture and food policy is because an increasing number of actors, from across world regions and classes, are contesting the framework within which food consumption and food security, especially for poor and vulnerable people, is conceptualized. There also is growing debate about the agriculture and food policy framework in which scientific, trade, and economic and ecological options are explored (Feldman et al. 2010; McIntyre et al. 2009). Many of these documents challenge a "business as usual" framework, but while the rhetoric may be shared, the substantive meaning of the challenge is quite different. Thus it is useful to explore the context in which this challenge is proposed. In the IFAD Poverty Report 2011 (2010: 222), for instance, the following frame is used:

> [it is important to challenge] 'business as usual' approaches to agriculture, which do not yet adequately address issues of productivity and market orientation in tandem with issues of sustainability. Yet more profoundly, what is lacking in all these conventional approaches is a full appreciation of both the risks and opportunities that affect the livelihoods of poor rural women and men, how both are changing today, and how mitigating or better managing risk is crucial for opportunities to flourish and for poor rural people to benefit.

In this deployment of the challenge to business as usual, the phrase generally promotes the promises of a neoliberal agenda and the new normal, globalized production for a world market. The Report does not engage the animating assumptions that shape its interpretation of the conditions that generate the need to challenge business as usual, nor does it offer a comparison to a past strategy that is implicitly drawn upon as a frame for a new one. In other words, the question of the need for a better understanding of risk and rural employment would benefit from explanation rather than assertion, so that the strategy employed in this pro-poor, sustainable framework can be open to public discussion and debate rather than foreclosed by a singular focus on issues of productivity and market orientation.

The IAASTD, in contrast, used the phrase 'business as usual' to emphasize an alternative approach to the study of rural relations, agricultural practices, and ecological and social sustainability in their offer of future options for action. This approach

highlighted the embeddedness of agricultural production and explored questions about production – its organization, social relations (recognizing power and inequality in access to agricultural resources), links to non- and off-farm work, relationships to "new" and "old" technologies and practices, including agroforestry and the use of genetically modified varieties – in relation to, and inseparable from its ecology and the natural resource base of which it is a part. Agricultural choices and decision-making also are elaborated in relation to consumption practices, trade relations, and political commitments by national governments and popular movements. Thus, for the IAASTD, the challenge of business as usual entailed opening to scrutiny how one thinks about and examines what is usually understood as an independent sector, with other issues examined as externalities which affect agricultural practices but do not constitute them.

Such an approach to research and policy-making is dependent on interdisciplinary thinking and engagement that builds on a range of expertise as was introduced by the Dams Assessment, but was also viewed as one of the merits of a farming systems approach. In this use of the phrase 'business as usual', agricultural research and policy-making depends on opening to question the popular assumptions that drive the neo-Malthusian model that supports the neoliberal agenda in their promotion of corporate sector driven industrial agriculture. This means taking Oasa's analysis seriously and recognizing that inequalities in resource endowments and consumption are inherent to the capitalist expansion of agriculture such that minor tinkering with its most egregious costs – as if they are simply managerial or technical problems – are not likely to be adequate in creating an approach that is ecologically and socially sustainable over the long term.

Thus, even though responses to the challenges of the current agricultural crisis have been part of ongoing debates for generations, and even if the debates may have been partial or identified different costs and consequences of specific agricultural practices (as opposed to seeking to challenge the epistemic underpinnings of the Green Revolution), what is new about the current conjuncture is that the debates over agriculture's future have extended beyond the expertise found in global institutions such as the FAO and the World Bank. Current debates are now part of popular discourse and include a broad-based commitment that extends the efforts of the social movements and civil society organizations that addressed some of these issues in the 1990s. Today, both social movements and civil society organizations (CSOs) engage agricultural scientists whose expertise informs their applied research and program activities, including their offering of alternative approaches to sustainable agriculture. Moreover, small-scale producers and consumers from the South as well as the industrialized North are more active in seeking to shape their production and consumption choices.[65] While not always able to significantly alter what might

[65] While there are crucial differences among these constituencies, and the costs of many of the interventions have been borne by producers in the South, it is important to mark synergies that can help to expose what are envisioned as the costs of maintaining business as usual in relation to agricultural production.

be termed the hegemonic understanding about how to increase and yet sustain production, ongoing discussion, including that in the popular media, has been productive; it has encouraged caution about production choices among some producers and consumers, led to greater attention to the ecological trade-offs of selected practices, revealed the partial way in which WTO rules are employed, and exposed some of the costs of industrialized agriculture.

What this engagement suggests is that even when there is little interest among some researchers and institutions to debate the substantive issues raised by the agrarian, land, water, and food movements and research and policy initiatives, the contemporary period is characterized by complex discussions about agriculture's future. While efforts to elide the IAASTD, for example, has meant that the global institutions that initially funded the initiative have not included it in debate, others, including members of governments, national research institutes and the academy continue to use its research findings and options for action as ways to think about alternatives to large-scale industrial production, a set of issues we return to below.

## 6 Food Policies and the Food System

A critical issue in ongoing discussions about agriculture is the growing demand for cheaper food for the burgeoning populations who have been dispossessed from rural as well as urban communities. In this context, and as especially evident in the growing number of food crises and riots across world regions, the significance of cheaper food in order to avoid public disaster is crucial. Yet, as Sainath (2001) eloquently notes:

> An exclusive focus on 'starvation deaths'—disconnected from the larger canvas—seems to imply this: if they don't die, everything's alright. If they lose their land, cannot feed their families, see their children enter bondage, are forced into debt-driven prostitution—all that is okay. They just shouldn't starve to death. That's upsetting. It's bad implementation.

What Sainath is highlighting here are the consequences of the maldistribution of food, but he does so by showing how access and adequate consumption are linked to questions of land control, particular labor relations, and indebtedness where, in each arena of social reproduction, people struggle for survival. He draws these connections to show how, under conditions when food is no longer available to sustain life, and where producers are excluded from their ability to produce, the contradictions of particular forms of production are revealed.[66] Amrith (2008) similarly reminds us of "the discursive power of food as a metaphor for justice" showcasing how broad debates on food actually invite attention to the parallel issues of access to land and other productive resources, including water, the livelihood strategies that secure production, and the emergent crises that attend to climate changes.

[66] Sainath also chides his readers by suggesting that the problem of starvation is not systemic, but rather technical or managerial – poor implementation – whose solution merely requires minor fixes or shifts in how production and producer relations are managed.

The concern with food production, the right to food, and the provisioning of sustainable and healthy food is a concern to increasing numbers of people. As social movements, Sainath, and the IAASTD Report make evident, not only must agriculture be embedded in issues of social and environmental sustainability, but it must also engage questions of equity, health and nutrition. Nutrition, or consumption in the narrow sense, concerns not only what we eat but how food is grown and prepared, the kinds of food to which people have access, under-consumption and hunger, as well as obesity or eating the wrong or poor quality food.

As Lang (2010: 87) argues, "food policies are failing to respond adequately to the squeeze on land, people, health and environment … [and] the dominant twentieth century productionist policy paradigm is running out of steam." With food as both the metaphor and the commodity itself, it is evident that even acknowledging the need to produce more food to meet growing population demand, need not default to a narrow focus on production. Rather, as current debate suggests, it is critical to move beyond treating food or the agricultural sector in isolation, as the productionist paradigm would have it, and instead to embed food (and energy) production and consumption in a larger social and environmental landscape. Food and its trade-off with fuel production also helps to make evident the policy choices that attend to the interests of some producers over others, opening opportunities to explore relations among production, "ecological public health," food access, and consumption. This focus also provides a context to examine questions of climate change as well as water access, quality, and safety, foci that currently take center-stage in research and policy debates in agriculture.[67]

Lang (2010: 89) also suggests that "[t]oday's food system exhibits a 'lock-in': over-production distorts what bodies need, while human aspirations and market power distort land use, and marketing distorts desire." To compensate for these practices and understandings, he concludes that we need to build food systems that can deliver low-carbon, nutritious, sustainable food. He assumes, in accordance with IAASTDs findings, the importance of moving beyond a narrow productionist paradigm in ways that integrate agricultural practices and policies with environmental, social justice, health, and security issues. Under these conditions food security must not only be realized by ensuring availability, or even accessibility and affordability, but by delivering sufficient:

> …production only on ecological terms, with sustainable food systems at the heart of international development; to judge food not just by price but meshing embedded carbon, water and land use with calories – a new set of heuristics; to factor in *all* diet-related ill-health, not just hunger; to draw on all the sciences, not just the 'natural' sciences, to help create resilient food systems; to focus on entire food chains, not just agriculture; to transform how food is produced, distributed and consumed; to re-frame consumer aspirations to engage them in lowering food's impact on the environment; and to deliver the above through democratic means, building movements that hold food systems to account and shape needs appropriately….

[67] (http://www.conferencealerts.com/water.htm).

> From this ecological public health perspective, food security *is* sustainability; only sustainable food systems can deliver meaningful security (Lang 2010: 94–95 *italics* in original).[68]

What is critical about this discussion for understanding shifts in agricultural debates and practice is the lack of consensus about the various ways to meet global food or, in some cases, even recognition that there may be alternatives to the promotion of a second Green/Gene Revolution that may employ modern technology without adequate consideration of the costs to doing so. Some of these costs have been identified from the extensive critiques of the earlier revolution; increasing landlessness and resource impoverishment, loss of control of decisions about food production and consumption, loss of biodiversity, and environmental degradation. But, unlike the earlier initiative, what the institutionalization of a second revolution reveals is greater dependence on industrial, large-scale forms of production, land grabs by government or the private sector to secure their own food needs, often through cross-national agreements, and efforts to ignore or foreclose opportunities for debate (Feldman et al. 2010). Under these circumstances, despite rhetoric to the contrary, the objectives of environmental and social sustainability continue to be treated as externalities. An examination of the food security and food sovereignty movements, however, offers a window on ongoing debate that is now centered on popular movements for food security and sovereignty.

## 7 Food Security and Food Sovereignty[69]

Food security and food sovereignty are key themes that characterize current discussions in agriculture. Food security as a key issue in agriculture emerged as part of a development approach that sought national food self-sufficiency and arose in relation to questions of land security/reform and peasant movements across world regions in the 1970s. Discussions within countries sought to sustain diversified agriculture in ways that would contribute to food self-sufficiency in a balance between food imports and stocks. This was a concern to limit, and, where and when possible, avoid, price fluctuations in a global market, dependence on foreign currency, and the lack of timely distribution. During this period, for instance, Bangladesh promoted a strategy of self-sufficiency in rice production. Subsequent policy decisions under structural adjustment lending agreements in the late 1970s and early 1980s,

[68] As Lang indicates, the small-scale farmer focus remains critical to discussions on many sides of the debate, and is not dissimilar to that raised by Johnston and Mellor (1961) and Johnston and Clark (1982) during the height of the first Green Revolution. However, comparison must be cautiously drawn given dramatic differences in the context of each historical moment.

[69] We do not address the changing practices or discourses associated with food aid or the role of the World Food Program (WFP) and the continued need for food during emergencies. Nor do we examine the Fair Trade movement that also is consequential for appreciating the range of issues shaping agricultural production and consumption.

however, led to the promotion of a comparative advantage strategy such that today the country is South Asia's largest rice purchaser. Moreover, food insecurity at the individual and household level, finds insecurity reproduced in national policy arenas as the current government of Bangladesh seeks to secure land for agricultural production in Uganda to be organized with the support of private Bangladesh investors (Reuters 2011). While such investments may provide more available crops for the Bangladesh market, they do not respond to the employment needs of those unable to sustain production in the country. As Reuters reports, "Some 25,000 people are needed for farming [but only] 10% will be Bangladeshi farmers." This approach opens debate on how the handling of single issues within agriculture can fail to respond to the multiple and complex issues that face current food crises.

Boyer (2010: 324–325) identifies a similar pattern in Honduras; "US official pronouncements on food security during the 'lost decade of the 1980s' must have possessed a particularly hollow ring. By this time, USDA had issued its definition to the world: food security for a household meant access by all members at all times to enough food for an active, healthy life. The definition purposely ignored how or where food is produced." Such a proclamation reinforces the notion that people should be able to purchase affordable food rather than worry about having access to the resources to enable them to produce food.

What these examples suggest is that the discourses of food security have been read in different ways by different constituencies. In some cases, they promote small-scale production and the right, not only to consume, but also to produce food. That is, discussions of food security emerged alongside the global commodification of food, as producers and consumers within countries began to experience reduced access to securing the means to meet their food needs, especially when policy decisions distinguish between production and consumption and focus only on the latter. For those who link consumption with production, mobilization has focused nationally or regionally and discussions generally include attention to land reform, credit access, the movement to privatize water, and rural class inequalities, although some also raise the negative costs of food aid (including PL480).[70] Not surprising in this context is what Patel (2009: 664–665) recognizes as the changing meaning of food security as it moved from being simply about producing and distributing food, to a whole nexus of concerns about nutrition, social control, and public health. An examination of current discussions in most assessments and reports on food and agriculture, particularly those from development institutions including the FAO, the World Bank, IFPRI, and IFAD, reveals the continued distinction between production and consumption, and an unambiguous commitment to the food security of individual households by increasing the production of food for market.

[70] PL480 (Public Law 480), now referred to as the Food for Peace Act (FPA), provides for government-to-government sales of United States agricultural commodities to developing countries on credit or grant terms. Depending on the agreement, commodities provided under the program may be sold in the recipient country and the proceeds used to support agricultural, economic, or infrastructure development projects (USDA 2010).

The food sovereignty movement, in contrast, is part of a discursive formation and practical politics that are grounded in countering the global corporate agro-industrial food system and embracing a number of agrarian-centered reforms. The call for food sovereignty was introduced as part of the Via Campesina platform of change,[71] with key elements that include prioritizing local agricultural production with assurances of access to land, water, seeds and credit by peasant and landless peoples. Assuring such conditions requires land reform, fighting for free access to seeds and being cautious of GMOs, and safeguarding water as a public good; securing the right of farmers, including women farmers, to produce food and the right of consumers to be able to decide what they consume, and how and by whom it is produced; and the right of countries to protect themselves from extremely low priced agricultural and food imports recognizing that agricultural policy choices should be made through democratic decision-making.[72] "At the heart of food sovereignty," notes Patel (2009: 670), is a radical egalitarianism in the call for a multi-faceted series of 'democratic attachments'.

Yet the sovereignty movement, like that of peasant calls for food security, shares important features that include securing the rights of the poor and dispossessed not only to food, but also to democratic and equitable access to the conditions that can secure their social reproduction, whether for subsistence production, decision-making in matters of agriculture, and in all matters that enable social and ecological sustenance. As Edelman (2005: 339) emphasizes, "food [is] a human right rather than primarily a commodity, [it] prioritizes local production and peasant access to land, and upholds nations' rights to protect their producers from dumping and to implement supply management policies." As well, McElwee (2007), writing from the vantage point of Vietnamese peasants, notes "the Zapatistas in Mexico to cooperatives of cheese artisans in France, [producers] are taking their claims to a global audience: that they are entitled not just to food security (the moral economy of times past) but to "food sovereignty" – the right to continue to be agriculturalists and retain autonomy over livelihood decision-making rather than ceding this autonomy to the WTO" (see also Windfuhr and Jonsén 2005). Significantly, OECD farmers and the food industry did not succumb to the WTO agreements, and in India there is still subsidization and protection of commercial agriculture even as agriculture is still comprised of a significant proportion of small-scale, under-subsistence producers.

Important for the argument here, and for understanding current debates and policy shifts in agriculture, is the continuity between these two arguments and movements despite their origins in different historical moments. As Sivaramakrishnan (2005: 327) suggests, "struggles over human rights, heritages, homelands, clean

[71] See Boyer (2010) who distinguished between food security that resonates with deeply held peasant understandings of security for their continued social reproduction in insecure social and natural conditions, and sovereignty which is generally understood as powers of nation states and thus distant from rural actors' lives.

[72] These attributes of the food sovereignty movement are drawn from the Via Campensina webpage (http://www.viacampesina.org/en/index.php?option=com_content&view=article&id=47:food-sovereignty&catid=21:food-sovereignty-and-trade&Itemid=38).

technologies, and healthy foods that dominate agrarian politics now are still mired, if differently, in questions of moral claims and the basic right of those who work the land to a dignified, secure, and fair livelihood." Also important from these debates are the ways in which food production and consumption engage people across world regions and classes, if differently, and how these debates challenge – in a democratic if unequal way – the business as usual model of agricultural development interventions characteristic of the 1980s. Such debates return us to the engagement and political space made during the first Green Revolution where agricultural research and policy formation were undertaken primarily as sectoral analyses that were disembedded from the agroecological landscape and the social and political relations that connect production and consumption to the right to food and the sustainable use of resources.[73] But, the period does remind us that global social movements and assessments that offer interdisciplinary, evidence-based, embedded analyses of agriculture can contribute to sustaining public debate on food and agriculture, identify the linkages between food, agriculture, and other social and environmental resources, reveal the political interests that shape policy reform, and what these processes mean for the contemporary structure and relations of global food production, and what, together, these mean for the lives and livelihoods of producers and consumers.

## 8 Concluding Reflections

In this review, we have argued for continuity in the themes and issues that have characterized agricultural debates since the early 1960s. We build this argument by revisiting the issues and challenges posed by the introduction of the Green Revolution during this early period, and explore the debates that were an ongoing feature of its development, beginning in South Asia, but also having resonance in other world regions. These debates, we suggest, in large part because they were grounded in long-term evidence-based research, offer important cautions for the research, policy, and extension communities as we move toward the promotion of a second Green/Gene Revolution. Of course, the social and political context has dramatically shifted during this time – no longer is state-driven development with its attendant subsidies, supports, and import substitution strategy a feature of global relations.

[73] It is important to recognize that the food sovereignty debate and its commitment to the rights of peoples and nations to define their own food, agricultural, and trade systems and policies includes what Kloppenburg (2010: 367) refers to as 'seed sovereignty.' Seed sovereignty incorporates the development of an institutional platform that, at the national level means "confronting state assertions of 'national sovereignty' over genetic resources and the role of national agricultural research services…[and at] the international level … means pushing the CGIAR centres and the Multilateral System of the ITPGFRA [The International Treaty on Plant Genetic Resources for Food and Agriculture] in open-source directions. …The CGIAR system in particular … retains a commitment to public purpose and its broad germplasm holdings and experience with participatory breeding would be invaluable resources for building the protected commons" (Kloppenburg 2010: 381).

Nor are national popular movements and civil society organizations the primary centers of debate and challenge. Instead, food is now a global commodity and production, for national consumption occurs not only within the boundaries of the nation state, but also through investments by individual countries or investors in production that takes place across world regions. This complements the increased dependence and promotion of free trade as part of the neoliberal assumptions animating global relations with its strategy of comparative advantage.

Despite these critical differences, we suggest that there is much to learn from these debates since many of the issues raised by critical engagement with them are salient today, and thus offer important cautions when reclaiming the successes of this earlier agrarian transformation. For instance, farmers continue to be viewed as rational actors whose ability to manage risk centers responsibility on individuals rather than households, communities, or states, and for whom solutions and accommodations are assumed to best be made through the market. This means, for instance, that while efforts to empower women include their increased access to resources, credit, the labor market, and education, they increasingly are also individually held responsible for the costs of their reproduction. These efforts reveal the contradictory processes that are involved in struggles for women's enhanced opportunity structures; they may feel more empowered to engage as individuals accessing and controlling resources, as with land titling programs, but they also are challenged to meet subsistence needs under increasingly more precarious ecological, climatic, and social conditions, conditions about which they can have only limited control.

For small-scale farm families, this has meant that multiple incomes have come to shape their resource base, as increasing numbers are either forced out of agriculture to secure employment in off-farm or non-farm activities, or choose to migrate if they are to find ways to meet their subsistence needs. An emphasis on the role of off-farm and non-farm rural employment has been a central feature of the post-Green Revolution debate. Today, these issues are even more central to the discussion of agricultural production as increasing numbers of people are displaced from control of their means of production. These issues also highlight a limitation of a productionist paradigm that treats employment as external to the changes that arise with the transformations of the agricultural economy and suggest the potential contribution of integrated approaches to the study of agricultural practices and policies, as well as to prognoses of agriculture's future.

New collaborative initiatives among global institutions (FAO/ILO/IFAD) signal the salience of these new issues as well as the potential for more embedded understandings. Crucially, they also identify new sites for public engagement to address the consequences of the substantive shift from the agrarian to the rural economy. The new issues that emerge with this shift include land grabs expanding and globalizing debates on land reform; recognizing "seed sovereignty" and corporate ownership as central to questions of the control of productive resources; expanding a focus on irrigation to now include water resources and climate change for their impact on land tenure and ecological security; and corporate regulation and responsibility for sustainable agricultural practices broadening a prior focus on the

environmental costs of land degradation, and how, together, these issues recast the social and ecological landscape.

While such collaborative efforts are promising, other indicators suggest that business as usual is more likely, even as rhetorical commitments to poverty reduction and sustainable development are part of the claims of almost all agricultural development research and policy initiatives. We have shown, for instance, that early critics of the Green Revolution, as well as those writing in its wake, debated the possible environmental and ecological costs of a transformation in agricultural production. Thus, contemporary debate about the centrality of environmental and ecological degradation to current discussions about agriculture's future is hardly surprising and one might argue that it is a consequence of a failure to integrate and address the costs of new agricultural practices over the past 30 years, where growth and profitability have taken precedence over long-term sustainability. This suggests that serious debate has yet to adequately address the compromises and trade-offs that need to attend to the meeting of multiple goals. It also suggests that such debate has yet to seriously be engaged by a number of the international institutions that play a central role in policy-making. For example, the International Food Policy Research Institute (IFPRI) reiterates the neo-Malthusian framework in their offer of 15 future scenarios for food security through 2050. As the IFPRI summary document makes clear,

> Each scenario involves an alternative combination of potential population and income growth and climate change. The authors … conclude that the negative effects of climate change on food security can be counteracted by broad-based economic growth—particularly improved agricultural productivity—and robust international trade in agricultural products to offset regional shortages. In pursuit of these goals, policymakers should increase public investment in land, water, and nutrient use and maintain relatively free international trade.[74]

These policy strategies are precisely the approach the Dams and IAASTD Assessment sought to open to critical debate as they built evidence-based understandings of agriculture, not as an independent sector, but rather in relation to "such cross-cutting issues as health, education, climate change, trade, indigenous knowledge, formal science (agroecology, modern biotechnology, etc.), gender, food security, access to resources, rights – and, even briefly, food sovereignty" (Ishii-Eiteman 2009: 691). What we also learn from these debates, and from the concerns and demands raised by the broad-based global movements focused on global agriculture, is that the issues they raise can readily be dismissed or ignored by some of the major institutions, especially if their analyses do not comport with those who continue to have a dominant role in agricultural policy-making, and where the commitment is to a relatively narrow focus on increasing production and securing international trade. Yet, it is precisely the struggle to keep debate alive that promises to expand the knowledge we bring to bear on agriculture's future.

From these contrasts and multiple goals we can conclude, as we have tried to suggest in this review, that the research focus and policy commitments that have

[74] http://www.ifpri.org/publication/food-security-farming-and-climate-change-2050

shaped international shifts in agricultural debates and practice continue to build on, and critically engage, key contradictions that emerged and were identified more than a quarter-century ago, with the promotion of the first Green Revolution and the deployment of a productionist model of agricultural growth. What is perhaps most striking about the current moment is that despite support from broad-based social movements, civil society organizations that represent constituencies the world over, and important support from key interlocutors – among policy-makers within countries and in international institutions – open debate in the common project of building toward food security and sustainable lives and livelihoods has yet to become a central part of the policy-making process and the debates upon which evidence-based decision-making unfolds. Rather, what characterizes the current conjuncture is an intellectual impasse opposing different arguments (here we characterize them as follows); one that centers on the call for a second Green Revolution and a growth-*cum*-productionist framework that promises to meet the food needs of a growing population, and a second that calls for an integrated approach to agriculture that centers social, ecological, and environmental sustainability within the discussion of food security and sovereignty. Unfortunately, we are currently witness to a narrowing of the intellectual terrain able to address the embedded character of agriculture, ecology, and social sustainability, equity, and justice.

**Acknowledgements** We thank all the participants in the IAASTD project, especially Robert Watson, Beverly McIntyre, Marcia Ishii-Eitman, and Rajeswari Raina.

## References

Agarwal B (1990) Social security and the family: coping with seasonality and calamity in rural India. J Peasant Stud 17:341–412

Agarwal B (1994) A field of one's own: gender and land rights in South Asia. Cambridge University Press, Cambridge

Agarwal B (1995) Gender, environment and poverty interlinks in rural India. United Nations Research Institute for Social Development, Helsinki

Agarwal B (1997) Bargaining and gender relations: within and beyond the household. International Food Policy Research Institute, Food Consumption and Nutrition Division, Washington, DC

Agarwal B (2003) Gender and land rights revisited: exploring new prospects via the state, family and market. In: Razavi S (ed) Agrarian change, gender and land rights. Blackwell, London, pp 184–224

Ahmed AU, del Ninno C (2002) The food for education program in Bangladesh: an evaluation of its impact on educational attainment and food security. International Food Policy Research Institute, Food Consumption and Nutrition Division, Washington, DC

Amrith SS (2008) Food and welfare in India, c. 1900–1950. Comp Stud Soc Hist 50(4):1010–1035

Bangladesh Rural Advancement Committee (BRAC) (1980) The net: power structure in ten villages. BRAC Prokashana, Dhaka

Berry A (2011) Review essay: the case for redistributional land reform in developing countries. Dev Change 42:637–648

Biggs SD (1989) Resource-poor farmers participation in research: a synthesis of experiences from nine national agricultural research systems, OFCOR comparative study paper 3. ISNAR, The Hague

Biggs SD, Justice S, Lewis D (2011) Patterns of rural mechanisation, energy and employment in South Asia: reopening the debate. Econ Polit Weekly 46 (9, February 26):78–82
Birgegard LE (1988) A review of experiences with integrated rural development. Manch Pap Dev IV(1):4–27
Blair H (1978) Rural development, class structure and bureaucracy in Bangladesh. World Dev 6:65–82
Bose S (1974) The Comilla co-operative approach and the prospects for a broad-based green revolution in Bangladesh. World Dev 2:21–28
Boyer J (2010) Food security, food sovereignty, and local challenges for transnational agrarian movements: the Honduras case. J Peasant Stud 37:319–351
Breman J (1996) Footloose labour: working in India's informal economy. Cambridge University Press, Cambridge
Brundtland GH (1987) Report of the World Commission on Environment and Development: our common future, annex. United Nations, New York
Byerlee D (1992) Technical change, productivity, and sustainability in irrigated cropping systems of South Asia: emerging issues in the Post Green Revolution Era, J Int Dev 4(5):477–496
Byres TJ (1981) The new technology, class formation and class action in the Indian countryside. J Peasant Stud 8:405–454
Cain M (1983) Landlessness in India and Bangladesh: a critical review of national data sources. Econ Dev Cult Change 32:149–167
Carter M, Barrett C (2006) The economics of poverty traps and persistent poverty: an asset-based approach. J Dev Stud 42:178–199
Chambers R, Conway G (1992) Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies, Brighton
Chambers R, Jiggins J (1987) Agricultural research for resource-poor farmers. Part I: Transfer-of-technology and farming systems research. Agric Adm Ext 27:35–52
Clay EJ (1986) Rural public works and food-for-works: a survey. World Dev 14:1237–1251
Clay EJ (2003) Responding to change: WFP and the global food aid system. Dev Policy Rev 21:697–709
Clay EJ, Stokke O (1991) Food aid reconsidered: assessing the impact on third world countries. Frank Cass and EADI, No. 11, London
Clay EJ, Pillai N, Benson C (1998) The future of food aid: a policy review. ODI, London
Cleaver HM (1972) The contradictions of the green revolution. Mon Rev 24:80–111
Conyers D, Mosley P, Warren DM (eds) (1988) Integrated rural development: the lessons of experience, vol IV, 1, Special issue, Manchester papers on development. Institute for Development Policy and Management, University of Manchester, Manchester, UK
Deere CD (2005) The feminization of agriculture? Economic restructuring in rural Latin America, United Nations Research Institute for Social Development, occasional paper 1. UNRISD, Geneva
Deere CD, León de Leal M (2001a) Who owns the land? Gender and land-titling programmes in Latin America. J Agrar Change 1:440–467
Deere CD, León de Leal M (2001b) Empowering women: land and property rights in Latin America. University of Pittsburgh Press, Pittsburgh
Dixon RB (1982) Women in agriculture: counting the labor force in developing countries. Popul Dev Rev 8:539–566
Dixon-Mueller R, Anker R (1988) Assessing women's economic contributions to development programmes. World Employment Office of the International Labour Office, Geneva
Doss C, Grown C, Deere CD (2008) Gender and asset ownership: a guide to collecting individual-level data, Policy research working paper 4704. The World Bank Poverty Reduction and Economic Management Network, Gender and Development Group, Washington, DC
Dreze J (1990) Poverty in India and the IRDP delusion. Econ Polit Weekly, Special Agricultural Issue A95–A103
Dreze J, Sen AK (2002) India: development and participation. Oxford University Press, Oxford
Eade D (2000) Preface. In: Eade D (ed) Development, NGOs, and civil society. Oxfam, Oxford

Edelman M (2005) Bringing the moral economy back into the study of 21st century transnational peasant movements. Am Anthropol 107:331–345
Edwards M, Hulme D (eds) (1992) Making a difference? NGOs and development in a changing world. Earthscan, London
Elliot C (1987) Some aspects of the relations between North and South in the NGO sector. World Dev 15(Supplement):57–68
Ellis F, Biggs S (2001) Evolving themes in rural development, 1950s–2000s. Dev Policy Rev 19:437–448
FAO/IFAD/ILO (2010) Gender dimension of agricultural and rural employment: differentiated pathways out of poverty (Status, trends and gaps). Rome: FAO/IFAD/ILO.
Farrington J, Bebbington A (1993) Reluctant partners? Non-governmental organisations, the state and sustainable agricultural development. Routledge, London
Feldman S (2003) Paradoxes of institutionalization: the depoliticisation of Bangladeshi NGOs. Dev Pract 13(1):5–26
Feldman S, Biggs SD (2012) The politics of international assessments: the IAASTD process, reception and significance. J Agrar Change 12:144–169
Feldman S, McCarthy FE (1984a) Rural women and development in Bangladesh: selected issues. NORAD, Ministry of Development Cooperation, Oslo
Feldman S, McCarthy FE (1984b) Constraints challenging the cooperative strategy in Bangladesh. South Asia Bull IV(2):11–22
Feldman S, Akhter F, Banu F (1980) The IRDP women's programme in population planning and rural women's cooperatives. Ministry of Local Government and Rural Development, Dhaka
Feldman S, Biggs S, Raina R (2010) A messy confrontation of a crisis in agricultural science. Econ Polit Weekly xlv 3(January 16):66–71
Feldstein HS, Jiggins J (eds) (1994) Tools for the field: methodologies handbook for gender analysis in agriculture. Kumarian Press, West Hartford
Feldstein HS, Poats SV (eds) (1989) Working together: gender analysis in agriculture. Volumes I and 2. Kumarian Press, West Hartford
Feldstein HS, Flora CB, Poats SV (1988) The gender variable in agricultural research. International Development Research Centre, Ottawa
Folbre N (1986) Hearts and spades: paradigms of household economics. World Dev 14(2):245–255
Fontana M, Paciello C (2009) Gender dimensions of rural and agricultural employment: differentiated pathways out of poverty: a global perspective. Paper presented at the FAO-IFAD-ILO workshop on gaps, trends and current research in gender dimensions of agricultural and rural employment: differentiated pathways out of poverty, Rome. Institute of Development Studies. http://www.fao.org/docrep/013/i1638e/i1638e.pdf. Accessed 21 June 2011
Food and Agricultural Organization (FAO) (1992) Institutionalization of a farming systems approach to development, Farm systems management series no. 5. Agricultural Services Division, Food and Agricultural Organization of the United Nations, Rome
Friedmann H (1982) The political economy of food: the rise and fall of the postwar international food order. Am J Sociol 88(Supplement):248–286
Friedmann H (1993) The political economy of food: A global crisis. *New Left Review* 197:29–57
Friedmann H (2005) From colonialism to green capitalism: social movements and the emergence of food regimes. Res Rural Sociol Dev 11:227–264
Gaud WS (1968) The green revolution: accomplishments and apprehensions. Address by The Honorable William S. Gaud, Administrative Agency for International Development, Department of State, before the Society for International Development, Shoreham Hotel, Washington, DC, 8 March. AgBioView Archives. http://www.agbioworld.org/biotech-info/topics/borlaug/borlaug-green.html. Accessed 23 Apr 2011
Gilbert EH, Norman DW, Winch FE (1980) Farming systems research: a critical appraisal. Department of Agricultural Economics, MSU rural development papers, no. 6, Michigan State University, East Lansing, Michigan

Glaeser B (1987) The Green Revolution revisited. Allen & Unwin, London
Greenough P (1980) Indian famines and peasant victims: the case of Bengal in 1943–4. Mod Asian Stud 14:205–235
Greenough P (1982) Prosperity and misery in modern Bengal: the famine of 1943–4. Oxford University Press, New York
Griffin K (1974) The political economy of agrarian change: an essay on the Green Revolution. Macmillan, London
Haas PM (1992) Introduction: epistemic communities and international policy coordination. Int Organ 46:1–35
Haddad L, Hoddinott J, Alderman H (1997) Intrahousehold resource allocation in developing countries: models, methods and policies. John Hopkins University Press, Baltimore
Hadenius A, Uggla F (1996) Making civil society work, promoting democratic development: what can states and donors do? World Dev 24(10):1621–1639
Haggblade S, Liedholm C, Mead C (1990) The effect of policy reforms on non-agricultural enterprises and employment in developing countries: a review of past experiences. In: Stewart F, Thomas C, De Wilde T (eds) The other policy. IT Publications, London
Harriss B (1977) Paddy milling: problems in policy and the choice of technology. In: Farmer BH (ed) The Green Revolution? Technology and change in rice-growing areas of Tamil Nadu and Sri Lanka. Macmillan, London
Harriss B, Harriss J (1984) 'Generative' or 'parasitic ' urbanism? Some observations from the recent history of a southern Indian market town. J Dev Stud 20:82–101
Hart G (1993) Regional growth linkages in the era of liberalisation: a critique of the new agrarian optimism. Working papers on International Employment Policies, no. 37, International Labour Organisation, Geneva
Harvey D (2005) A brief history of neoliberalism. Oxford University Press, Oxford
Hazell PR, Ramasamy C (eds) (1991) The Green Revolution reconsidered: the impact of high-yielding rice varieties in south India. The Johns Hopkins University Press, Baltimore
Hopper WD (1965) Allocation efficiency in traditional Indian agriculture. J Farm Econ 47 (3):611–624
International Food Policy Research Institute (IFPRI) (2010) Food security, farming, and climate change to 2050: scenarios, results, policy options. International Food Policy Research Institute, Washington, DC
International Fund for Agricultural Development (IFAD) (2010) Rural Poverty Report 2011, new realities, new challenges: new opportunities for tomorrow's generation. International Fund for Agricultural Development, Rome
Ishii-Eiteman M (2009) Food sovereignty and the international assessment of agricultural knowledge, science and technology for development. J Peasant Stud 36:689–700
Jasanoff SS (1987) Contested boundaries in policy-relevant science. Soc Stud Sci 17:195–230
Johnson H (1996) Vulnerability to food insecurity among Honduran maize farmers: challenges for the 1990s. J Int Dev 8:667–682
Johnston BF, Clark WC (1982) Redesigning rural development: a strategic perspective. The Johns Hopkins University Press, Baltimore
Johnston BF, Mellor J (1961) The role of agriculture in economic development. Am Econ Rev 51(4):566–593
Journal of Peasant Studies (2010) Special issue: the politics of biofuels, land and agrarian change. 37(4):575–962 (October)
Kelkar G (2009) Gender and productive assets: implications of national rural employment guarantee for women's agency and productivity. UNIFEM, India. Paper presented at the FAO-IFAD-ILO workshop on gaps, trends and current research in gender dimensions of agricultural and rural employment: differentiated pathways out of poverty. Institute of Development Studies, Rome
Khan AH (1971) Tour of twenty thanas. Bangladesh Academy for Rural Development, Comilla
Khan AH (1973) The Comilla Project: a personal account. Paper presented at the Workshop on Rural Development, Addis-Ababa

Khan AR (1979) The Comilla model and the integrated rural development programme of Bangladesh: an experiment in 'cooperative capitalism. World Dev 1:391–422
Kloppenburg J (2010) Impeding dispossession, enabling repossession: biological open source and the recovery of seed sovereignty. J Peasant Stud 37:367–388
Lang T (2010) Crisis? What crisis? The normality of the current food crisis. J Agrar Change 10:87–97
Lastarria-Cornhiel S (1997) Impact of privatisation on gender and property rights in Africa. World Dev 25:1317–1333
Leaf M (n.d.) Green revolution. www.utdallas.edu/~mjleaf/GreenRevshorter.doc. Accessed 20 June 2011
Lewis D, Hossain A (2008) Understanding the local power structure in rural Bangladesh. www.sida.se. Accessed 6 July 2011
Leys C (1996) The rise and fall of development theory. James Currey, London
Lipton M (1968) The theory of the optimizing peasant. J Dev Stud 4(3):327–351
Lipton M (2009) Land reform in developing countries: property rights and property wrongs. Routledge, New York
McCarthy FE (1977) Bengali village women as mediators of social change. *Human Organization* 36:363–370
McCarthy FE (1978) The status and condition of rural women in Bangladesh. Planning and Development Cell, Ministry of Agriculture and Forests, Dhaka
McCarthy FE (1980) Patterns of employment and income earning among female household labour. Ministry of Agriculture and Forests, Women's Planning Cell, Dacca
McCarthy FE (1981) Patterns of involvement and participation of rural women in post-harvest processing operations. Ministry of Agriculture and Forests, Women's Planning Cell, Dhaka
McCarthy J, Prudham S (2004) Neoliberal nature and the nature of neoliberalism. Geoforum 35:275–283
McElwee P (2007) From the moral economy to the world economy: revisiting Vietnamese peasants in a globalizing era. J Vietnamese Stud 2:57–107
McIntyre BD, Herren HR, Wakhungu J, Watson RT (eds) (2009) International assessment of agricultural knowledge, science and technology for development: synthesis report. Island Press, Washington, DC
Millennium Ecosystem Assessment (MEA) (2005) Ecosystems and human well-being: our human planet: summary for decision makers. Island Press, Washington, DC
Moore D, Dore J, Gyawali D (2010) The world commission on dams + 10: revisiting the large dam controversy. Water Altern 3:3–13
Moser C, Felton A (2010) The gendered nature of asset accumulation in urban contexts longitudinal results from Guayaquil, Ecuador. United Nations University and World Institute for Development Economics Research, Helsinki
Norman DW (1978) Farming systems research to improve the livelihood of small farmers. Am J Agric Econ 60:813–818
Oasa EK (1987) The political economy of international agricultural research: a review of CGIAR's response to criticism of the 'Green Revolution. In: Glaeser B (ed) The Green Revolution revisited. Allen & Unwin, Boston, pp 13–55
OECD (2007) Rural areas and agricultural changes, atlas on regional integration in West Africa, Land series, ECOWAS-SWAC/OECD©2007. http://www.oecd.org/dataoecd/28/43/38903590.pdf. Accessed 22 Apr 2011
Patel R (2009) What does food sovereignty look like? J Peasant Stud 36:663–706
Pearse A (1977) Technology and peasant production: reflections on a global study. Dev Change 8:125–159
Pearse A (1980b) Seeds of plenty, seeds of want: social and economic implications of the Green Revolution. Oxford University Press, Oxford
Pieterse E (1997) South African NGOs and the trials of transition. Dev Pract 7(2):157–166
Poats SV, Schmink M, Spring A (1988) Gender issues in farming systems research and extension, Special studies in agriculture science and policy. Westview Press, Boulder

Pretty JN (1995) Participatory learning for sustainable agriculture. World Dev 23(8):1247–1264
Ranis G, Stewart F (1987) Rural linkages in the Philippines and Taiwan. In: Stewart F (ed) Macro-policies for appropriate technology in developing countries. Westview Press, Boulder
Raper AF (1970) Rural development in action: the comprehensive experiment at Comilla, East Pakistan. Cornell University Press, Ithaca
Razavi S (2009) Engendering the political economy of agrarian change. J Peasant Stud 36:197–226
Reuters (Dhaka) (2011) Uganda keen to lease farmland to Bangladesh, 22 May. http://af.reuters.com/article/investingNews/idAFJOE74L08R20110522. Accessed 10 June 2011
Sainath P (2001) It's the policy stupid, not implementation. India together, March and September. http://www.indiatogether.org/opinions/ps1.htm. Accessed 6 June 2011
Schelzig K (2005) Poverty in the Philippines: income, assets, and access. Report to the Southeast Asia Department, Asian Development Bank (ADB), Manila
Schultz TW (1964) Transforming traditional agriculture. Yale University Press, New Haven
Sen AK (1981) Poverty and famines: an essay in entitlement and deprivation. Oxford University Press, Oxford
Sen AK (1990) Gender and cooperative conflict. In: Tinker I (ed) Persistent inequalities: women and world development. Oxford University Press, New York, pp 123–149
Sivaramakrishnan K (2005) Introduction to 'moral economies, state spaces, and categorical violence'. Am Anthropol 107(3):321–330
Stewart F (ed) (1987) Macro-policies for appropriate technology in developing countries. Westview Press, Boulder
Stewart F, Lall S, Wangwe SM (eds) (1992) Alternative development strategies in Sub-Saharan Africa. Macmillan, London
United States Department of Agriculture (USDA) (2010) Foreign Agricultural Service, Public Law 480, Title I. www.fas.usda.gov/excredits/FoodAid/pl480/pl480.asp. Accessed 8 Nov 2010
Vidal J (1999) The real battle for Seattle. The Observer, Sunday 5 December. http://www.guardian.co.uk/world/1999/dec/05/wto.globalisation. Accessed Jan 2000
Weis T (2010) The accelerating biophysical contradictions of industrial capitalist agriculture. J Agrar Change 10:315–341
White BNF (1980) Rural household studies in anthropological perspective. In: Binswanger HP (ed) Rural household studies in Asia. Singapore University Press, Singapore
White S (1996) Depoliticising development: the uses and abuses of participation. Dev Pract 6(1):6–15
Whitehead A, Tsikata D (2003) Policy discourses on women's land rights in Sub–Saharan Africa: the Implications of the return to the customary. J Agrar Change 3:67–112
Wield D, Chataway J, Bolo M (2010) Issues in the political economy of agricultural biotechnology. J Agrar Change 10:342–366
Windfuhr M, Jonsén J (2005) Food sovereignty: towards democracy in localized food systems. FIAN-International, The Schumacher Centre for Technology and Development. www.itdgpublishing.org.uk. Accessed 26 Apr 2011
Winkelmann D (1976) The adoption of new maize technology in Plan Puebla: Mexico. CIMMYT, Mexico
Woodhouse P (2010) Beyond industrial agriculture? Some questions about farm size, productivity and sustainability. J Agrar Change 10:437–453

# Sustainability Standards and Their Implications for Agroecology

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**Abstract** Agroecology has helped produce a movement where consumers are concerned about more than price. The qualities sought include the process by which a product is grown or produced. When supply-chains are long, it is difficult to know whether to believe any particular production quality claimed on a label. This review describes the evolution of market, government (state) and civil society efforts to devise credible certification schemes that would allow consumers to use their dollars to build healthy ecosystems that are socially just and economically secure for producers and workers. Market groups now control governmentally sanctioned certifiers, such as the International Standards Organization and the ISO 14000 family of standards, regulation and enforcement mechanisms. At the same time, numerous market-led and civil-society led certifying efforts are competing to determine what is ecologically sound and socially just. These mechanisms and their negotiations are discussed and the future of sustainability standards for agroecology assessed.

**Keywords** Sustainability • Standards • Private • Certification • Civil society organizations • ISO • Supply-chains • Market-driven regulation • Agrofuels • Eco-labels • Trade • Governments • Globalization • Governance • Commoditization • Collaborations

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W.B. Campbell and S.L. Ortíz (eds.), *Integrating Agriculture, Conservation and Ecotourism: Societal Influences*, Issues in Agroecology – Present Status and Future Prospectus 2,
DOI 10.1007/978-94-007-4485-1_3, 

## 1 Introduction: Historical Evolution of Sustainability Standards

Agroecology as a science, practice and as a movement come together to transform shared norms and values about sustainability, food security, conservation and biodiversity into standards for the minimum levels of sustainability that will result in rules, regulations and mechanisms to enforce them. Agroecology began as holistic practices that co-evolved through science and practice aimed at increasing sustainability through producer action (Wezel and Jauneau 2011). Standards became important for agroecology when agroecology moved beyond the practice and the science to market attributes for food, fuel and fiber.

Standards apply to all phases of collective life, including education and health. Within a market context, standards are a way to manage supply-chains (Boltanski and Thévenot 2006; Thévenot 2001). Early standards were introduced by national governments to insure that purchasers received what they assumed they had paid for. The United States, for example, passed the Grain Standards Act in 1916 which provided for Federal enforcement of uniform standards (Hill 1990), while English law established stands of weights and measures in 1271. The state enforced these standards in order to make market transactions possible among people who had no way of establishing trust that the seller would deliver and that the buyer would be obligated to pay. Early standards were based on product qualities that could be observed and measured at the points of sale.

Eco- or sustainability standards reinforce what Thévenot (2001) refers to as the civic convention – when one of the product characteristics sought is a civic good – in this case, a sustainable ecosystem. Goodman includes a preference for products that are grown sustainably as part of the "quality turn" (Goodman 2003). Rising incomes have encouraged some consumers to embrace alternatives to "the production methods, techniques and products of mass consumption" (Hatanaka et al. 2005:363). In particular, there is a growing segment of consumers willing to pay more for products, such as Fair Trade coffee or organic bananas, which make them feel as if they are acting in a socially and environmentally responsible manner. Acknowledging this shift, Walmart™ CEO Mike Duke told a meeting of 1,500 suppliers and other partners at company headquarters in July of 2009 that "Customers do want low prices, but not by sacrificing quality… increasingly, they want information about the entire life-cycle of a product so that they can feel good about buying it. They want to know that the materials in the product are safe, that it was made well and that it was produced in a responsible way" (Gage 2009).

In the early stages of civil society-generated standards, sustainability standards supporting agroecology were intertwined with those of Fair Trade, as sustainability was defined socially as well as ecologically. The different political bases of sustainability – environmental and social justice – drew from different consumer groups, but at times found common cause (Barham 2002; Raynolds 2000, 2002). These standards are based on the process of production, not just observable qualities of the product.

Sustainability standards grew from what was important to consumers in the food they ate and the materials they used, particularly timber and timber products; that their production and distribution did not contribute to environmental or social degradation (Goodman and Dupuis 2002). Standards are a consumer-oriented strategy to help the end-users trust the labels on the products. Boström and Klintman (2011) point to lack of trust in producers, firms, and state entities leading to the need for sustainability standards and eco-labels. Science was used to inform the consumer that agroecologically sound practices were used in production, processing and distribution. In turn, purchasing certified sustainable products helped consumers feel that their actions contributed to a more sustainable future.

In developed countries, the nation state has traditionally been looked to as the institution primarily responsible for regulating market and corporate practices to ensure general welfare. Often under pressure from unions and other civil society organizations, the state established and monitored rules for ensuring food safety, worker health, safety and welfare, and environmental protection (Giovannucci and Ponte 2005). However, the growing integration of global markets, especially since the establishment of the World Trade Organization (WTO) in 1995, has constrained the regulatory ability of the state. With the liberalization of international trade rules, major corporations moved to source goods and services from wherever they could maximize their returns and access new products (e.g. tropical fruits), typically by going to developing countries (Fox and Vorley 2006; Blowfield 1999). Firms now source products produced under a diverse, or in many cases nonexistent, set of regulations related to product and worker safety, quality, and sustainability (Hatanaka et al. 2005). Within this context, the nation state simply does not have the power or the resources to fully regulate the enormous array of products and production practices coming from a wide range of countries (Reardon and Berdegue 2002). Nevertheless, it would be erroneous to assume that the state has disappeared. Rather, the state continues to play a central role in providing basic guarantees to consumers, especially in relation to food and product safety (Giovannucci and Ponte 2005).

Over the past decade a plethora of sustainability standards have emerged within the global agrifood system and, more recently, the agrofuel system. Agroecological producers, particularly organic producers, were the first to regulate agricultural products, while pressuring the state to take a role; often a very slow process, with civil society (mainly producer organizations) pushing for state legitimization of their efforts. Boström and Klintman (2006) contrast state-centered versus non-state-driven organic food standardization by comparing the United States and Sweden. They argue that non-state eco-standards have flexibility and enforcement that is difficult for state systems to match.

As Boström and Klintman (2011) point out, politics empowers labeling, but the state is increasingly second to market and civil society forces in setting or enforcing sustainability standards. Nation states have evolved specific organic standards such as the National Organic Standards Act in the United States passed in 1990, but fully implemented in 2002, New Zealand's National Organic Standard (2003), and Canada's Federal 2007 regulation of organic food and feed. Governments accredit certifiers in the European Union using the International

Standards Organization (ISO) Guide 65. Yet, as more and more trade becomes international, national standards have lost their enforceability and thus their utility.

The shift to market-driven regulation has created a fundamental paradox of globalization. On the one hand, major corporations, especially retailers, have become increasingly powerful and have assumed greater market dominance. At the same time, many of these corporations are confronted with a growing assortment of stakeholder concerns about how their products are produced, their social and environmental impacts, and the overall sustainability of the system. These concerns include, for example, the use of pesticides, genetically modified organisms (GMOs), child labor, food miles (how far food travels from where it is grown to where it is processed to where it is purchased), and the sustainability of fish stocks or indigenous forests (Barrientos and Dolan 2006). In relation to agrofuels, civil society organizations (CSOs) are questioning the impact of biomass production on land use changes, greenhouse gas emissions, environmental resources such as water, and food prices (Mol 2010). In addition, with hunger and food insecurity rising, some have questioned the morality of shifting land, especially in developing countries, from food production to fuel production for consumers in the global North (McMichael 2009).

The ISO, the largest standards organization in the world, is a non-governmental organization and an example of nation states delegating standard-setting and enforcement to the private sector. It describes itself as forming a bridge between the public and private sectors. Many of its member institutes are part of the governmental structure of their countries or are mandated by their government to enforce the standards. However, some of the member institutes have their roots in the private sector, having been set up by national partnerships of industry associations. As with many standard-setting organizations, the resulting standards are negotiated between industrial firms and, as they put it, "the broader needs of society" (Fulponi 2006; ISO 2011).

In 1996, the ISO began putting into place the 14000 "family" of generic standards related to eco-labels, which addresses various aspects of environmental management. ISO 14020:2000 identifies nine principles for "environmental labels and declarations" that stress they be science-based, verifiable, open, and derived by a consultative process (ISO 2000). ISO 14001:2004 provides the requirement for an Environmental Management System (EMS) and ISO 14004 deals with environmental management. By 2011, 159 nations deferred to the ISOs 14000 series for official eco-labeling. This has done little, however, to stem the emergence of private eco-labels (Galan et al. 2007; Wall et al. 2001).

In the United States, the Consumers Union (a CSO rather than a government entity) has been monitoring eco-labels since 2005. They use five key elements to verify label claims and certify groups:

- **Meaningful, verifiable standards**: Eco-labels should have a set of environmentally meaningful standards. These standards should be verifiable by the certifying group or other independent inspection organization.
- **Consistency**: An eco-label used on one product should have the same meaning if used on other products. Standards should be verifiable in a consistent manner for different products.

- **Transparency**: The organization behind an eco-label should make information about organizational structure, funding, board of directors, and certification standards available to the public.
- **Independence**: Certifying organizations and their employees should not have any ties to, and should not receive any funding, sales fees, or contributions, from logo users except fees for certification. Employees of companies whose products are certified, or who are applying for certification, should not be affiliated in any way with the certifier.
- **Public comment**: All certification standards should be developed with input from multiple stakeholders including consumers, industry, environmentalists and social representatives in a way that does not compromise the independence of the certifier. Industry representatives, for example, can play an important advisory role without having direct financial, decision-making or management ties to the certifier (Consumers Union 2011).

The science of agroecology is an important piece of this social movement action to ensure that standards are actually met.

As indicated by the role of the Consumers Union, the private sector, especially major buyers and retailers, together with CSOs have emerged as key drivers in developing sustainability standards. The minimal presence of the public sector in setting sustainability standards reveals that the traditional boundaries between the market, state, and civil society concerning the regulation of markets and value-chains are increasingly blurred.

Under growing pressure, companies have sought to reassure their stakeholders that they are acting in a responsible manner by initiating or supporting CSO initiatives to establish sustainability standards. Such standards are purportedly designed to ensure that their corporate practices are socially and ethically responsible, ensure the economic viability of small-scale farmers, and that they conserve the environment (Giovannucci and Ponte 2005). Such changes have important implications for vulnerable populations, particularly indigenous peoples. Like small-holders, it is difficult to gather together the resources necessary to certify small lots and certification of cultural integrity is often not amenable to conventional measurement (Silva Castañeda 2012). Thus, the ISO standards *de facto* limits sustainability markets to producers that in fact are sustainable but are already economically excluded.

## *1.1 What Are Sustainability Standards, Eco-Labels, and Certification?*

Standards represent agreements about assessable criteria relating to a product's technical and physical characteristics and/or the process and conditions under which it was produced or delivered (Nadvi and Wältring 2004). Sustainability standards are groups of criteria and indicators which describe the requirements that must be fulfilled by a product or production process (Daviron and Vagneron

2011; Lewandowski and Faaij 2006). The setting of standards is the most common example of private rule-making. Although these rules are voluntary in nature, they necessitate some degree of compliance to be considered private regulations (Schouten and Glasbergen 2011; Pattberg 2005).

Traditional standards defined the character of a product based on a set of physical attributes such as weight, color, or size. Sustainability standards go beyond these basic physical attributes of the product to include detailed criteria regarding social and environmental aspects of the production process (Daviron and Vagneron 2011). Such quality-based sustainability standards result in products with eco-labels like 'Fair Trade Coffee', 'Ethical Tea', 'Sustainably Certified Forests', 'Sustainable Palm Oil', 'Eco-Friendly Pineapples', 'Responsible Soy' or 'Better Bananas'.

Campaigns by CSOs, together with changing expectations among some consumers regarding the quality and sustainability of products, have been instrumental in driving sustainability standards. Standards are agreed criteria for assessing the performance (characteristics of the final product) or process (production of the raw product into a finished good) in which an agrifood or bioenergy product was produced in relation to its environmental, social, or other values (Reardon et al. 2001; Scarlat and Dallemand 2011). Today we find that a significant number of firms and CSOs have instigated a dizzying array of initiatives to implement, measure, monitor and publicize sustainability efforts, including standards, codes of conduct, certification, and labeling schemes (van Dam et al. 2008).

Eco-labels are a form of sustainability measurement directed at consumers and buyers with the intention of communicating information regarding the nature of social, environmental, or economic sustainability involved in the production process and/or the product. Eco-labeling is seen as one possible means of informing consumer decisions so as to bring about necessary changes in consumption and production patterns, thus facilitating the transition toward a more sustainable society (Bratt et al. 2011).

Eco-labeling can be utilized for various purposes. The ISO is a network comprised of representatives from various national standards organizations. As an international standard-setting body, the ISO seeks to establish and disseminate worldwide proprietary industrial and commercial standards. The ISO delineates between three broad types of environmental labeling: Type 1 includes multi-criteria, third-party programs aimed at informing the consumers; Type 2 includes self-declared environmental claims; and Type 3 provides quantified environmental data on environmental product declarations primarily used for business-to-business communication (Bratt et al. 2011).

Sustainability standards must have proficient enforcement mechanisms if they are to gain legitimacy. The proliferation of private sustainability standards has therefore led to an increase in the use of third party certification. Certification is "the process whereby an independent third-party (called a certifier or certification body) assesses the quality of … management in relation to a set of predetermined requirements (the standard). The certifier gives written assurance that a product or process conforms to the requirements specified in the standard" (Rametsteiner and Simula 2003:88). Independent third-party certification is usually considered

more objective and effective than first-party (supplier) and second-party (buyer) certification. Since the cost of third-party certification generally falls on the actors seeking certification, the state, retailers, and NGOs see third-party private certification as an indirect and cost-effective means of regulation (Hatanaka and Busch 2008).

Many activist CSOs argued that international trade liberalization encouraged a "race to the bottom." Here, the logic of capitalist competition and profit serves to benefit those companies that can source goods and services from wherever they can maximize their returns by externalizing their social and environmental costs (Rupert 2005; Fox and Vorley 2006; Blowfield 1999). Moreover, the ability of the nation state to regulate business practices was limited while the growing dominance of international institutions, such as the WTO, favored economic rather than social or environmental objectives (Little 2003; Robinson 2002).

Within this context, the response of many CSOs was to shift their attention away from trying to change the policies and practices of the nation state, seeking instead to advance their broader social and environmental objectives through engagement with the corporate sector. A major strategy is to publicly shame and stigmatize corporations into changing their behavior by publicizing cases of malpractice within their supply-chains regarding human rights or the environment (Klein 2009; Gereffi et al. 2001). Working on the idea that "high-profile brand-name corporations can run but they cannot hide" (Utting 2005:380), these campaigns target highly visible, reputation-sensitive, corporate brands at the retail end of the supply-chain – those with direct links to consumers (O'Rourke 2005). In publicizing the adverse effects of global production systems, CSOs hope to pressure firms to embrace the notion of corporate social responsibility, which assumes that companies are responsible for their impacts on society and the environment, as well as the behavior of others within their supply-chains.

Ironically, strategies designed to give firms more power in the marketplace, greater capacity to govern their global supply-chains, and to enhance their status as credible and trustworthy in the public eye have at the same time made them more vulnerable to CSO campaigns. For example, activists are able to take advantage of the shift by buyers, such as Walmart™, towards global supply-chains that are more tightly controlled. Activists have found that in tightly integrated supply-chains it is easier to link the abusive practices of buyers with their consequences for workers, producers and the environment at the production end, versus open markets where "[f]ragmented supply chains conceal the social relations and exploitative practices of production" (Barrientos and Dolan 2006:5).

The risk to the corporation is that these campaigns will damage their reputation and undermine consumer trust in their brand. Bad publicity could affect the shopping habits of consumers, potentially leading some consumers to shift allegiances to another store (Freidberg 2004), thereby affecting market share and share prices (Barrientos and Dolan 2006). Many corporations – from McDonalds™, to Walmart™ to Shell Oil™ – have discovered that they are not immune to embarrassing exposés and that their bottom line can be directly affected, especially when their valuable brand names and corporate reputations are linked to objectionable environmental and social practices.

## *1.2 Historical Progression/Emergence of Sustainability Standards*

Private governance arrangements, including sustainability standards, have grown rapidly in many global value-chains over the past three decades (Schouten and Glasbergen 2011; Hatanaka and Busch 2008). The global economy is increasingly permeated with standards developed, monitored, and enforced by private sector coalitions of NGOs and companies rather than the state. Comparable to state governance, however, the rules and regulations of private governance still seek to bring organization and regulation to the spontaneous, uncoordinated actions and interactions of the market. The partnership between various private institutions, including non-profit organizations, transnational corporations (TNCs), and global governance organizations, is not a completely new phenomenon. New, however, is the bypassing of state authority through the creation of new institutions and organizations of governance to regulate market products and processes (Pattberg 2005).

The recent emergence of the widespread use of sustainability standards signals a shift away from the arrangements wherein nation states were deemed solely responsible for the regulation of food and agriculture within their own borders. For example, governmental agencies like the Food and Drug Administration, Department of Agriculture, and Environmental Protection Agency develop and enforce standards to ensure safe products and production processes. The capacity of the state to regulate, however, has been increasingly challenged by political and socio-economic changes to the food and agricultural system led by the WTO, which examines national standards to make sure that they in no way interfere with the international flow of goods and services. For example, the policy tools used by Latin America from the 1930s through the 1970s of import substitution are now illegal under WTO. The WTO privileges the free flow of goods and services above other ends, such as environmental sustainability or working conditions, penalizing countries which on their own enact such standards. These new rules of the global economy make it more difficult for developing nations to make and enforce policies that favor their own environmental sustainability or income equality within their borders. (See the section on sustainability standards and biofuels below.)

Globalization indicates an extension and expansion of value-chains, resulting in transnational movements of food and agriculture products between locations of production, processing, and consumption. When products cross in and out of the state's jurisdictional boundaries, the state-based regulation becomes more challenging. Neoliberalism's growth as the prevailing ideological paradigm has led to constraints and reductions in state budgets, responsibilities, and regulatory authority. Product differentiation, especially in regards to quality attributes of the product and production process, has stretched governmental ability to keep pace with rapidly multiplying complexities in creating and enforcing standards. Furthermore, government agencies have felt the pressure to 'ratchet-up' regulatory requirements in response to consumer concerns about food safety and quality and scientific developments regarding the risks associated with food (Henson and Reardon 2005). Some scholars view these

drivers as signaling a shift from "government to governance" in regulating the food and agricultural system and its products (Hatanaka and Busch 2008). Novel forms of governance from the private sector have emerged to meet these challenges, thus influencing not only the targeted transnational corporations, but many smaller entities throughout the global commodity-chain (Pattberg 2005). Since agroecological practices are often adopted by small-holders to reduce risk, the introduction of sustainability standards aimed at industrial monocultures could eliminate small-holders from many markets.

Governance has not, however, always been a privilege of states alone. The active involvement of private entities in global governance was common in the nineteenth century, when such actors assisted greatly in ordering transnational economic relations (Falkner 2003). The state's regulatory role grew in the twentieth century, replacing notions of private governance with an increasing association of governance with public authorities. With the restructuring of the state's functions in an economically globalized world, the trend from private governance to public governments now appears to be reversing in the late twentieth and early twenty-first centuries (Falkner 2003).

As commodity-chains grew increasingly globalized and state-based regulation became more challenging, state actors made attempts at an international level to create binding conventions. For example, growing concerns about the forestry sector led to international collaboration to create some form of transnational regulation. The international efforts toward a binding global forest convention, however, terminated in an institutionalized stalemate. The failure of these attempts became the impetus for private actors to forge new partnerships and agreements regarding sustainability standards to address public concerns over deforestation in the tropics, loss of biodiversity, and the perceived low quality of forest management in developing nations from which timber products were sourced (Gulbrandsen 2004; Rametsteiner and Simula 2003). As a spin-off from these international discussions, the private Forest Sustainability Council (FSC) was successfully established in 1993. A decade later, the FSC had certified more than 53 million hectares of forest in 78 countries. In addition the FSC has become a model for private rule-making and implementation in many other sectors of commodity production (Pattberg 2005).

Until the late 1800s, direct physical contact and personalized criteria and requirements constituted the buyer's means of determining the value of agricultural products. The physical senses of touch, sight, sound, smell, and taste were used to evaluate. Non-local products were also identified by their geographical origin. Grades and standards for agricultural products emerged in the second half of the nineteenth century approximately simultaneous with the birth of futures markets in relation to the trade of agricultural commodities like grain, cotton, coffee, rubber, and cocoa (Daviron and Vagneron 2011). Criteria used in standards to characterize products were extremely generic, including cleanliness, the absence of damage due to disease or insects, and size (Daviron and Vagneron 2011). By focusing on physical attributes of the product, these grades and standards deliberately ignored or even hid information regarding the characteristics of both farm-level production processes

(such as child labor, pesticide usage, soil impacts, etc.) and local marketing conditions (price, credit, intermediaries) (Daviron and Vagneron 2011).

Following the establishment of grades and standards, internationally traded commodities were identified specifically by their national origin and grade according to a national standard. This was typically the extent of the information given regarding the producer, the production process, and the product. In the absence of common international standards, market traders established a system of equivalencies between national origins and central market prices. Domestic standards were further developed to organize farm-level transactions and define the quality of the commodity crop before physical transformation, sorting, and/or cleaning (Daviron and Vagneron 2011). These generic standards minimized interest in process criteria and local particularities, diminished the demand for variety in a mass-production economy, and introduced greater degrees of invisibility between producers and consumers. According to the efficiency conventions of the industrial sector, agriculture moved increasingly toward standardization, interchangeability, and compatibility between crops produced in diverse locations, a shift facilitated by the development of standards and criteria that were primarily regulated by state-based, national regulatory agencies.

Alternatives to the mainstream agrifood system arose in the 1960s with the emergence of new agricultural chains based on quality, place, and nature, as represented in organic agriculture and Fair Trade movements. These movements precipitated differentiation in agricultural products through specific alternative retailers and market-chains, and eventually, through more mainstream market channels. In their early stages, these movements depended on collective values and informal norms rather than standardized criteria. Rather than turning to technical criteria, social values like trust and transparency were organized through specific channels, such as peasant markets, specific local brands, contract farming, local producer-consumer associations, and specialized health stores selling own-branded products (Daviron and Vagneron 2011).

Alternative Trading Organizations (ATOs) based in developed nations began to facilitate global "Fair Trade" by directly purchasing from producer organizations in developing countries and selling those goods directly to consumers through specialized retail shops. Fair Trade was defined not by a common external standard, but by self-regulated trading practices between organizations and their partners. Consumers depended on self-declaration and reputation, rather than certification, and the personalized relationships between producers, shops, and consumers (Daviron and Vagneron 2011).

The organic food movement remained distinct from the mainstream food and agricultural system until the early 1990s. Widely publicized outbreaks of Bovine Spongiform Encephalopathy (BSE), *Escherichia coli* (or *E. coli*), salmonella, and dioxin-contaminated chicken raised food safety concerns among consumers, increasing their demand for organic products. The creation of state-created organic standards, labels and certification practices in Europe (1991), Japan (1991) and the United States (2002) provided occasion for the commercializing and mainstreaming of organic products to an increasingly wider spectrum of supermarkets and restaurants.

While celebrated as a success by some critics of industrial agriculture, two major changes occurred. First, the very definition of "organic" moved from a holistic concept to an input-oriented regimen denoting the absence of synthetic fertilizers and pesticides. Second, this conceptual transformation enabled the elaboration of precise and largely universal technical specifications in the form of standards, and introduced the mandatory use of third-party certification (Daviron and Vagneron 2011).

Concerning Fair Trade, new labeling initiatives in the 1980s began to challenge the vertically-integrated models heralded by the ATOs. The second generation of Fair Trade initiatives differed in two major ways. First, Fair Trade organizations expanded beyond buying goods from developing countries. They focused rather on setting standards regarding the conditions of trade and certifying that the standards had been respected by the various actors in the value-chain. Second, Fair Trade-labeled products began to move through conventional marketing channels, which significantly expanded the market for these products (Daviron and Vagneron 2011). These changes, however, endangered the original values and principles of the movement, as certification created conditions for greater competition between actors. For example, large-scale producers were more likely to be advantaged over small and marginalized producer-groups because of their ability to pay high certification costs and deliver large and consistent volumes of products at a constant quality. Certification benefited large corporate downstream firms by allowing them to control and switch between certified, substitutable suppliers. Suppliers who were unable to conform to the wishes of the buyer were ultimately excluded from the chain (Daviron and Vagneron 2011).

Private sustainability standards began to proliferate in markets for raw materials in the 1990s. In this case it was the corporate firms themselves, not necessarily CSOs, which led the way in developing company codes, supplier guidelines, and sustainable business principles. Transnational corporations also utilized well-known NGOs and their standards and certification processes to build a reputation for social and environmental responsibility. NGOs began to compete to create standards and certification mechanisms that were more appealing to industries. For example, alternatives to Fair Trade were developed by the Rainforest Alliance, Utz Kapeh, and Conservation International. Transnational corporations viewed these NGO-based standards and certification mechanisms as a means to deflect and reduce growing pressure from activists and gain greater acceptability among concerned consumers (Daviron and Vagneron 2011).

The mid-1990s, and especially the 2000s, witnessed the emergence of sustainability standards defined by multi-stakeholder initiatives. Unlike previous standard-setting and certification bodies, these initiatives represented the collaboration of groups with sometimes conflicting interests, for example TNCs, banks, retailers, traders, processors, international organizations, and NGOs representing various environmental and social concerns. Concurrent with the trend toward the proliferation of multi-stakeholder sustainability standards was the evolution from multi-sectoral to crop-specific standards. For example, multi-stakeholder initiatives like the Forest Stewardship Council (1993) and the Marine Stewardship Council (1997) have been followed by crop-specific collaboration to create standards for soy, palm oil, cotton,

**Table 1** Chronology of sustainability initiatives by type

| Year | Multi-sectoral initiatives | Crop specific initiatives |
|---|---|---|
| 1972 | IFOAM | |
| 1992 | Rainforest Alliance | |
| 1993 | | Forest Stewardship Council |
| 1997 | Fairtrade Labeling Organization | Marine Stewardship Council |
| | EurepGap | Ethical Tea Partnership |
| | Social Accountability International | |
| 1998 | Ethical Trade Initiative | Flower Label Program |
| 1999 | | Programme for the Endorsement of Forest Certification |
| 2000 | Global Food Safety Initiative | |
| 2001 | | Eliminating Child Labor in Tobacco-Growing |
| 2002 | | |
| 2004 | | Roundtable on Sustainable Palm Oil |
| | | Common Code for the Coffee Community (4C) |
| 2005 | | Better Cotton Initiative |
| | | Better Sugar Cane Initiative |
| 2006 | | Roundtable on Responsible Soy |
| 2007 | | Roundtable on Sustainable Biofuels |
| | | Roundtable on the Sustainable Cocoa Economy |
| 2009 | | Aquaculture Stewardship Council |

Modified from Daviron and Vagneron (2011)

sugarcane, coffee, tobacco, and more (Daviron and Vagneron 2011). Table 1 illustrates this movement from multi-sector to crop-specific initiatives.

IFOAM (http://www.ifoam.org/about_ifoam/inside_ifoam/history.html)

Rainforest Alliance (http://www.rainforest-alliance.org/about/history)

Fairtrade Labeling Organization (http://www.fairtrade.net/history_of_fairtrade.html)

Eurepgap (http://www2.globalgap.org/about.html)

Social Accountability International (http://www.sa-intl.org/index.cfm?fuseaction=Page.viewPage&pageId=938&grandparentID=472&parentID=490)

Ethical Trade Initiative (http://www.ethicaltrade.org/about-eti/funding)

Global Food Safety Initiative (http://www.mygfsi.com/about-gfsi/background.html)

Forest Stewardship Council (http://www.fsc.org/history.html)

Marine Stewardship Council (http://www.igd.com/index.asp?id=1&fid=1&sid=5&tid=155&foid=77&cid=800)

Ethical Tea Partnership (http://www.ethicalteapartnership.org/about/)

Flower Label Program (http://www.ecolabelindex.com/ecolabel/flower-label-program-flp)

Pan-European Forest Certification Council (later changed to Programme for the Endorsement of Forest Certification) (http://www.pefc.org/about-pefc/who-we-are/history)

Eliminating Child Labor in Tobacco-Growing (http://www.eclt.org/about-us/history)

Roundtable on Sustainable Palm Oil: (http://www.rspo.org/page/10)
Common Code for the Coffee Community (http://www.4c-coffeeassociation.org/index.php?id=18&PHPSESSID=oqdpir7e3kg618fqdttphk9aj0)
Responsible Soy Roundtable (http://www.responsiblesoy.org/index.php?option=com_content&view=article&id=259&Itemid=177&lang=en)
Better Sugarcane Initiative (http://www.bonsucro.com/about.html)
Better Cotton Initiative (http://www.bettercotton.org/index/120/history.html)
Roundtable on Sustainable Biofuels (http://www.biofuels.nsw.gov.au/__data/assets/pdf_file/0003/105429/RSB_Principles_and_Criteria_v0.pdf)
Roundtable on the Sustainable Cocoa Economy (http://www.roundtablecocoa.org/showpage.asp?accra_meeting)
Aquaculture Stewardship Council (http://www.ascworldwide.org/index.cfm?act=tekst.item&iid=2&lng=1)
RIO (http://www.uncsd2012.org/rio20/index.php?menu=22)
Johannesburg (http://www.uncsd2012.org/rio20/index.php?menu=22)

Transnational corporations (TNCs) currently use NGO-based and multi-stakeholder-based initiatives as their two primary sources of sustainability standards. Developing, implementing, and monitoring their own proprietary standards tends to be too costly for TNCs and lacks the credibility of third-party standards and certification. TNCs adopt NGO-based sustainability standards because of their legitimacy and the opportunity to "buy themselves an image of cleanliness and access to niche markets with considerable margins" (Daviron and Vagneron 2011). TNCs choose to enter into highly-contested multi-stakeholder standard-setting initiatives not only for the enhanced legitimacy that comes through consensus from various actors, but also to strategically position themselves for greater market access (Daviron and Vagneron 2011).

## *1.3 Sustainability Standards and Commoditization: A Historical Analysis*

Daviron and Vagneron (2011) trace the historical progression of standards and their intersection with commoditization, claiming that the recent trend toward sustainability standards proliferation signals a return to commoditization. This view contrasts with the work of Kaplinsky (2006) who claims that sustainability standards promote de-commoditization through the formation of new barriers to market entry. Daviron and Vagneron (2011:93) claim that standards are used to "differentiate products at the consumer level and to avoid blame while ensuring a regular supply of sustainable products provided by anonymous certified producers", therefore representing a new phase in the commoditization process of agricultural products. The early Fair Trade and organic agricultural movements criticized the commodity status of products and sought to manifest greater transparency and less anonymity between consumers and producers, thus limiting producer substitutability. However, the mainstreaming, systematizing, and harmonizing of sustainability standards and

the increasing role played by third-party certification signals increasingly minimized relationships between buyers and suppliers, signaling to some scholars an end to a trend toward de-commoditization and a return to commoditization of agricultural products (McEvoy 2003; Daviron and Vagneron 2011). "With sustainability standards, what is at stake is the emergence for each product of one global hegemonic standard incorporating sustainability issues and being used by all actors of the value chain" (Daviron and Vagneron 2011:107).

## *1.4 Drivers of Sustainability Standards*

The proliferation of private sustainability standards can be traced to several key drivers. Activist CSOs, especially those hoping to develop alternative food networks, have played an important role in the development and use of sustainability standards. Compared to the state's standards that are based on the physical attributes of the product, private standards are more suitable tools to indicate the quality of products, a value important to CSOs interested in the social and environmental impact of production processes. Public standards were seen primarily as 'neutral market lubricants' intended to boost market efficiency by minimizing transaction costs (Clayton and Preston 2003; Hill 1990). Private standards, on the other hand, represent the diverse goals of various stakeholders (Hatanaka and Busch 2008), providing CSOs a public arena into which they can assert their values and interests. Examples of these standards in which CSO agendas are embedded include labor standards to prevent sweatshop and child labor, including in the production of tobacco and cacao, environmental standards to reduce pollution and deforestation, and standards for social justice and equitable compensation of small-scale producers and indigenous communities. Some scholars have declared this proliferation of sustainability standards to be the rise of a new "NGO-Industrial Complex" (Bartley 2010).

CSOs and other private institutions have changed their approach to more strategically position themselves to influence transnational governance. No longer are they primarily concerned with indirect influence through affecting the domestic and international policy-making and enforcing structures. Instead they are increasingly agreeing upon, implementing, and monitoring different forms of self-regulation, including the creation of sustainability standards. Therefore, CSOs and other private institutions have moved from working within the national and international political system to establishing rules that exist primarily outside of it. Their public authority, therefore, derives chiefly from their ability to persuade, not to coerce. The market provides the context in which authority is, at least partially, allocated by the consumer, producer, trader, and retailer who legitimize a certain rule-making system (Schouten and Glasbergen 2011; Pattberg 2004).

Private sustainability standards have evolved as a means for gaining position and competitive advantage in high-value agricultural and food markets (Henson and Reardon 2005). Consumer demand has reoriented agriculture and food markets to

some degree from price-based conventions to quality-based conventions. Agricultural and food products are increasingly recognized as representing a host of quality attributes which may or may not be visible or knowable at the point of purchase or consumption (Henson and Reardon 2005). Concomitant with consumers' quality-based concerns is increased concern with food safety. From a food supplier standpoint, failure to provide and assure food safety could tarnish the food supplier's reputation and thus reduce sales. Sustainability standards are viewed as an opportunity to address these concerns and reassure consumers of the product's safety. Private standards can fill the gap of missing or insufficient public standards regarding food safety (Henson and Reardon 2005).

In general, private standards provide several key incentives for food suppliers. First, compliance with sustainability standards meets consumer demand for product differentiation on the basis of quality. Second, sustainability standards, and the premium prices they generate, create opportunities to reward suppliers for their investment in quality and safety management systems. Third, private standards help increase profits through "facilitating product differentiation, and thus provide incentives to suppliers to make asset-specific investments and drive consumers to satisfy their desire for product diversity through food purchases at major supermarket or food service chains or by buying the brands of major processors" (Henson and Reardon 2005:246). Fourth, supermarket and restaurant chains and major food processors use private standards to reduce costs and risks in their supply-chains. Fifth, private standards bring standards convergence to regional and global food chains; cutting costs through the standardization over multiple countries and suppliers to the level of standards in the toughest market they serve (Henson and Reardon 2005).

The concept of sustainability in agriculture has gained momentum over the past several decades, causing sustainability standards to obtain greater recognition and a fast-growing market value. Economic viability, environmental health, and social responsibility are three core tenants of agricultural sustainability (Giovannucci and Ponte 2005). The rise of global media and information-communication technologies has facilitated increased awareness of the socio-economic plight of developing world farmers, increased publicity and interest in the health and safety of food, and increased scientific recognition of the threat of agricultural expansion and industrial agriculture to biodiversity, especially in developing nations. Existing and emerging sustainability standards attempt to address some or all of these specific challenges.

Public controversy and legitimacy crises, as communicated through global media, have opened the window for the growth of sustainability standards. Dramatic instances of exploitation within a certain sector have catalyzed public pressure for regulatory change through transnational activism. Sustainability standards provide opportunities for firms or whole economic sectors to address legitimacy crises by improving their reputation and differentiating themselves from other sectoral actors (Bartley 2010). Examples include how the "blood diamond" frame created a legitimacy crisis for the diamond industry, leading to support for the Kimberley Process certification system; the "coffee crisis" of the 1990s which highlighted ecological damages and spurred the growth of various sustainability certification initiatives; anti-sweatshop activism that created a legitimacy gap between societal

expectations and the current practices of firms, leading to labor standards; and timber companies seeking to differentiate themselves from a crowd of unethical competition and compete against the supply of cheap illegal wood (Bartley 2010). Many firms "ultimately view certification as critical for their public images, or to avoid scrutiny and criticism" (Espach 2009:77, as quoted in Bartley 2010:5).

The export dependence of industries and their position in supply-chains has also created increased incentive for compliance with sustainability standards. Where export-orientation constitutes a large portion of a certain sector within a developing country, private regulatory initiatives become increasingly important in order to integrate and enter into global trade with developed nations. Furthermore, the degree of export dependence will likely determine whether private regulatory standards are implemented, as standards become a mechanism by which the impact of international controversy on market demand can be abated. Within these developing countries, however, sectors oriented toward domestic consumption have been relatively unaffected by private regulatory initiatives (Bartley 2010).

From the perspective of CSOs, the adoption of sustainability standards is a tool that can help promote social and environmental protection in an era of global free trade (Gereffi et al. 2001). In contrast to standards set by the nation-state, private-sector standards operate within markets and within value-chains. An important value, therefore, is that they are transnational in scope and applicability, transcending various national regulatory frameworks. Furthermore, many of these standards are more stringent and comprehensive than standards set by governments and international standard-setting organizations. From the corporate perspective, many firms now recognize that an important segment of their customers and stakeholders – investors, the state, and CSOs – expect them to incorporate norms and values for social and environmental responsibility into their business practices. Sustainability standards then have become good business practice, and through such standards firms hope to silence the activists, protect their valuable brand-names, minimize risk, improve their traceability systems, and quell calls for tighter government legislation (Barrientos and Dolan 2006; Fox and Vorley 2006).

In contrast to public standards, both CSOs and firms can use private sector standards strategically. Since standards encapsulate formal and informal rules and codes of conduct regarding practices and processes from production to consumption, actors can use them to achieve a broad range of objectives. Such objectives can include, for example, creating alternative agrifood networks, such as Fair Trade, governing global value-chains, providing quality and safety assurance to consumers regarding a product's attributes, and creating niche markets (Bain et al. 2010).

As a result, the range of sustainability standards, their goals and objectives, and the stakeholders involved, are rich and varied. Sustainability standards initiatives include individual company schemes (e.g. Walmart™), independent CSO initiatives (e.g. Fair Trade, the International Federation of Organic Agriculture Movements [IFOAM], Marine Stewardship Council, Rainforest Alliance) and sector-based initiatives (e.g. GlobalGAP, Kenya Flower Council). Moreover, since CSOs are now considered influential stakeholders, capable of swaying the views of consumers and shareholders, many corporations want to be seen as collaborating

with them (Freidberg 2004). This has resulted in a number of multi-stakeholder collaborations to develop sustainability standards (e.g. Ethical Trading Initiative, Roundtable on Sustainable Biofuels, Roundtable on Sustainable Palm Oil, Social Accountability 8000).

## *1.5 The Relationship Between State, Civil Society, and Private Actors in Sustainability Standards*

Considerable attention comes from scholars seeking to examine changes in the power, responsibility, and function of the state in relation to private and multi-stakeholder standard-setting and certification. The proliferation of private standards and certification is often perceived to be precipitated by a lack of governmental and intergovernmental power and capacity (Glasbergen 2011; Overdevest 2009; Falkner 2003). For example, as noted earlier, attempts at an intergovernmental state agreement to regulate forest products and eco-labeling resulted in a deadlock. Non-state forest standard and certification schemes, however, emerged to become a powerful market-driven governance system (Gulbrandsen 2004). Pattberg (2004) suggests that the concepts of "private organizations" and "private sector international regimes" both denote responses to a perceived state failure, the former being the failure of the state to provide stable environments for social and commercial transactions, and the latter being state failure to provide an overarching global political regime.

Falkner (2003) outlines three main claims regarding the relationships between private governance and state governance models. First is the relationship between globalization and the perceived decline of the nation-state, wherein increased private governance is viewed as part and parcel of a long-term neoliberal shift away from state authority to private actors and market mechanisms within the global economy as the means for encouraging more sustainable development trajectories. Private actors apparently "emerge as the new sovereigns" (Falkner 2003:74), signaling the retreat of the state and the legitimizing and sustainment of the neoliberal agenda (Glasbergen 2011). A second claim couples private governance with the growth of global civil society and their ability to exert pressure on TNCs and thereby shape and influence numerous public issues. Governance is dispersed from its singular position in the state to multi-level sites of governance emerging out of interactions with the larger system that includes the global economy and civil society. Critical political economy informs the third claim regarding private governance, asserting that capitalist forces are building alliances with numerous state and civil society actors in order to "realign the ideological and material bases of the dominant hegemonic order" (Falkner 2003:75).

Discussions regarding the relationship between public and private governance are complicated by imprecise and oversimplified dichotomies. Falkner (2003) points to a blurring between public and private spheres of governance, leading to the emergence of "hybrid private-public governance". In these relationships, states can play a role partnering with private actors to develop standards and regulations,

or might choose later involvement by adopting private standards and codifying them in law.

Rather than undermining or supplanting the regulatory authority of the state, some scholars claim that state regulation and private/multi-stakeholder standards and certification are mutually reinforcing. States may not be the driving force behind the creation and enforcement of new standards, but can lend strength to such initiatives through official recognition or incorporation of these standards into state or international law (Falkner 2003). On the other hand, many private governance regimes are beneficial to states in removing the burden of standard implementation and enforcement and placing it into the hands of the private sector. Where no public demand for state-based regulation exists, states may find it expedient to allow for self-regulation, saving states from the complicated task of negotiating international standards and the further cost of implementation and enforcement (Falkner 2003). Sustainability standards are seen by some as supplementing, rather than providing alternatives to state authority by filling important gaps (Gulbrandsen 2004). Others have been more cautious, claiming that private regulations not only sustain and complement governmental regulations, but sometimes oppose, compete, and challenge them (Glasbergen 2011). Nevertheless, most private regulations are based to some degree on state-held norms and values, and only differ from state regulation in their operationalization and capacity for implementation. Contrary to the notion that private sector governance is contributing to the decline of the state, states may actually benefit from the proliferation of private governance mechanisms (Falkner 2003).

New arrangements are challenging the conventional notion that effective governance must remain firmly embedded in a state-centric authority that establishes and implements international regimes (Falkner 2003). Gaps do exist in many fields between state authority and state capacity (Glasbergen 2011). Rather than diminishing the role of the state, some would claim a current transition is occurring, leading to potentially new arrangements where states should exercise "meta-governance", which is loosely articulated as "the organization of self-organization" or the "regulation of self-regulation" and thereby strengthen governance systems as a whole (Glasbergen 2011; Hatanaka and Busch 2008). Governance is increasingly a joint activity between the state and multiple stakeholders from civil society and private business. The state is not necessarily retreating from the realm of regulation, but withdrawing from direct oversight and monitoring to play a more indirect role in regulating the food and agricultural systems (Hatanaka and Busch 2008).

## *1.6 How Do National Contexts Shape the Application of Sustainability Standards?*

Thus far, in addressing sustainability standards as mechanisms for governance of global value-chains, we have neglected to examine the way in which national context shapes the formation, application, and monitoring of standards. Sustainability standards span

multiple and diverse geographic, political, economic, ecological, and socio-cultural regions. Standards have a number of differences, including historical roots, regional origin, targeted users, level of stringency, and rate of adoption in producing and consuming countries. Initiatives to create worldwide private governance through sustainability standards have not led to any single standards solution. Instead multiple standards have created a space for mutual coexistence (Manning et al. 2011). The translation of global standards to specific contexts requires great negotiation by actors in the "chain of demand and assurances" (Bartley 2010). Rather than bypassing and transcending conventional state-centric regulatory frameworks, global sustainability standards are "filtered, renegotiated, or compromised as they enter particular political economies" (Bartley 2010:27).

The domestic political economy context in which private regulation and standards form and are utilized can significantly shape their evolutionary trajectory. Bartley (2010) points to several key factors. First, the nature of the relationships between the business and state will impact the readiness of firms to see value in quickly shifting to sustainability standards. Second, the clarity of legitimacy of property rights and their administration will affect the harmonization of domestic conditions with transnational regulations. Third, the nature of the national political regime and their openness to non-business agendas will influence the incentives for international and domestic actors to pursue private arenas of rule-making in that context. These three areas of consideration highlight why vast differences may exist in the conceptualization of sustainability standards in the affluent democracies of Europe and North America compared to the on-the-ground implementation of sustainability standards in developing countries (Bartley 2010).

Not only do national political economies matter, but the actors embedded within those contexts significantly influence the shape of transnational governance mechanisms. The emergence and adoption of multiple, dynamic sustainability standards is influenced by key initiators and stakeholders such as TNCs, NGOs, development agencies, and others. The position of the standard-setters and adopters within global value-chains, national business and institutional contexts brings greater understanding to the proliferation and convergence of diverse sustainability standards; how multiple actors in value-chains influence the proliferation, variation, and evolution of sustainability standards within a certain industry (Manning et al. 2011). First, leading buyers, by responding to their target consumers, affect the transmission of selection of sustainability standards in producer countries through the communication of preferences to suppliers. Second, producer size and type differentiate the types of standards adopted in a particular country. Third, national exporters and traders play an important role in transmitting standards on behalf of clients through facilitating and overseeing the process of implementation and certification.

National economic and institutional contexts interlink with global economic and regulatory structures in diverse ways. The adoption of a particular standard, therefore, can differ by country as affected by their economic structures, trade relationships with global buyers, and institutional conditions (Manning et al. 2011).

It is important to note that, depending on their current state of development, countries differ in regard to their needs, possibilities, and resources to make use of certification. For some it may be perceived as another requirement and barrier for integration into the global economy, rather than as a way of promoting exports (Rametsteiner and Simula 2003). Therefore, standards must be based on, and adapted to, the different regional, national, and local socio-economic, political, and environmental conditions in which they operate (Rametsteiner and Simula 2003).

## 2 Comparison of Different Types of Sustainability Standards

As sustainability standards have proliferated, diverse types of standards from diverse configurations of actors have emerged. Actors have individually and collectively proposed standards and certification systems that suit their interests and advance their causes. Private firms, non-profit organizations, international governance bodies, intergovernmental organizations, and state agencies are just some of the actors who seek to position themselves to negotiate the shape of sustainability standards and certification systems.

A range of stakeholders compete to participate in determining how products and production processes are governed by sustainability standards. They include public or private owners, local communities and indigenous peoples, industry and corporate firms, and different groups advocating for the protection of public goods, such as environmental NGOs. Therefore, standards are produced by negotiation among different actors and their respective interests. Industry and corporate interests see sustainability standards as instruments for marketing and market access. Consumers see them as providing information on the quality and impacts of products they purchase. Owners and producers see them as tools for market access or market advantage. Governments see them as a soft policy instrument to promote sustainable consumption patterns. Environmental activists see them as mechanisms to encourage sustainable environmental outcomes (Rametsteiner and Simula 2003).

The importance of protecting interests is evident from examining the factors influencing the decisions of transnational corporations (TNCs) regarding various configurations of sustainability standards and certification systems. In certain cases, TNCs might choose to create their own standards and certification systems, relying on the reputation of their brand and seeking to evade the stringency of third-party systems. However, the high cost of creating, implementing, and monitoring proprietary standards, as well as the question of legitimacy and credibility, might lead TNCs to adopt standards promoted by NGOs or multi-stakeholder initiatives. NGO-based strategies potentially offer a clean and green reputation, credibility, and access to premium niche markets (Daviron and Vagneron 2011). When NGO-based standards are too stringent or cumbersome for TNCs, they might pursue multi-stakeholder initiatives, wherein they can exert more power while still obtaining the credibility that comes from collaboration with various interest groups. The stiff

contestation involved in such negotiations, however, could lead them to pursue other strategies.

The difficulty of categorizing standard-setting and certification strategies is evident in the case of the Forest Stewardship Council (FSC). Scholars have described the FSC as a nonprofit organization, a certification institution, a rule-making process, a system of rules for private governance, and a form of multi-stakeholder business regulation (Pattberg 2005). Pattberg (2005) considers the FSC exemplary of global, private governance because it sets general and specific standards, utilizes institutionalized procedures to ensure compliance with and constant improvement of its rules, and regulates transnational space that differs from both national and international regulative systems. The FSC provides three types of standards: (1) global forest management standards that serve as the basis for the development of national and regional standards; (2) chain of custody standards proposing detailed rules along the production chain; and (3) standards for the accreditation of independent certifiers (Pattberg 2005).

The implementation of FSC's regulative output is achieved through three inter-related functions: certification, accreditation, and labeling. Certification is the process of verifying compliance with all three types of standards through validating standard implementation, issuing certification, and auditing to ensure continued compliance (Hatanaka and Busch 2008). Certification programs can use processes either internal or external to the organization, but most programs favor the credibility offered by third-party certification. Although some public certification bodies do exist, most tend to be private organizations, and either NGOs or commercial firms. The size of certification bodies can vary from a single individual to large organizations (Hatanaka and Busch 2008). Accreditation is the process of endorsing organizations with certifying authority according to some pre-established criteria. Some accreditation programs engage independent organizations in the process, seeking to limit interdependencies between those who create the standards and those who monitor compliance. Accreditation bodies include NGOs, government agencies, industry associations, or some combination of the three (Hatanaka and Busch 2008). Labeling is the process of attaching an information-giving tag or marker to products or production chains (Pattberg 2005).

The simple classification of the FSC as a "nonprofit NGO" approach implies a false notion of complete autonomy from business and state actors. The governing structure of the FSC includes equal membership from actors representing social, environmental, and economic interests. This unique multi-stakeholder arrangement has prevented capture by strong economic interests, but nevertheless entails some degree of influence from corporate business firms. Additionally, a range of governments have endorsed FSC certification and integrated FSC standards into national policies, signaling an increasing convergence between private and public governance (Pattberg 2005). Forest Stewardship Council funding reveals another point of potential corporate influence. Although the FSC has historically relied on nonprofit foundations such as the Ford Foundation, Rockefeller Brothers Foundation, MacArthur Foundation, and Wallace Global Fund for funding, the long-term viability of this model is questionable. Membership fees and accreditation

fees were a much smaller source of funds. In order to be financially sustainable, the FSC might require greater profit-orientation, a shift that could threaten its credibility and run counter to some of its fundamental principles (Pattberg 2005).

Although configurations of sustainability standards are constantly evolving and converging, a simple classification will be used to explain the dominant types of sustainable standards: private NGO, private corporation, multi-stakeholder, and roundtable.

## *2.1 Sustainability Standards from Non-governmental Organizations/Civil Society Organizations*

Non-governmental organizations (NGOs) and civil society organizations (CSOs) are major players in the development of private sustainability governance. Under traditional state-based forms of regulation, NGOs attempted to achieve more socially, environmentally, and/or economically sustainable outcomes indirectly through influencing the rule-makers. Non-governmental organizations have since shifted their efforts from influencing the rule-makers to becoming the rule-makers.

NGO-based standards, certification systems, and eco-labels enjoy legitimacy because of their perceived objectivity. As non-profit actors NGOs are seen as providing appropriate checks and balances that counteract the potential dominance of private for-profit firms. This confrontational strategy in the context of private regulation for sustainability, however, has been replaced by a more collaborative approach. NGOs are increasingly working in partnership with companies instead of campaigning against them. What would prompt NGOs to explore these new institutional arrangements? NGOs, as non-market actors, have struggled to exert influence over wider public values and practices. Partnerships with private for-profit firms, however, open possibilities of changing transnational markets through interjecting a sustainability agenda, an opportunity many NGOs find too tempting to pass up (Glasbergen 2011).

Critics of NGO involvement in private regulation point out numerous disadvantages to NGO participation. Some interpret NGO involvement in private regulation to be a result of rent-seeking; desiring to capitalize on new opportunities for funding. Needing to secure long-term financial stability for private systems of rules as they grow in scale and scope, independent nonprofit agents must begin to operate like businesses and turn their issue-specific knowledge of structure, procedures, and relevant players into a source of revenue. This business-orientation potentially compromises the foundational principles and original intentions of NGOs (Pattberg 2005). Other critics point to the uneven dominance of Northern interests where NGOs enjoy institutional support from middle and upper class members. Yet NGO-based private governance has implications in the global South on local producers. The voice of these stakeholders is often assumed or not heard, resulting in an imbalance of power (Glasbergen 2011).

## 2.2 *Sustainability Standards from Private Corporations*

Private actors are assuming pivotal regulatory roles once considered the prerogative of state actors. Alongside traditional state agency regulation, alternative forms of regulation are emerging, including self-regulation, co-regulation, management-based regulation, and other private forms of governance that encompass a wide variety of instruments such as voluntary and cooperative agreements, codes of conduct, corporate reporting and accounting, and self-auditing. For example, food industry retailers have become strategic actors in the governance of the global food system by formulating governance institutions such as private standards, corporate social responsibility initiatives (CSR), and public-private or private-private partnerships (PPPs). They have become rule-setters instead of rule-takers (Fuchs et al. 2011). Private regulatory initiatives can be categorized as retailer dominated, equal partnership arrangements between retailers and producers, and multi-stakeholder initiatives (Fuchs et al. 2011). Table 2 explains several configurations of private standards and certification initiatives in the retail food industry.

In an era of global economic market exchanges, private corporate actors such as transnational corporations (TNCs) and large retailers recognize the importance of preserving their reputation and protecting their market positions by becoming active participants in private governance mechanisms such as sustainability standards, certification, and eco-labeling (Glasbergen 2011). These private firms, not wanting to adopt the more rigorous and stringent standards offered by NGOs and multi-stakeholder collaborations, choose instead to devise their own sustainability standards, certification processes, and labeling procedures. Although they may borrow heavily from the guidelines established by sectoral codes of conduct, they rarely undergo the scrutiny of third-party verification (Giovannucci and Ponte 2005). Individually, or in strategic groups, private firms develop sustainability standards that fit their business needs.

Private standards created by TNCs and large retailers are perceived to be diluted and weakened versions of existing sustainability standards. The weakness of these guidelines lies not only in their content, but also in their verification methods. Proponents see these efforts as stepping stones toward more sustainable practices by firms that are yet unable to meet the stringent guidelines of other sustainability standards and certification schemes. Critics, on the other hand, view these schemes as deceptive marketing ploys aimed at communicating a sustainability ethic to buyers and consumers without taking clear steps to promote and assure sustainable practices. Furthermore, the market dominance of these firms threatens to undermine wider consumer demand for more rigorous standards, and instead promote the acceptance of weak, cosmetic standards (Giovannucci and Ponte 2005).

Despite potential benefits, TNCs and large retailers assume large risks when developing and implementing private standards and internal certification. The firm's reputation and the credibility of the standard system are prone to attack when minimalized safeguards fail and unsafe or unsustainable products and production

**Table 2** Retail food industry private standards and certification

| | | Roles played by actors | | | |
|---|---|---|---|---|---|
| Category | Standard/initiative | Retailers | Food industry growers, fishermen | Certification bodies | Civil society/NGOs |
| Retailer dominated | British Retail Consortium Global Standard for Food Safety | Absolute power, standard owner | Only consultative | Only consultative | No voice |
| | International Food Standard | Absolute power, member organizations, standard owner | Only consultative | Only consultative | No voice |
| | Safe Quality Food | Absolute power, standard owner | Only consultative | Only consultative | No voice |
| | Global Food Safety Initiative | Clear majority | Only consultative | Only consultative | Participation in annual meetings and regular information exchange |
| Equal partnership retailers and producers | GlobalGap | Joint power, representative democracy (elections) | Only consultative | Only consultative | Participation in annual meetings |
| Multi-stakeholder initiatives | Marine Stewardship Council | Represented (minority on Board) | Not on Board | Not on Board | Environmental NGOs 1 in 4 on Board |
| | Ethical Trading Initiative | Minority on Board | Not on Board | Not on Board | 2/3 majority on Board (trade unions and developmental NGOs) |

Modified from Fuchs et al. (2011)

processes are made public. What appears to be an advantageous certification system with huge benefits and low costs can prove dangerously short-sighted. While rigorous oversight from third-party auditors may not result in perfect compliance, it nevertheless encourages a reduction in unethical behavior, thus reducing risk to the private firm. Furthermore, private corporations or retailers often undermine the credibility of their own systems of standards by failing to incorporate an adequate range of stakeholders in the development of criteria for sustainability standards systems (Giovannucci and Ponte 2005).

The legitimacy of private corporation-based sustainability standards has been questioned. Public, state-based regulation gains legitimacy from decision-making taken through democratically-elected representatives by the general public to uphold the common good and include all relevant interests. While internal accountability for corporate firms is ensured through hierarchal relationships relating back to stockholders, external accountability is more difficult, if not impossible, to achieve in private governance arrangements, where corporate decisions are not effectible by those whom they affect (Fuchs et al. 2011). Therefore, private corporation sustainability standards lack democratic legitimacy on the grounds of limited or non-existent participation by affected stakeholders like civil society actors, indigenous communities, and small-scale farmers and fishermen. Limited participation by stakeholders decreases transparency, which is evidenced by less open processes, limited issue coverage, voluntary information provision, and self-reporting (Fuchs et al. 2011). While some positive outcomes on food safety, food quality, and environmental quality result from retailer-dominated standards and certification systems, the lack of participation, transparency, and accountability has had negative consequences, including the marginalization of millions of small-scale farmers in developing countries (Fuchs et al. 2011).

Business-to-business standards (B2B) have grown increasingly common in regulating the relationship between retailers and suppliers, ensuring compliance with national regulations, and limiting exposure to liability claims (Neilson and Pritchard 2009). For example, under increased activist scrutiny for the labor practices of their suppliers in developing nations, brands like Nike®, Adidas®, and The Gap® have developed internal monitoring programs to assure compliance with social sustainability criteria in the garment and footwear sector (Bartley 2010). These brands likely chose internal standards over third-party standards because their brands are reputable and individualized enough to make investments in brand reputation more cost-effective than buying into an external symbol of sustainable practice. Furthermore, these retailers are able to monitor compliance more directly due to their geographic and positional closeness in the supply-chain. Some suggest that this arrangement of internal regulation may, in fact, be more effective than the third-party auditing that exists in other types of certification schemes (Bartley 2010). Other observers fear that the transition from business-to-consumer to business-to-business standards signifies and allows for further weakening of sustainable standards (Daviron and Vagneron 2011).

**Table 3** Stakeholder groups and interests in certification

| Stakeholders | Interests in biomass certification |
|---|---|
| National Governments and Transnational Organizations | Policy instrument to promote sustainable management and sustainable consumption pattern; information for policy making |
| Intergovernmental Organizations | Neutral forum for negotiations between all kinds of stakeholders (particularly countries) |
| Companies (producers, trade, industry) | Instrument for environmental marketing, risk management and market access, control of origin and quality of raw materials, products or services, information for optimization of production processes, allows for product differentiation |
| NGOs | Information on the impacts of products, provides information whether the product meets quality or technical standards, promote sustainable management |
| International Bodies and Initiatives | Promote sustainable management and sustainable consumption pattern, information for policy consultancy and collaboration |

Modified from van Dam et al. (2010)

## *2.3 Sustainability Standards from Multi-Stakeholder Collaborations*

Multi-stakeholder collaborations in standard-setting began in the early 1990s with the Forest Stewardship Council (FSC), and have proliferated with increasing speed since the mid-2000s. After beginning as multi-sectoral initiatives, they now tend to represent crop-specific standard-setting (Daviron and Vagneron 2011). Various stakeholders participate in these initiatives. For example, Table 3 lists stakeholders in biomass certification. The various stakeholders represent different interests, agendas, and roles that contribute to the unique nature of multi-stakeholder initiatives. A summary of potential roles is listed in Table 4.

Multi-stakeholder partnerships represent unique arrangements in private sustainability standard-setting because they combine various non-state actors that are typically perceived as antagonistic. The relationship between businesses and NGOs, and between the commercial sector and civil society, has historically been steeped in tension and conflicting interests. The combination of market logic and civil society, therefore, makes multi-stakeholder collaborations particularly novel arrangements (Pattberg 2004). Four posited criteria for a "private environmental governance institution" are fulfilled in multi-stakeholder partnerships: (1) intention to regulate a specific environmental or social issue by voluntary norms and rules, including management standards, codes of conduct, and labels, (2) self-organized networking of at least two transnational private actors, (3) representation of both profit and non-profit logic, and (4) institutional stability over time (Pattberg 2004).

**Table 4** Overview of possible roles of stakeholder groups in the development of biomass certification

| Stakeholders | Possible roles |
|---|---|
| International bodies | Assist in developing international framework conditions or agreements for bioenergy |
| | Initiate debate about the role of the WTO in biomass certification |
| | Coordinating role in stakeholder debates from various stakeholder groups |
| | Support to promote sustainable biomass (financially, expertise, sharing knowledge) |
| Regional bodies | Policy or legal framework on biomass certification at a regional level, integrating standards certification system into regional policy |
| | Promoting coherence of national policies at a regional level |
| | Refine standards to local and regional conditions, further specification of setting biomass standards |
| | Support for building expertise to implement biomass certification systems |
| | Provide specific assistance to developing countries |
| Government bodies | Policy framework for biomass certification, setting biomass minimum standards possible with more extended set of private standards |
| | Policy measures (subsidies, regulations) to promote sustainable biomass |
| | Support for building expertise in implementing biomass certification systems |
| | Provide specific assistance to developing countries |
| Companies | Key activities with the focus of initiatives depending on interests of the company |
| | Build experience in certification through (pilot) studies over the complete biomass chain, gradual learning and expansion of system over time |
| | Promote coordination and cooperation between companies on developing certification systems, e.g. energy companies in Europe may stimulate coherence in the development of biomass certification systems, at least on a regional level, and form a strong incentive to other producers in the world |
| | Technical improvements of biomass related products |
| | Financial assistance (especially for the banking sector) |
| NGOs | Keep watch over the reliability of the system in development |
| | Represent and involve the less powerful in discussions on biomass certification |
| | Build experience through pilot studies and work in the field, mainly on the biomass production side |
| | Trigger the discussion of proposals by developing principles and pathways for the implementation of biomass certification systems |
| Roundtables | Facilitate discussions on biomass certification among stakeholder groups, at this time mainly for biomass production |
| | Promote initiatives on biomass certification (*via* biomass production) in coordination with other initiators in biomass certification systems |
| | Implement pilot studies |

Modified from van Dam et al. (2010)

The conglomeration of diverse interests found within multi-stakeholder partnerships brings legitimacy to the sustainability standards, certification procedures, and eco-labeling that result from these negotiations. For example, the global 4C project initiated by the Deutsche Gesellschaft für Internationale Zusammenarbeit (formerly the GTZ, now the GIZ), the German international development agency, included various Multinational Corportations (MNCs), NGOs, traders, roasters, and coffee producers and associations as a way of building legitimacy into the process of developing global sustainability standards for the coffee industry (Manning and von Hagen 2010). Not only was legitimacy secured, but chances of successful implementation were enhanced by representing all key players in the coffee commodity-chain. Embedding multiple actors into the collaborative process was not easy. Trust was built through local development projects where low-risk institutional partnerships established the first steps toward a growing global project network. These project-based relationships established common ground among various actors and promoted opportunities to work toward similar goals. A global-scale development project eventually emerged with the desire to create sustainability standards to govern products and production processes along the commodity-chain (Manning and von Hagen 2010). Multi-stakeholder initiatives are inherently vulnerable, as the long-term effectiveness of these partnerships relies on long-term shared notions of common goals and shared understanding of how to adapt the private governance system to new technologies and ongoing environmental change (Manning and von Hagen 2010).

Multi-stakeholder standards and certification schemes have taken hold to varying degrees around the world. The case studies of Bartley (2010) on the forestry and garment industries in Indonesia challenge the notion that multi-stakeholder systems become prominent forms of production governance under conditions of industry-wide or firm-specific controversy and export dependence. Although these are important factors, he claims that international certification efforts can be symbolically important but practically limited in certain political economy contexts in developing nations, thus impacting the prominence of certification systems.

## *2.4 Roundtables*

Roundtables are a type of multi-stakeholder partnership for sustainability standard-setting that has gained prominence in recent years. As a specific form of private governance, such collaborations focus on improving sustainability within one specific commodity-chain or sector. As with other multi-stakeholder partnerships, roundtables include actors from private businesses as well as NGOs. Representatives from government agencies might participate by consulting and observing, but have no decision-making role. Roundtables go beyond merely creating niche markets and instead aim to transform entire commodity-chains toward more sustainable practices. The current generation of roundtables – such as Roundtable on Sustainable Palm Oil (RSPO), Round Table for Responsible Soy (RTRS), Better Cotton Initiative

(BCI), Better Sugarcane Initiative (BSI) and Round Table for Sustainable Biofuels (RSB) – trace their conceptual origins to the multi-stakeholder initiatives of the forest and marine stewardship councils (FSC and MSC) (Schouten and Glasbergen 2011). Roundtables connect commodity-chain actors from around the globe. These actors come from diverse locations, occupy various roles within the commodity-chain, and hold different belief systems regarding sustainability. The legitimacy of their collective actions is based on the justification for why they are the right actors to govern the commodity-chain, and the creation of a common understanding about what and how they desire to govern (Schouten and Glasbergen 2011). The establishment of shared goals and common activities are the basis for the working relationship.

The Roundtable on Sustainable Palm Oil is a prominent example of this type of private governance for sustainability standard-setting. The RSPO set the trend for the creation of other commodity-specific roundtables. The World Wide Fund for Nature and Unilever, a company spanning production in the Global South and consumption in the Global North, initiated the RSPO in the European context (Schouten and Glasbergen 2011).

## *2.5 Sustainability and Palm Oil*

The palm oil industry has been subject to extensive criticism in terms of its environmental and social impacts, as traditional production systems around the world have been converted to palm oil plantations, making palm oil the most widely used vegetable oil in the world (World Bank 2011). The Roundtable on Sustainable Palm Oil was organized in 2004 by the CSO World Wildlife Fund and sectors of the palm oil industry to respond to the increasing concern around this massive conversion of landscape and lifescape. Its purpose is to define the principles and criteria of sustainable palm oil production as well as a certification process. The RSPO certification process has been negotiated between CSOs, national governments, and private firms. It involves principles and criteria for growers and supply-chain certification for manufacturers and retailers. Included in those principles is Free, Prior and Informed Consent (FPIConsent), which is to insure that indigenous peoples collectively agree to the transformation of their land. A number of major brands, including Kellogg's™, McDonald's™ and KFC™ announced in 2011 that they will use only RSPO-certified sustainable palm oil in the future. However, many indigenous groups and Community Based Organizations felt these standards were weakly enforced.

These negotiations and the resulting third-party certification have not resolved the social and environmental issues revolving around land use, and in fact have disadvantaged indigenous peoples in such places as Indonesia (Silva Castañeda 2012). Indigenous peoples, in particular, are disadvantaged by certification standards that make ancestral land-claims extremely difficult to document using industrialized standards of proof as opposed to local knowledge. The Union of Concerned Scientists (a CBO) has addressed the issue of the strength of palm oil sustainability standards in terms of deforestation (Boucher 2011). In early 2011, the World Bank

Group, which had suspended financing for palm oil plantations, conducted an open consultation after an audit of the IFC's investments and extensive papers on the social and environmental impacts of oil palm plantations. The final document, adopted by the Bank board, was released in March 2011. A number of CBOs, including the Forest Peoples Programme, Oxfam, Greenpeace and World Resources Institute, raised concerns despite the improvements in the new standards. The policy would discourage but still allow the takeover of indigenous peoples' and local communities lands without their Free, Prior and Informed Consent. The policy has weaker provisions on the clearance of peatlands and forests than industry best practice. "The policy is also still unclear about how implementation will be monitored and evaluated. Nor are the IFC and World Bank offering to make reparations for harm caused by previous investments, something indigenous peoples and local communities in Indonesia have strongly demanded" (Forest Peoples Programme 2011).

As with many sustainability standards that involve resources on indigenous land, the new strategy refers only to Free, Prior and Informed *Consultation*, despite continuing demands from indigenous peoples that only by adopting Free, Prior and Informed (FPI) *Consent* will fair and non-coercive negotiations between investors and affected communities be possible. The strategy argues that FPIConsent is currently under consideration in the ongoing formulation of the IFC Performance Standards strategy, and cannot be part of the palm oil strategy until this process is completed. Norman Jiwan of the Indonesian NGO SawitWatch points out that "the IFC is a member of the RSPO, which recognizes FPIConsent, but the new strategy refers only to FPIConsultation. This is effectively a breach of the RSPO code of conduct by the IFC, and means there will be far less incentive for IFC-backed companies to comply with the principles and criteria of FPIConsent" (Bretton Woods Project 2011). The difficulties of enforcement and the willingness of some signers of the RSPO to deviate from the principles and criteria undermine the legitimacy of these sustainability standards, despite the massive efforts that have been put into developing them.

The implementation of RSPO standards has been fraught with challenges. The RSPO's approach is pragmatic, as the diversity of actors and divergence of interests has necessitated a gradual, step-by-step approach to implementing change. Tensions exist between developing country producers and developed country processors and retailers. Where standard-less market channels are still available, producers see no need to implement the very sustainability standards that they helped design as part of the RSPO process. NGOs criticize the pragmatic, stepwise approach and argue for more fundamental discussions regarding sustainability (Schouten and Glasbergen 2011). The legality and legitimacy of the RSPO is dependent on the inclusion of a wide variety of stakeholders and consensus-based decision-making. However, pragmatic compromises often lead to a perceived undermining of the principles of sustainability. The resulting sustainability standards are less stringent. When NGOs feel like the key tenants of sustainability have been excluded, they refuse to endorse the standard, hence decreasing its legitimacy. This, in turn, compromises the legitimacy of the RSPO standard in the eyes of concerned external observers and the public (Schouten and Glasbergen 2011). Table 5 shows the timeline for the RSPO.

**Table 5** Timeline of the Roundtable for Sustainable Palm Oil (RSPO)

| Year | Major event |
|---|---|
| 2001 | Internal discussions at WWF about palm oil |
| 2002 | WWF hires consultant to explore possibilities for a more sustainable palm oil industry |
| | Preparatory meeting with European companies |
| | Unilever and WWF meeting in Switzerland |
| 2003 | First meeting of the Organizing Committee |
| | Second meeting of the Organizing Committee |
| | First Roundtable on Sustainable Palm Oil RT1 |
| | Working group meeting |
| | Third meeting of the Organizing Committee |
| 2004 | Fourth meeting of the Organizing Committee |
| | Formal establishment of the RSPO |
| | Establishment of the secretariat in Kuala Lumpur |
| | Second Roundtable RT2 |
| 2005 | Third Roundtable RT3: Principles and Criteria Launched |
| 2006 | Fourth Roundtable RT4 |
| 2007 | Fifth Roundtable RT5: Certification System Launched |
| 2008 | Sixth Roundtable RT6 |
| | First shipment of Certified Palm Oil arrives in Rotterdam |
| 2009 | Seventh Roundtable RT7 |

Modified from Schouten and Glasbergen (2011)

Although roundtables do not involve state actors in decision-making processes, states play a key role in providing incentives for roundtable standard and certification adoption. For example, the Dutch government presented a manifesto, signed by all the suppliers and purchasers of palm oil, to trade only RSPO-certified palm oil in The Netherlands by 2015. State promotion signals the growing market acceptance of certification schemes, creating further synergies in trade that could lead to great sustainability outcomes (Ackrill and Kay 2011).

## *2.6 Impact of Different Types of Certification: First-Party, Second-Party, Third-Party*

Unlike private governance institutions, certification institutions are not classified according to the actors and interests involved, but to a more instrumental approach to ensuring verification. The implementation of sustainability standards (as voluntary norms and rules) are verified through three ideal types of certification (reporting and monitoring mechanisms): first-party, second-party, and third-party. In first-party certification (also called self-assessment or self-reporting), the organization internally generates, monitors, and reports compliance to rules. In second-party certification (also called joint assessment or co-reporting), firms and organizations work together to generate, monitor, and report compliance to rules that govern their

own operations. Third-party certification (also called independent assessment or independent reporting) involves parties independent of firms and organizations that set, monitor, and report compliance to standards (Pattberg 2004). The rules set by multi-stakeholder partnerships not only create standards regarding products and processes, but also define who accounts for compliance with management standards, codes of conduct, or labeling (Pattberg 2005). Third-party certification has proliferated rapidly because it is perceived as being more credible than first-party and second-party certification (Linton 2005). Hatanaka and Busch (2008) claim that third-party certification benefits from the independence of certification bodies and accreditation bodies, a complex oversight system, and a built-in structure of multiple audits both hierarchically and horizontally.

Sustainability standards depend on (1) who sets the standards, and (2) who is the certifier to be sure they are followed. In the case of the Sustainability Consortium, Walmart™ took the lead in putting both into place.

## *2.7 Walmart™ Sustainability Index*

While the RSPO and the World Bank involved multiple stakeholders and iterative negotiations to derive sustainability standards, Walmart™ developed theirs from "customer demand" (Walmart Corporate 2011). Prior to this effort, Walmart™ had been a subject of criticism from CSOs involved in both environmental and social justice issues, which might have been the customers (or determined non-customers, Kummer 2010) making the demands. At the same time, they put together a Sustainability Consortium, including academics (Arizona State University and the University of Arkansas who serve as staff and other academic partners) and consumer product companies (Sustainability Consortium 2011).

The Supplier Sustainability Assessment Walmart™ developed incorporates energy and climate, material efficiency, nature and resource, and people and community. For each of these, they attempt to develop transparent measurements that will help them "reward suppliers for innovative, affordable products that are more sustainable for people and the planet." Each supplier answers each of the following questions:

1. Have you measured and taken steps to reduce your corporate greenhouse gas emissions? (Y/N)
2. Have you opted to report your greenhouse gas emissions and climate change strategy to the Carbon Disclosure Project (CDP)? (Y/N)
3. What are your total annual greenhouse gas emissions in the most recent year measured? (Enter total metric tons $CO_2e$, e.g. CDP 2009 Questionnaire, Questions 7–11, Scope 1 and 2 emissions)
4. Have you set publicly available greenhouse gas reduction targets? If yes, what are those targets? (Enter total metric tons and target date, e.g. CDP 2009 Questionnaire, Question 23)

Scores will be automatically calculated based on participation in the Packaging Scorecard in addition to the following:

5. If measured, please report total amount of solid waste generated from the facilities that produce your product(s) for Walmart™ for the most recent year measured. (Enter total lbs)
6. Have you set publicly available solid waste reduction targets? If yes, what are those targets? (Enter total lbs and target date)
7. If measured, please report total water use from the facilities that produce your product(s) for Walmart™ for the most recent year measured. (Enter total gallons)
8. Have you set publicly available water use reduction targets? If yes, what are those targets? (Enter total gallons and target date)
9. Have you established publicly available sustainability purchasing guidelines for your direct suppliers that address issues such as environmental compliance, employment practices, and product/ingredient safety? (Y/N)
10. Have you obtained third-party certifications for any of the products that you sell to Walmart™? If so, from the list of certifications below, please select those for which any of your products are, or utilize materials that are, currently certified.
11. Do you know the location of 100% of the facilities that produce your product(s)? (Y/N)
12. Before beginning a business relationship with a manufacturing facility, do you evaluate their quality of production and capacity for production? (Y/N)
13. Do you have a process for managing social compliance at the manufacturing level? (Y/N)
14. Do you work with your supply base to resolve issues found during social compliance evaluations and also document specific corrections and improvements? (Y/N)
15. Do you invest in community development activities in the markets you source from and/or operate within? (Y/N)

Clearly, the suppliers are large firms with excellent accounting procedures. The members of the Sustainability Consortium meet those criteria. Their guidelines explain the reasons for each item in terms of how it adds to sustainability and how to gather the necessary data. The scoring procedure is very transparent. They are particularly interested in third-party certification that is part of the value-chain of each supplier. The Sustainability Consortium is developing life-cycle analysis into the accounting procedures to integrate the four components of sustainability, although life-cycle analysis is a bit weak on the people and community part of the system.

Smaller-scale suppliers, particularly those that provide the local food that Walmart™ features, are pleased with the opportunity to sell local products to the local branch of the conglomerate. However, most farmers realize that Walmart™ seeks to sell products as cheaply as possible, thus leading to thin profit margins for producers (Brasher 2010). However, these standards have great power to move the industry toward increased sustainability, if not family farms or community prosperity

(Vandenbergh 2007). The report by the National Research Council was cautiously optimistic about the positive impacts of the Walmart™ Sustainability Standards (2010) on the environment.

## *2.8 State and Private Sustainability Standards*

Much scholarly debate focuses on the changing role of the state with the emergence and proliferation of private governance for sustainability. The ability of the state is called into question by the complexity of regulating diverse, geographically expansive, global markets. In a system of checks and balances within a constitutional state, the state designs a framework in which private activities, including private governance, are legitimately regulated with a system of rules, enforcement, and sanctions. Private governance and certification systems denote law-making that occurs outside of the realm of states. Who then, supplies the system of checks and balances? In what ways is the state limited in its ability to regulate private governance? Some critically associate private standards with neoliberal market dominance and a weakening of the state. Others claim that private standards neither bypass nor trump the state, but through various rules and actors, intersect with the state in novel ways (Bartley 2010).

The role of the state regarding private standards has been conceptualized as "meta-governance," which is defined generally as "the organization of self-organization" or the "regulation of self-regulation" (Glasbergen 2011; Hatanaka and Busch 2008). Meta-governance describes a new type of interaction between classic governmental rule systems and private regulation. Meta-governance is proposed as a solution that restores the state as an important player in the oversight, steering, and coordination of governance arrangements. In a position of "regulating self-regulation," governments must maintain "the ability to set the agenda by defining the key issues and terms of debate; determine what interests or stakeholders are involved; allocate resources (including information) to the network; and decide on how much power or authority is to be shared with non-government parties and how this relationship is to be managed" (Glasbergen 2011:194).

The concept of meta-governance has been challenged, however, by those who argue against the ability of state-centric regulation models to adequately promote sustainability outcomes. For example, Glasbergen (2011) notes four problems with the meta-governance position: (1) the problems are too complex to make state-centric solutions likely, (2) the emergence of central sustainability parameters will be unlikely without supranational authority, (3) no state can restrict or prevent the emergence of regulations based on private initiative, and (4) it is doubtful whether private governance arrangements are always self-serving. Others would argue that the "discursive power" of private regulations marks a two-way, mutually influencing relationship with the state. States may affect the context in which private standards operate, but private standards shape and disseminate politically

relevant values and norms, thus affecting the behavior of states and other political actors (Glasbergen 2011).

The role between state and private governance has also been conceptualized as a new form of social contract whereby states provide a basic level of guarantee, while private parties work out the details of agreements (Giovannucci and Ponte 2005). Some private regulations can only be effectively implemented when strong governmental regulation in complementary areas is exercised as well. For example, standards on sustainable forestry will only have the potential of success if governments provide strong legislation and enforcement to fight illegal logging (Glasbergen 2011). The state, therefore, continues to display power as an enabler, legitimizer, public monitor, and influential buyer of sustainability standards (Overdevest 2009). Therefore, many continue to argue for an increasingly active role of the government in governance, especially in combining innovatively, or intervening selectively, where market solutions are insufficient (Hatanaka and Busch 2008).

## *2.9 "Orchestration Deficit" of Having a Multiplicity of Standards*

The proliferation of sustainability standards created by various actors such as NGOs, corporations, and multi-stakeholder partnerships creates great fragmentation of standards and frequent disharmony with state standards, leading to an "orchestration deficit" (Glasbergen 2011; Henson and Reardon 2005). The dynamic co-evolution of private and public standards raises questions regarding the future of sustainability standards. Will private standards develop more rapidly and thoroughly so as to be differentiated from public standards? Will public and private standards begin to converge? Will time lead to greater harmonization between standards? The outcomes of sustainability standards proliferation are still uncertain. Will standards order with one another in a kind of hierarchy, complement each other, pile up on each other, or even replace each other (Glasbergen 2011)?

Fragmentation occurs when multiple (often competing) regulations address similar issues in different ways within the same sector. Standards proposed by NGOs, business, and the state may have more or less different goals and different means of achieving those goals. As a result, conflicting standards create inefficiencies and poor performance when products move through the commodity-chain, cross jurisdictional boundaries, and require integration between various actors. The excessive multiplicity and fragmentation of standards complicates global governance. Dozens of voluntary, *ad hoc* certification schemes compete and work alongside each other as well as state initiated policies in the same economic sector, sometimes complementing each other and sometimes conflicting with each other. The amalgamation of regulation generally lacks strategic linkages and reinforcing mechanisms between private and public governance. The state is often called upon to fix these disjunctions by creating forms of meta-governance, although forms of meta-governance can, and may need to, arise from the private sector as well (Glasbergen 2011).

# 3 Values and Norms: What Criteria Are Used for Sustainability Standards and Indicators?

## *3.1 General Thoughts*

Sustainability standards cover a large range of economic, social, and environmental criteria. The criteria used within a specific certification system relate to various aspects of sustainability. For example, forest sustainability schemes might include criteria addressing environmental preservation, labor relations, occupational health and safety, resource use rights, fair employment, extent of forest resources, forest health and vitality, productive functions of forests, biological diversity, protective functions of forests, socio-economic benefits and needs, and legal, policy and institutional frameworks (Rametsteiner and Simula 2003). Of the three general aspects of sustainability (economic, social, and environmental), the social dimension, such as issues of worker welfare and impacts on local communities, receives the least attention (Markevičius et al. 2010; Fuchs et al. 2011).

Different standards certification systems may have similar goals but utilize different means to achieve those goals. For example, the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) both have goals of preferring natural regeneration, not engaging in clear-cutting harvest, increasing dead wood and ecologically valuable trees, banning fertilizers and pesticides, and protecting biotopes, water, and soil. However, rules differ between the PEFC and the FSC for certifying wood from timber plantations, as the FSC markets this wood with the same label as wood from natural forests (Rametsteiner and Simula 2003). Furthermore, certain goals (such as greenhouse gas balance and land use change) regarding the three dimensions of sustainability may lack easily measurable criteria that can be used as verifiable standards (Markevičius et al. 2010). Table 6 provides examples of potential social, economic, and environmental criteria proposed by Markevičius et al. (2010) for the development of biofuel standards. Table 7 provides examples of social, economic, ecological, and general criteria proposed by Lewandowski and Faaij (2006) for the development of biomass/bioenergy standards.

**Table 6** Potential social, economic, and environmental criteria for liquid biofuels

| Crit. No. | Criterion name | Criterion explanation |
|---|---|---|
| 1 | Compliance with laws | Complies with all applicable laws and internal regulations like certification principles, countering bribery |
| 2 | Food security | Enough land locally available for food production, preference of marginal sites for energy crops |
| 3 | Land available for other human activities | Enough land locally available for housing, energy (e.g. firewood), recreation, and other resource supplies |
| 4 | Participation | Stakeholders included in decision-making; facilitation of self-determination of stakeholders |

(continued)

**Table 6** (continued)

| Crit. No. | Criterion name | Criterion explanation |
|---|---|---|
| 5 | Cultural acceptability | Consider spiritual values, local knowledge |
| 6 | Social cohesion | Migration and resettlement, wealth distribution, fair wages, intergenerational equity, charity |
| 7 | Respect for human rights | Health services, liberty rights, security, education |
| 8 | Working conditions of workers | Worker health, work hours, safety, liability regulations, exclusion of child labor |
| 9 | Respecting minorities | Recognition of indigenous peoples' rights, gender issues |
| 10 | Standard of living | Public service support, access to energy services (e.g., electricity lifeline tariffs) |
| 11 | Property rights and rights of use | Land and resource tenure, dependencies on foreign sources (e.g., financial investments, knowledge), fair and equal division of proceeds, customary rights |
| 12 | Planning | Stating clear objectives, a management plan is written, implemented, and updated as necessary |
| 13 | Monitoring of criteria performance | Monitoring systems in place for all criteria (e.g., leakage or additionality in GHG accounting) |
| 14 | Visual impacts | Visual effects of construction and feedstocks on the landscape |
| 15 | Noise impacts | Noise from production, transportation and conversion processes |
| 16 | Employment generation | Number of jobs created, quality of jobs created |
| 17 | Microeconomic sustainability | Cost-efficiency including startup costs, internal rate of return, net present value, payback period |
| 18 | Macroeconomic sustainability | Trade balances, foreign investments, financial flows across project boundary, changes in overall productivity, 'economic development' |
| 19 | Economic stability | Project lifetime, degree to which applied technology and operational aspects are proven, flexibility to changes in demand and supply, product diversification |
| 20 | Capacity to adapt to environmental hazards and climate change | Diversification of feedstocks, available knowledge on site demand of feedstocks |
| 21 | Energy balance | Conversion efficiencies, energy return on investment, energy return per hectare |
| 22 | Natural resource efficiency | Efficient use of resources at all stages of the system |
| 23 | Species protection | Protection of rare, threatened, or endangered species |
| 24 | Ecosystems protection | Safeguarding protected, threatened, representative, or other valuable ecosystems (e.g., forests), protecting internal energy fluxes/metabolism |
| 25 | Ecosystem connectivity | Preventing land fragmentation (e.g., presence of wildlife corridors) |
| 26 | Crop diversity | Impacts and risks associated with monocultures: impacts on landscape and wildlife and susceptibility to catastrophic failure |
| 27 | Exotic species applications | Protection of exotic species |
| 28 | Use of genetically modified organisms | Compliance with law, avoid risk to other land uses |

(continued)

**Table 6** (continued)

| Crit. No. | Criterion name | Criterion explanation |
|---|---|---|
| 29 | Use of chemicals, pest control, and fertilizer | Insecticides, herbicides, chemicals in the conversion process, impacts on surrounding environment |
| 30 | Soil protection | Impacts on soil fertility: nutrient cycling, rooting depth, organic matter, water-holding capacity, erosion |
| 31 | Land use change | Impacts of land conversion on energy fluxes, radiation balance, roughness of land cover, biochemical fluxes, hydrological cycles |
| 32 | Water management | Surface and groundwater impacts, riparian buffers, irrigation and cooling cycles and waste water management |
| 33 | Waste management | Disposal of ashes, sewage, hazardous/contaminated solid and liquid material |
| 34 | Greenhouse gas balance | GHG-balance of system covering $CO_2$, $CH_4$, $O_3$, $NO_2$, $H_2O$ |
| 35 | Potentially hazardous atmospheric emissions other than greenhouse gases | Emissions of $SO_x$, CO, $NO_x$, and particulates |

Modified from Markevičius et al. (2010)

**Table 7** Criteria for sustainable biomass production and trading

| Areas of concern | Criteria |
|---|---|
| Social criteria labor conditions | Freedom of association and collective bargaining |
| | Prohibition of forced labor |
| | Prohibition of discrimination |
| | Least minimum wages |
| | No illegal overtime |
| | Equal pay for equal work |
| | Regulations to protect the rights of pregnant women and breastfeeding mothers |
| Protection of human safety and health | Protection and promotion of human health |
| | Farmers, workers, etc., are not unnecessarily exposed to hazardous substances or risk of injury |
| | Safe and healthy work environment: machine and body protection, sufficient lighting, adequate indoor temperature, fire drills |
| | Availability of documented routines and instructions on how to prevent and handle possible near-accidents and accidents |
| | Performance and documentation of training all co-workers; training ensures that all co-workers are able to perform their tasks according to the requirements formulated for health protection and environmental benign management or resources |

(continued)

**Table 7** (continued)

| Areas of concern | Criteria |
|---|---|
| Rights of children, women, indigenous peoples and discrimination | Elimination of child labor: minimum age and prohibition of the worst forms of child labor |
| | Children have access to schools; work does not jeopardize schooling |
| | Indigenous people's and tribal rights respected |
| | Recognizing and strengthening the role of indigenous peoples and their communities |
| | Women are not discriminated against; their rights must be respected |
| | Spouses have the right to search for work outside the entity where their partner works |
| Access to resources ensuring adequate quality of life | Farmers are content with their social situation |
| | Access to potable water, sanitary facilities, adequate housing, education and training, transportation, and health services |
| | Promotion of education, public awareness and training |
| | Market access for small-scale farmers and producers |
| | Equitable access to forest/farm certification among all forms of forest/farm users and tenure-holders |
| | Establishment of a communication system that facilitates the exchange of information |
| Food and energy supply safety | Availability of enough food of sufficient quality |
| | No severe competition with food production and the shortage of local food supply |
| | Energy supply in the region of biomass production should not suffer from biomass trading activities |
| Capacity-building | Local organizations, institutions or companies involved in the process, through control and certification |
| | Marginalized social groups should play an equitable role in certification processes |
| | Jobs should be generated |
| | Trade-related skills development and social justice oriented capacity-building are facilitated through learning exchanges between trading partners |
| | Building and use of local labor and skills |
| Combating poverty | The activity should contribute to poverty abatement |
| Democratic participation | Stakeholder involvement in the decisions that concern them |
| Land ownership | Avoidance of land tenure conflicts |
| | Land ownership should be equitable |
| | Tenure and use rights shall be clearly defined, documented and legally established |
| | Projects should not exclude poor people from the land in order to avoid leakage effects |
| Community (institutional) well-being | Farms must be 'good neighbors' to nearby communities and a part of the economic and social development |
| | A basis is created for strengthening the mutual confidence between business and the society in which they are active |
| | Involvement of communities into management planning, monitoring and implementation |

(continued)

**Table 7** (continued)

| Areas of concern | Criteria |
|---|---|
| Fair trade conditions | Transparency and accountability of negotiations |
| | Direct and long-term trading relationships |
| | Fair and equal remuneration – all supply-chain partners are able to cover costs and receive fair remuneration for their efforts through prices that reflect the true value of the product. Risk sharing mechanisms are actively encouraged. |
| | Communication and information flow – supply-chain partners communicate openly with each other showing a willingness to share information |
| Acceptance | Acceptance of the production methods by producer and consumer |
| | The activities do not lead to disadvantages for the local population like losses of jobs or food shortages |
| | The activity carries advantages for the local population |
| Economic criteria viability of the business | The business must be economically viable |
| | Minimization of costs to ensure competitiveness |
| | There is sustained and adequate funding for running the operation (i.e., the liquidity of cash flow to support infrastructure development, acquisition of machines and to meet day-to-day running of the operation) |
| Long-term perspective | Long-term commitments, contracts and management plans |
| Strength and diversification of local economy | The activity should contribute to strengthening and diversifying the local economy |
| | Local labor and skills should be used |
| | Professional and dedicated human resources are enhanced |
| Reliability of resources | Minimization of supply disruptions |
| | Supply security for the biomass consumer |
| | No over-dependencies on a limited set of suppliers should be created |
| Yields | Sustainable rate of harvesting – forests should only be harvested at the rate that they regrow |
| | Agricultural yields should be maintained on an economically viable and stable level |
| | A management plan that describes the operational details of production is in place |
| | A comprehensive development and research program for new technologies and production processes is in place |
| No blocking of other desirable developments | The activity should not block other desirable developments |
| Ecological protection of the atmosphere | Reduction and minimization of greenhouse gas emissions: |
| | Efficient use of energy |
| | Use of renewable resources |
| | Low atmospheric nitrogen emissions |
| | No use of persistent organic pollutants (POPs) and substances that deplete the ozone layer |

(continued)

**Table 7** (continued)

| Areas of concern | Criteria |
|---|---|
| Preservation of existing sensitive ecosystems | Avoid polluting natural ecosystems neighboring the fields |
| | Prevention of nutrient leaching |
| | Plantations should not replace forests |
| | Maintenance of high conservation value forests |
| Conservation of biodiversity | No use of GMOs |
| | Careful/no use of exotic species; their monitoring and control |
| | Prevention of spreading diseases |
| | Environmentally sound management of biotechnology |
| | Consideration of the needs of nature and species protection |
| | The development and adoption of environmentally friendly non-chemical methods of pest management should be promoted and the use of chemical pesticides should be avoided |
| | Preservation of habitats |
| Conservation and improvement of soil fertility – avoidance of soil erosion | No impoverishment of the soil; nutrient balances should remain in equilibrium |
| | Optimized utilization of the soil's organic nitrogen pool |
| | Measures to prevent soil erosion are applied and described in a management plan |
| | No accumulation of heavy metals in soil |
| | No irreversible soil compaction; measures to prevent soil compaction are taken and described in a management plan |
| | No pesticide residues in the soil |
| Conservation of ground and surface water | No depletion of ground and surface water resources |
| | Protection of the quality and supply of freshwater resources |
| | Avoid polluting ground and surface waters |
| | No eutrophication of surface waters by phosphorus emissions |
| | No pesticide residues in the water |
| Combating deforestation | Plantations should not replace forests |
| | Sustainable harvest rates – harvest at the rate the forest regrows |
| | Limitations for the size of the harvested areas |
| | No logging activities in protected forests |
| Combating desertification and drought | Measures to combat desertification and drought are taken and described in a management plan |
| Landscape view | Increase and improvement of the variation of the landscape |
| | Conservation of typical landscape elements |
| Conservation of non-renewable resources | Efficiency in the use of natural resources, including energy |
| | Positive energy balance |
| | Minimization of the use of raw materials, resources and land |
| | Focus on increased efficiency by increasing filling rates, decreasing fuel consumption and by using transport modes that release less greenhouse gases |
| | Minimize phosphorus extraction from non-renewable deposits |

(continued)

**Table 7** (continued)

| Areas of concern | Criteria |
|---|---|
| Waste management | Minimization of wastes |
| | Sorting of wastes |
| | Proper handling and disposal of waste |
| | Recycling of waste where possible |
| | Recycling of ashes from biomass combustion |
| | Environmental training of employees, to facilitate waste sorting and initiate energy-saving |
| | Environmental checklist on waste management, training of employees, etc. |
| Environmental additionality | Projects have to be environmentally additional by improving the environmental situation against a baseline |
| | (*status quo*) scenario |
| General compliance with laws and international agreements | Activities have to comply with national laws and international agreements |
| | All applicable and legally prescribed fees, royalties, taxes and other charges shall be paid |
| | In signatory countries, the provisions of all binding agreements such as CITES, ILO Conventions, etc., shall be respected |
| Traceability | Biomass must be traceable |
| | Biomass from non-certified resources cannot enter the trade-chain |
| | A chain-of-custody control system is in place |
| Avoidance of leakage effects | (Negative) leakage effects should be avoided |
| | People should not involuntarily be driven from their land |
| | The biotrade activity provides local people with income opportunities that are at least equivalent in quality and quantity to the baseline situation (i.e., situation without biomass trade activity) |
| Strengthening the role of non-governmental organizations | The role of non-governmental organizations should be strengthened |
| Improvement of conditions at the local level | Generation of jobs |
| | Generation of education opportunities |
| | Capacity-building |
| | Support of infrastructure development |
| | Enhancement of democratic development |
| | Increase of (farmers) income |
| | Improvement of environmental management at the local level |

Modified from Lewandowski and Faaij (2006)

## 4 How Successful Are Sustainability Standards in Promoting Sustainability?

Evaluations concerning the success of private and private-public sustainability standards have been mixed. While some positive impacts are noted in various cases, numerous limitations remain. Standard-setting and certification initiatives have

endeavored to address an incredibly diverse range of issues across a diverse scope of local contexts through globally applicable instruments. Their success in promoting economic, social and environmental sustainability has been varied and widely unclear (Rametsteiner and Simula 2003). Following is a summary of general positive and negative impacts of sustainability standards.

## *4.1 Positive Impacts of Sustainability Standards*

Sustainability standards seem to be inducing a "modest drive for change" in creating new sustainable niche markets, but have not yet been able to change the market as a whole in a more sustainable way (Glasbergen 2011). For example, the few companies that have applied for and received FSC certification have been influenced to provide more sustainable practices, yet the broader forestry and timber sector seems largely unaffected, as deforestation and land degradation continues (Bartley 2010).

Within the food and agricultural system, private governance has marked positive effects on food safety and quality, yet these impacts appear limited to export markets, and domestic markets seem largely untouched. Private food governance also has generated positive environmental outcomes, although the scope of these outcomes has been partial and restricted to developed countries and industrial agricultural systems (Fuchs et al. 2011).

Sustainability standards and certification systems allow some suppliers to add value, assimilate new functions into niche markets, improve their products, and benefit from enhanced exchanges and cooperation among actors within a particular commodity-chain, industry, or region (Giovannucci and Ponte 2005). The quickly evolving nature of voluntary private standards and certification systems allows developing country exporters to bypass the slower negotiation of conventional standards and instead pursue opportunities to upgrade and increase the export value of their products in response to the changing needs of global trade (Giovannucci and Ponte 2005). The benefit to suppliers can be determined by understanding whether the extra efforts and investment to implement sustainability standards and gain certification are greater or less than the premium prices received for certified compared to non-certified products (Giovannucci and Ponte 2005).

Giovannucci and Ponte (2005) describe how the certification processes for sustainability standards can have positive spill-over effects on nearby communities. In Uganda, both farming practices and coffee quality improved among small-holders under organic and shade-grown certification systems. These improvements were noted among neighboring non-participants as well. In a Fair Trade system, spill-over effects are noticed when Fair Trade premiums are invested in community projects.

Glasbergen (2011) claims that wider societal impacts will result as well. The emergence and public recognition of private sustainability standards may lead to discussions on political and institutional reform in the state governance system, leading to innovations and transformations in policies and procedures toward more sustainable outcomes. Countering those who are strongly critical,

Glasbergen (2011:200) defends change through sustainability certification as an "inherently incremental process, only gradually transforming the underlying causes of environmental degradation and social injustice". Reviewing a history of the FSC, Pattberg (2005) claims some measurable positive effects on national forest policies, largely owing to the success of environmental and social organization in shaping sustainable forestry discourse through constant support, cooperation, and endorsement from key public actors.

## *4.2 Limitations and Shortcomings of Sustainability Standards*

Despite some positive outcomes, sustainable outcomes have exhibited various limitations and shortcomings. Sustainability standards have been criticized for being cosmetic strategies that hide deeper problems of unsustainability. A problem arises when global standards are translated into local practices. The presence of private sustainability systems in particular locations does not always imply that on-the-ground results are sustainable. The adaptation process may require, involve, or allow a weakened version of the standard, resulting in certification systems that give the appearance of sustainable robustness without the substance. Bartley (2010) claims that for various reasons the degree of success in the implementation of FSC certification in Indonesia is not accurately reflected by the number of hectares certified. Many of the forest companies were required to make only procedural, not substantive, changes to obtain or maintain certification status. The result is that changes toward sustainability did not occur. Furthermore, Bartley (2010) claims that despite changes within a few companies at a macro–level, forest certification has not substantially affected the overwhelming rate of deforestation, agricultural conversion of forest, illegal logging, and land degradation.

Sustainability standards and certification systems have been criticized for creating entry barriers and adding burdens to small-holders. The demanding, knowledge-intensive technical requirements and the certification process itself can exclude small-holders who are not given adequate extension service support or training in how to adapt to new standards (Daviron and Vagneron 2011). The high financial, time, and opportunity costs of implementation can cause additional burdens, resulting in income loss and market access restrictions for small-scale farmers and enterprises, particularly those considered among the poorest (Fuchs et al. 2011; Giovannucci and Ponte 2005). Sometimes the extra investment and effort needed to gain certification status does not pay off in terms of price premiums gained for certified products. Existing developing country suppliers might lose their position in global market-chains as rising standards create new challenges (Giovannucci and Ponte 2005). If and when a standard becomes widely accepted, it could become *de facto* purchasing criteria. Buyers may be less willing to pay extra premiums for standards compliance, thus leaving producers to bear the burden of higher production and compliance expenses but with no direct financial incentive apart from market access (Giovannucci and Ponte 2005). When expected benefits do not materialize in the

short-term, the hidden costs of compliance undermine effective and cohesive collective action by cooperatives or associations designed to take advantage of certification systems (Giovannucci and Ponte 2005).

Sustainability standards and certification systems have also been criticized for exacerbating inequalities in commodity-chains. Even when producers receive some benefits, power relations remain unaltered when producers are non-participants in the decision-making processes that affect them (Giovannucci and Ponte 2005). Downstream actors such as retailers can set higher consumer prices due to the value attached to symbolic attributes of the products; yet these higher prices don't always yield higher producer prices. Therefore, the inequalities of value distribution within different stages of certified chains are often higher for certified chains compared to conventional chains (Daviron and Vagneron 2011). Moreover, sustainability standards and certification systems may enhance product quality and environmental outcomes for export-oriented production, giving the appearance of success, but fail to create incentives for sustainability in domestic markets, hence creating additional difficulties for companies wanting to produce for both markets.

Observers have further criticized sustainability standards for their failure to recognize and uphold certain social criteria for sustainability. For example, (Fuchs et al. 2011) (quoting Pearson 2007) note that the Ethical Trading Initiative (ETI) fails to address gender-specific concerns of female workers and farmers arising from their domestic and household responsibilities. Furthermore, the degradation of social well-being for populations in producing countries is one implication of uneven, unequal standards-induced employment and income in these areas. Some scholars go as far as to question the democratic legitimacy of sustainability standards, noting that "What private food governance does not foster and in fact tends to worsen, however, is the aspect of the social sustainability of the global agrifood system" (Fuchs et al. 2011).

## *4.3 Reasons for Shortcomings*

### 4.3.1 Problem of Demand and Consumption Habits

Sustainability standards, rather than regulating sustainability through mandatory rules like conventional state-based governance systems, rely on the voluntary compliance of actors in the market-chain. Therefore, sustainability standards are successful to the degree that they provide incentives and desirable outcomes for both producers and consumers. Certification, and the eco-labels that represent certification systems, are primarily aimed at providing information to the consumer at the end of the supply-chain regarding the quality of the products and production processes. If consumers fail to recognize the impact of their purchasing habits, or are unwilling to pay premium prices for products with sustainability eco-labels, then the interest of large retailers in promoting such standards might wane (Glasbergen 2011). When demand for certified products is low, fewer incentives will exist for producers to be

certified (Bartley 2010). Furthermore, when the supply of certified products is low or inconsistent, it is difficult for retailers to require sourcing from certified sources. For example, forest products exported from Indonesia are rarely certified because consumer and retailer demand for sustainable products is low in the Asian markets where Indonesian lumber is sold (Bartley 2010). Certified forest products are more reliant on environmentally sensitive developed country markets, such as those in Europe. The more geographically extensive that supply-chains of wood and paper become, the more influence a particular big market like Europe can play in influencing countries involved with international trade so that they supply certified raw wood and processed wood products (Rametsteiner and Simula 2003).

### 4.3.2 Reliance on Market Logic

The limitations experienced by sustainability standards and certification systems have been attributed to their inherent reliance on market logic. Based on such logic, the durability of certification systems hinges on the voluntary participation of rational and utility-maximizing producers, and this participation is based on the profitability of certification in terms of net benefits from price premiums and increased market access, or the profitability of avoiding net costs. Unlike public policy where rules must be followed, private (non-state market-driven) governance systems allow for actors to participate and suspend participation contingent on their own needs. Also, unlike public policy regulation, where enforcement lies in the hands of sovereign states, private certification bodies are able to suspend certificates, but are unable to actually enforce compliance with certification standards in any direct way. Furthermore, private governance arrangements have a limited capacity to ensure or enable the participation of producers who are unable to comply with standards or afford the cost of certification (Gulbrandsen 2004).

Influencing the practices of a certain economic sector hinges on the extent to which a certification scheme is supported by the market. As noted previously, the degree of market penetration will usually depend on the willingness of actors (buyers and consumers) to choose certain eco-labels over other eco-labels or conventional labels, and to be willing to pay a premium for it (Gulbrandsen 2004). However, we must be careful of attributing the popularity and prevalence of a certain certification system to the demand of ordinary, off-the-street consumers (Gulbrandsen 2004). Retail purchasers may seek to take precautionary measures to manage the risks associated with bad publicity, public shaming, consumer boycotts, and conflict with NGOs. It is this response to the activism and pressures of environmental and social organizations that sometimes leads professional purchasers to require certified products.

Furthermore, the motivation of individual firms to become certified will depend on individual cost-benefit analysis. If tangible benefits stemming from certification are minimal, enterprises will have very little motivation to participate in certification systems. However, if certification can be obtained without significant changes in current management and production practices, then firms will have incentive to join. Consequently, certification systems are likely to attract those actors through whom

little impacts on sustainability will occur, while those actors most in need of improvement will only be attracted if someone else is paying the cost (Rametsteiner and Simula 2003). Whole industries are even less motivated to change and submit themselves to stricter controls (Rametsteiner and Simula 2003), unless doing so would lessen the pressure of activists and social-environmental organizations.

Gulbrandsen (2004) notes two key conditions that must be met for effective, voluntary, market-driven governance instruments. First is the need for strong environmental standards, and second is the need for widespread participation of producers. These two criteria, however, run in tension with one another. If markets do not provide significant benefits for strong eco-labels representing robust sustainability criteria and certification procedures, then producers will prefer labels representing weaker and more flexible standards. Nevertheless, the competition between different schemes in forest certification has revealed increasingly stringent environmental standards, likely the result of increasing pressure from environmental groups (Gulbrandsen 2004).

Pattberg (2005) examined the problem slightly differently, claiming that effective market-based systems for governance toward sustainability outcomes must meet two basic conditions. First, demand for eco-labeled products must be sufficiently high and steady to affect changes in production processes and business practices beyond temporary, "hot topic" public relation campaigns that are acted on in the media. To meet this condition, the champions (such as civil society organizations) of standards and certification systems must adequately inform consumers about existing choices. Second, effective private governance requires an adequate and consistent supply of certified products. When new systems are unable to provide a consistent visible presence in the market, they lessen their credibility, reduce their market share, and face difficulties in rivaling the non-certified products of competitors.

### 4.3.3 Failure to Address More Systemic Problems

Sustainability standards and certification systems have been criticized for failing to address more systemic sustainability problems. For example, Bartley (2010) notes that deforestation and illegal logging may be symptoms of a deeper problem of overcapacity in the pulp, paper and plywood sectors. Market-based solutions pursued through sustainability standards may fail if more fundamental economic problems are not addressed.

### 4.3.4 Difficulty of Navigating Local Land Tenure Arrangements

The condition of the national context in which sustainability standards are implemented greatly impacts the success or failure of standards systems to reach compliance and enhance sustainability. Indonesia, where sustainable forestry standards conflict with local land tenure arrangements, provides a good example. The logic of certification does not adapt well to the political economy of land use in Indonesia. Certification systems rely on evaluations occurring in specific forest units, but the system of forest

governance in Indonesia does not respect the integrity of such units (Bartley 2010). Certification requires clearly defined forest boundaries and clear classification of forest types. Such clarity, however, does not exist in Indonesia, as 90% of state forest land has ambiguous legal status. Ambiguity results from conflicting interpretation of land rights and land use practices between the central government and customary, community-based land rights (*adat*). Land reforms to address these issues have stalled.

The resulting predicament runs counter to FSC principles. FSC principle 2.2 says, among other things, that "… local communities with legal or customary tenure or use rights shall maintain control, to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies …". FSC principle 3 includes that "… the legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected …". Despite these FSC principles, the Indonesian Ministry of Forestry has often granted timber concessions to large firms in areas where communities claim land use rights or where the legal status of the land is still unresolved (Bartley 2010).

Consequently, these timber firms face challenges in receiving FSC certification, and certifiers and NGOs face the dilemma of handling these cases. Companies claim that they were granted concessions through legal channels and therefore should not be sanctioned for issues beyond their control. The FSC and certifiers respond that companies could better work with communities to form private agreements and satisfy the "free and informed consent" principle. Critics argue that these private arrangements are still insufficient, especially if companies possess the power to purchase or coerce the community's consent through gifts and bribes to community elites (Bartley 2010). The resulting implementation of FSC certification in Indonesian forests remains contentious, and in the tense and uncertain environment, may lead to accelerated deforestation as various actors compete for short-term profit maximization while the system is still in their favor.

Under current land tenure conditions, some NGOs claim that credible FSC certification is structurally impossible in Indonesia and that there may be no alternatives to serious land tenure reform. Initiatives to certify the Indonesian timber and forestry sector have illuminated the fact that the state continues to play a prominent role in determining the success of private governance initiatives. Rather than transcending the state's power, sustainability standards and certification systems in the Indonesian context reveal that the nature of the state and its relationship with industry is a vital factor in determining the effectiveness of sustainability-promoting efforts (Bartley 2010).

### 4.3.5 Lack of Regional and National Specific Standards

The implementation of FSC certification in Indonesia has been compounded by the lack of an FSC-approved standard for Indonesia. The FSC has established universal principles and criteria for their worldwide operations. However, the universal principles and criteria are intended to be adapted by national or regional bodies to particular

ecosystems and societal conditions. This multi-stakeholder national or regional standard-setting process includes important dialogue concerning the specific operationalization of FSC's broad principles in the local context. The process of establishing national FSC criteria in Indonesia has thus stalled, and after two decades of FSC activity in Indonesia, a national FSC standard remains unrealized (Bartley 2010). In the Indonesian case, the failure to create a nationally-recognized FSC standard largely stems from the poor relationship between the international FSC and the national Lembaga Ekolabel Indonesia (LEI), which was developed in 1993 as a competing system "from within Indonesia" in response to international scrutiny (Bartley 2010).

### 4.3.6 Dilution Through Negotiation in Multi-Stakeholder Partnerships

Because the development of sustainability standards and certification systems requires compromise between multiple stakeholders with potentially divergent interests, critics have claimed that the resulting schemes represent weak and diluted means of promoting sustainability. Developing sustainability standards requires the involvement of multiple stakeholders for legitimacy and contextual applicability (Lewandowski and Faaij 2006). The negotiation between different actors, and the concessions necessary to achieve agreement, may result in the adoption of standards that are far less stringent and rigorous than the standards of sustainability pioneers, such as those in the organic agriculture and Fair Trade movements (Daviron and Vagneron 2011). Negotiation and constructive dialogue between environmental and social NGOs and corporations implies a new form of interdependence that threatens the independence of civil society activism. While these collaborations draw NGOs with the appeal of greater influence and power, their social and environmental interests may be co-opted in the process. As Falkner (2003:81) notes, "NGOs are effectively lending legitimacy to these corporations and their business operations. Rather than empowering NGOs, private governance can thus be seen as taming civil society actors". Global self-regulation by Multi-National Corportations (MNCs), as legitimized by collaboration with NGOs, upholds the predominant neoliberal paradigm and undermines and precludes a more radical critique by NGOs of the global economic system and the ecological crises it has created (Falkner 2003). However, viewing NGOs as homogeneous oversimplifies the various ways in which NGOs have sought to exert influence and power.

The Roundtable for Sustainable Palm Oil (RSPO) serves as a good example. Although some NGOs participated in the RSPO standard-setting deliberations, other NGOs have remained external to the process and criticized the resulting criteria as being too lax. For instance, the RSPO actually legitimizes large-scale plantations, a stance that has garnered negative publicity, campaigns, and actions against the RSPO and its members. Furthermore, the involvement of RSPO members does not guarantee that they comply with the RSPO principles and criteria. In addition, external NGOs have continued to criticize the RSPO as an excuse for governments to not take more intentional action (Schouten and Glasbergen 2011).

### 4.3.7 Challenges of Documentation for Certification

The documentation required for certification poses another potential shortcoming in sustainability certification systems. Producer documentation of production practices is essential for third-party certification and auditing. For small-scale producers and enterprises, this additional demand may exceed the limits of capacity or cost-effectiveness, resulting in the exclusion of these actors from the market-chain. Furthermore, the growing importance of documentation increases the tendency for reporting to take precedence over actual practices that enhance sustainability. Making processes auditable becomes more important than making processes sustainable. The ability to document and report key performance factors becomes the primary emphasis of the standards (Daviron and Vagneron 2011). The result is a watering down of standards and eco-labels that represent good documentation but not sustainable practices and products.

### 4.3.8 Marginalization of Small-Scale Producers and Retailers

One shortcoming of sustainability standards and certification systems is their tendency to undermine social sustainability by marginalizing small-scale producers, enterprises, and retailers. In the food system, for example, large-scale food processors and retailers have the purchasing power whereby they can make private standards obligatory for any producer who wants market access to global chains. When small-scale farmers, food processors, and retailers are unable to overcome the constraints of these private standards, they face reduced market access, marginalization in global food-chains, and increased economic inequality (Fuchs et al. 2011). Forest certification can also marginalize small-scale private forest owners and producers in developing countries. Certification adds cost to the production process, costs that are more heavily felt by small-scale producers who are unable to spread costs out across a larger operation. The result is loss in market share as they fail to cost-effectively meet market demands for certified timber and forestry products (Rametsteiner and Simula 2003).

### 4.3.9 Inadequacy of Auditing Systems

The sufficiency of auditing systems to independently certify has also been called into question. Third-party assessments under industry-dominated sustainability schemes are criticized for lax standards, sub-standard interpretation of standards, interpretive leniency, and deficient procedures. Auditors face the challenge of assessing environmental and social criteria that are often ill-defined, irrelevant to local conditions, or poorly operationalized. Due to the subjective nature of assessment, different auditors within the same certification schemes may come to opposite conclusions. Even greater variation may exist among audits performed under different certification schemes. Competition between auditors for clients in the markets, and therefore the

advantage of providing successful audit outcomes, may further undermine the objectivity and independence of these so-called "third-party" actors (Gulbrandsen 2004). In a review of FSC certification bodies, the Rainforest Foundation reported that FSC certification suffered from inadequate audits by accredited certification bodies, weakness in the operation of the scheme, and a lack of effective control mechanisms (Gulbrandsen 2004). The proliferation of certification bodies in response to the proliferation of private standards has further exacerbated the disharmony between fragmented auditing systems, hence threatening the effectiveness and legitimacy of third-party certification (Hatanaka and Busch 2008). Furthermore, not all auditors possess the knowledge and technical skills necessary to provide thorough, accurate audits (Hatanaka and Busch 2008).

Hatanaka and Busch (2008) describe accreditation and certification bodies as possessing organizational, but not operational independence from the actors they monitor. These relationships are often based on relationships of "trust", whereby the granting of certification depends primarily on self-assessments. While certification bodies claim greater objectivity than suppliers or buyers based on their external position as third-party auditors, they tend to conduct audits that merely evaluate the internal documentation prepared by those being audited, checking to see if appropriate systems are in place, and in good faith believing that those systems are implemented. Because it is advantageous for both certification bodies and business actors to present themselves in the best light possible, opportunities to engage in fraudulent certification are possible (Hatanaka and Busch 2008). Utilizing their "external" position, certification bodies can emphasize their objectivity while abdicating responsibility when unsustainable practices become public controversy. Rather than being independent, auditors exhibit strong interdependence. As actors embedded in political, social, and economic networks, auditors may pursue their own interests, benefits, and agendas, thus affecting the outcomes of their audits.

### 4.3.10 Competition Among Actors

Closely linked to concerns regarding the independence and objectivity of auditors is the increasing competition between actors in sustainability standards and certification systems. For instance, critics of the FSC claim that environmental organizations have usurped governing authority and portrayed themselves as self-appointed authorities in a sector where they have inadequate knowledge, narrow experience, and no legitimate right to regulate. As a result, industry actors chose to develop and establish competing schemes that were more affordable and accommodating to the industry (Gulbrandsen 2004). The result has been competing schemes whose differences are rarely understood by the average consumer or buyer. Since competition occurs *via* pricing, private governance may very well lead to a "race-to-the-bottom" where standards are lowered to obtain competitive advantages (Pattberg 2005).

Competition may also lead to accountability conflict between the public goals of sustainability standards and the private goals of actors (Schouten and Glasbergen 2011). Third-party certification is a business, and therefore the offering of services

amounts to a strategic business decision. This is especially true as third-party certification bodies have proliferated, leading to a highly profitable and competitive industry. As a business, certification bodies must survive and remain profitable through the provision of cost-effective services beneficial to their clients. When a particular certification body evaluates a market actor as failing to comply with sustainability standards, they assume the risk that this unfavorable assessment will cause the private actor to cease business with that certification body. Competitive certification bodies now find it difficult to substantiate their independence as civil society actors.

Certification bodies also seek to strategically position themselves within sectors to pursue their own profit maximization or cater to the social or environmental sustainability agendas of their donors. Certification bodies make strategic business decisions about within which sector they operate, which standards and auditing practices they use, and to what extent they publicly advertise their services. These decisions are made in order to secure strategic positions in relation to other certification bodies. For example, the food and agricultural sector has witnessed an increasing number of certification bodies. Certification bodies include start-up organizations as well as certification bodies from other sectors that have expanded into food and agriculture. As a result of this competitive atmosphere, observers have questioned the agriculture and food-related knowledge, training, and competency of new auditors, and are concerned that the proliferation of certification bodies might lead to poor auditing practices and inconsistencies in third-party certification. In the long run, this could undermine the legitimacy and credibility of third-party certification (Hatanaka and Busch 2008).

Furthermore, some certification bodies, especially those that are smaller in size, might find the cost of accreditation outweighs the benefits, and therefore choose not to become accredited. This leads to further fragmentation of certification bodies and increased inconsistencies in their practices. Facing different constraints and pressures, large certification bodies might oppose efforts to harmonize standards and auditing practices. These certification bodies are often large because of the widespread use of standards and auditing practices that they themselves created. These proprietary standards, which often remain confidential, are the certification body's basis for success, and represent strategic niches that establish a competitive advantage. To forego their own standards and auditing practices in order to harmonize with other standards and practices might lead to the organization's downfall (Hatanaka and Busch 2008). Although harmonization of standards and auditing practices might benefit the entire sector, the vested interest of large certification bodies creates inertia against such change.

### 4.3.11 Failure to Precisely Address a Range of Concerns

Formulating sustainability standards that precisely address a wide scope of concerns is another challenge for private governance. When NGOs are behind the creation of sustainability standards, they often proceed in an unsystematic, uneven manner,

**Table 8** Potential trade-offs between competing values in relation to sustainable forest fuel production and harvesting

| | Option 1 | Option 2 |
|---|---|---|
| 1 | Local people have the right to collect firewood from the forest | Firewood resources used for other management objectives than support for local people |
| 2 | Residues removed to maximize use of harvested residues and to protect against pests and wildfire | Leaving residues in the forest as substrates for biodiversity and ecological functions, and to provide a protective skid-trail mat |
| 3 | Compensatory fertilization, liming or wood ash recycling to off-set increased nutrient removals and accelerated soil and water acidification | Avoiding the use of chemicals in the forest |
| 4 | Stump harvesting for energy purposes and root-rot abatement | Avoiding soil disturbances |
| 5 | Storing biomass in the forest to shed nutrient-rich needles and increase woodfuel quality by reducing moisture content | Avoiding temporary storage of raw wood-fuel material in the forest because of the risk of pest insects, or loss of rare species using biomass as habitat |
| 6 | Establishment of energy plantations on degraded forest lands to produce sustainable biomass for industrial energy needs and climate change mitigation | Full restoration of degraded forest lands for subsistence use by local communities, and improved environmental conditions |
| 7 | Establishment of energy plantations on agricultural land for sustainable biomass for industrial energy needs and climate change mitigation | Using agricultural land for food production or other purposes |
| 8 | Improved yield and efficiency through use of exotic species and GMOs | Maintenance of natural genetic diversity for resilience |

Modified from Stupak et al. (2011)

preferring to concentrate on those environmental issues that are most salient among supporters, or that attract the most media coverage (Falkner 2003). Consequently, other less-sensationalized or less-popular social and environmental issues remain unaccounted for in sustainability schemes. An additional challenge is faced in precisely defining and operationalizing indicators for various social and environmental criteria. Statements may express the aims that are to be pursued, such as respect for the rights of indigenous peoples or the conservation of ecosystems, yet these criteria are difficult to describe in terms of "hard" indicators (Lewandowski and Faaij 2006). Furthermore, necessary trade-offs occur between various economic, social, and environmental values (see Table 8). Following Option 1 in Table 8 on some of the alternatives does not mean following Option 1 on others. Each of these potential trade-offs involves discrete decisions on the use of (1) firewood, (2) residue removal, (3) use of chemicals, (4) stump removal, (5) storage of biomass, (6) use of degraded forest lands, (7) use of agricultural land, and (8) choice of genetics.

## 5 What Is the Result of Competing Sustainability Standards? Does Competition Lead to More Stringent Standards or to Lowest Common Denominator Requirements?

The multiplicity of standards has thus far defied conventional wisdom. It might be expected that industry actors would require efficient regulation schemes. Therefore, schemes would evolve over time and, by process of elimination due to weakness and inefficiencies, dominant standards solutions would emerge (Manning et al. 2011). Such has not been the case. The proliferation and competition of sustainability standards systems poses interesting questions regarding the evolution of private governance. Will trends toward the proliferation of standards continue? Will alliances between standards systems be forged to compete for greater market control? Will competition result in convergence or greater differentiation between various standards? Will competition in general lead to more stringent standards or will standards be reduced to the "lowest common denominator" requirements?

Based on trends in the forestry sector, Pattberg (2005) proposed three potential scenarios for the future. First, if the demand for certified sustainable products remains constant or continues to grow due to popular pressure and consumer preference, then dominant private standards systems could emerge based on high levels of credibility. Second, diverse consumer demands could lead to further fragmentation in private regulation systems. High-credibility, high-cost systems would satisfy the demands of a certain consumer market, while lower-quality, lower-cost certification systems would service other portions of the market. Third, consensus between various private regulation systems could be reached at an international level, resulting in the integration and convergence of different standards into global, industry-wide standards. While individual standard-setting and certification bodies may lose their autonomy, expanded influence over entire sectors might be appealing to certain actors. As a potential extension of this third scenario, private regulation systems may be further integrated into mandatory state-based public regulation, hence bringing further harmonization and integrity to standards systems (Pattberg 2005). However, competition and possible interplay and overlap may also exist between private and the numerous public bilateral, regional, and global agreements on issues of sustainability standards and regulation.

As a result of competition and proliferation, consumers and policy-makers may be given too much complex and contradictory information, resulting in companies taking advantage of various schemes that are played against each other (Pattberg 2005). When each scheme uses its own label, it becomes difficult for buyers and consumers to quickly differentiate between the reliability of different claims. Buyers and consumers cannot be expected to make quick assessments of the credibility of different systems, as this evaluation requires expertise, information, and time that they usually do not have (Rametsteiner and Simula 2003).

As certifiers compete for legitimacy among advocacy groups, consumers, and multinational corporations, there is no guarantee that the best standards will always win (Linton 2005). For example, in the case of standards certification for Indonesian

apparel and footwear production, competition among initiatives was won by the weaker competitor, resulting in a certification system that lacked credibility (Bartley 2010). It is vital that we better understand the conditions under which private regulatory competition leads to a "racheting down" of private standards and when, on the contrary, competition might raise the level of private standards (Overdevest 2009).

The forestry and timber sector provides a good case study on the dynamics of competition between various sustainability standards and certification systems. Although the FSC was founded in 1993 and was the primary certification system for much of the 1990s and early 2000s, its privileged position in the sector has been challenged. As of 2005, a least 23 different national, regional, and global standards competed with the FSC. One competitor, the Programme for the Endorsement of Forest Certification (PEFC), was established in 1999 by forest owners and the timber industry as an umbrella scheme for national standards. By mid-2002, the PEFC had become the world's largest forest certification scheme in terms of certified forest land (Gulbrandsen 2004).

The marginalization of the FSC and the widespread support for the PEFC and other programs originating from within the industry has disappointed many environmental groups, who see the industry initiatives as inherently weaker. For example, unlike the FSC, the PEFC does not rely on independent on-the-spot inspections, demand annual inspections, or implement regular checks. This should be no surprise, however, as competing forestry standards allow for producers and suppliers to choose from the standards systems that best fit their needs, reduce their costs, and maximize their profits (Pattberg 2005).

What has caused forest owners to develop and utilize schemes other than the FSC? First, the dominant role of social and environmental groups, and hence the negligible role played by forest owners, in creating the FSC sustainability criteria calls into question its credibility and independence. Forest owners perceive an "accountability crisis" whereby environmental and social interests dominate the decision-making process of the FSC, thus marginalizing the interests and concerns of forest owners (Gulbrandsen 2004). Second, forest owners perceive that the FSC lacks the interpretive and applicative flexibility necessary to provide standards relevant to the various "on-the-ground" conditions and numerous sizes, scales, and types of forest management. Third, the FSC system was perceived as being intrusive, paying more attention to social and environmental criteria and less to economic criteria. In response, industry-based standards may be viewed as "an attempt co-opt the discourse on forest certification and attract forest owners away from the stronger standards of the FSC" (Gulbrandsen 2004).

The competition among schemes has been influenced by the degree of widespread participation within schemes. For instance, because the supply of FSC-labeled forest products is often limited, most "green" professional purchasers only require their suppliers to be certified, regardless of the stringency and credibility of the particular certification label. In this case the competitive advantage of more rigorous standards is undermined by the inability to supply sufficient quantities of certified wood products. Self-imposed policies requiring purchase of particularly labeled products

may need to be softened or disregarded if supplies are too limited (Gulbrandsen 2004). The long-term result is a lost opportunity to gain a greater share of the market.

Some see a positive relationship between the multiplicity of standards and effective development efforts. Rather than being viewed as problematic, the diversity of standards allows different countries to participate in the process. The development of different regulatory schemes and the competition for adoption address particular producer needs, thus creating feedback loops that are beneficial for effective development efforts (Manning et al. 2011). Nevertheless, Giovannucci and Koekoek (2003:36) predict that "… the industry is clearly headed for a shakeout of the many initiatives. It is likely that the survivors will (a) have true international credibility with farmers, their representatives, and consumers; (b) be verified by independent certification; and (c) will be simple and accessible enough to satisfy both the farmers and the corporate bottom line".

## 6 Eco-Labeling and the Impact of Sustainability Standards on Consumers – What Happens When Proliferation of Sustainability Standards Occurs? Do They Lose Market Utility?

Due to the market-logic inherent in private sustainability standards, consumer purchasing preference forms an important juncture of influence on the degree of success achieved by sustainability standards. However, large consumer markets still remain unaware, indifferent to, or unconcerned by the numerous social and environmental sustainability issues covered by various eco-labels. Changing society's norms regarding the need for sustainable goods in the marketplace precludes sustainability outcomes that can be achieved through implementing sustainability standards (Linton 2005). If there is no consumer demand for sustainably-produced products, then the producers and retailers will see no need to participate in these systems.

Eco-labels are the primary means of communicating information about sustainability standards to consumers. Eco-labels are one form of quality assessment of producers, products, production processes, and services that indicate social and environmental qualities that consumers cannot ascertain by themselves. In its brief, concise form, the label is designed to facilitate quick decision-making. The average consumer, faced with limited time to make multiple purchasing decisions from a wide spectrum of options, may contemplate one particular decision for only a few seconds. Eco-labels especially attract environmentally and socially-sensitive consumers, but also communicate awareness to the larger market (Bratt et al. 2011). The average consumer, however, has very little reason to switch from familiar brands to likely higher-priced eco-labeled brands. Without considerable advertising and promotional efforts, proponents of various eco-labels have limited opportunity to transmit more in-depth and compelling information to mainstream consumers.

Simpler, more easily identifiable eco-labels might attract more mainstream consumers who value sustainability, yet find the proliferation and complexity of various eco-labels too challenging to navigate (Giovannucci and Ponte 2005).

Certain eco-labels have achieved a large degree of success, although some limitations for wide-spread consumer acceptance remain. Eco-labels for "Fair Trade" and "organic" convey a positive image to consumers, are familiar, and are generally available in developed country markets. As these labels have grown from small niche markets into mainstream distribution channels, however, the meaning of their sustainability claims remains ambiguous to many mainstream consumers (Giovannucci and Ponte 2005). In mainstream markets, eco-labeled products sit alongside a large selection of other competing brands conveying different messages. Although these eco-labels are often considered to be new brands, they lack the promotional drivers of conventional brands. Differentiation usually focuses on five characteristics: convenience, health, flavor, quality/prestige, or price. While eco-labeled products may compete in terms of health, flavor, and quality, they have rarely managed to compete with the established brands' abilities to convey powerful and persistent messages about convenience and price. Neither are they likely to secure large and prominent shelf space in supermarkets (Giovannucci and Ponte 2005).

The proliferation of sustainability standards has the potential to undermine the credibility of these private regulatory schemes. The number of eco-labels in multiple sectors has grown rapidly. When consumers are faced with multiple labels representing different levels and types of economic, social, and environmental criteria, they can become overwhelmed and unable to make informed decisions. In general, different labeling systems lack cohesion. Researching and understanding the various labels requires too much time and effort, resulting in confusion and erosion of trust and confidence in these labels (Bratt et al. 2011). The global competition between various eco-labeling schemes may discredit the whole system of eco-labeling and damage the reputation of sustainability standards of any type (Gulbrandsen 2004).

Evidence from various coffee eco-labeling systems reveals that consumer confusion is not always the result of multiple eco-labels sitting side-by-side in the market. Diverse issues are carried by a variety of labeling systems, such as protecting the environment, preserving bird habitat, and guaranteeing the subsistence of small-scale farmers. Nevertheless, none of these labeling systems claims to exclusively address one issue or inclusively address all issues. Media and advertising campaigns have popularized the various issues, leading to a growing consumer base that connects their coffee purchase to social and environmental issues in developing countries. Rather than seeking to address all relevant issues, consumers seem content to address at least one of any interchangeable sustainability issues, revealing "some amorphous worry or concern on the part of the consumer that might be generically addressed by any of several anxiety-relieving certificates" (Linton 2005:610). The need or demand for a "super seal" for coffee that addresses sustainability more holistically remains to be seen (Linton 2005). Other scholars remain less optimistic, citing that recent large-scale

industry surveys in 14 major markets suggest that the specific characteristics of certifications are confusing to the coffee industry – and especially to consumers (Giovannucci and Ponte 2005).

## 6.1 Sustainability Standards as Good Business

Participation in sustainability standards and certification systems is increasingly viewed as "good business". New types of private standards are becoming important factors in international trade. Sustainability standards are no longer just neutral market lubricants, but are also tools of product differentiation. Compared to conventional grades and standards, sustainability standards are about more than reducing transaction costs of commodity market-players. They now serve as strategic instruments for market penetration, branding, commodity-chain coordination, niche definition, and quality and safety assurance (Giovannucci and Ponte 2005; Melo and Wolf 2005).

The Malaysian and Indonesian Palm Oil Associations serve as good examples of sustainability standards as "good business". During the early stages of the formation of the RSPO, the Malaysian Palm Oil Association saw that their participation could help counteract criticism from NGOs regarding deforestation and land conversion. At the same time they were hesitant to join the RSPO, fearing that by doing so they would admit that there were unsustainable practices in the industry that needed to be addressed. Nevertheless, they believed the advantages of joining outweighed the risks of not joining and thus being isolated and labeled as "unsustainable producers". Furthermore, participation in the RSPO created new market links with the European market, a relationship Malaysian producers were eager to strengthen. The Indonesian Palm Oil Association was not as interested in forming these linkages with European markets, as their primary markets were in Asia. Nevertheless, they did not want to be viewed unfavorably compared to Malaysia, and thus joined the RSPO as well (Schouten and Glasbergen 2011).

## 6.2 Impact of Sustainability Standards on Domestic vs. Export Markets in Developing Countries

While sustainability standards may have some positive effects on the social, economic, and environmental sustainability of export-oriented production in developing countries, the impact on domestic markets has at times been negligible and even detrimental. Private food standards, for example, address issues of food safety throughout global food-chains. These positive effects, however, exist mainly for consumers in industrialized countries and the elite consumers in developing countries. While proponents claim the existence of some positive spillover effects on domestic markets, more critical observers claim that the private retail standards contribute to an increasing inequality between the quality of export and domestic food products (Fuchs et al. 2011).

### *6.3 FSC Certification and Its Failure to Be Implemented on a Wide Scale in Tropical Countries, Despite This Being Its Original Intent*

Sustainability standards have not always succeeded in achieving the original intention for which they were developed. For example, the FSC was formulated with the aim of preserving biodiversity and limiting the harvesting of old-growth forests, especially in tropical developing nations. However, after 10 years of implementation, the largest portions of certified forest were in temperate and boreal zones, leading some to claim that the FSC had largely failed to achieve its original intentions (Rametsteiner and Simula 2003). Although there is some FSC certified forestland in developing, tropical nations, certification has primarily been a tool applied in the developed-world forests in Europe and North America. The areas where biodiversity most needs to be preserved, therefore, are barely impacted by the FSC (Rametsteiner and Simula 2003). Furthermore, FSC certified forests in tropical nations are largely made up of timber plantations, thus reducing the impact of certification on preserving natural grown tropical forests. This indicates that the market benefits resulting from certification are not sufficient to convince a large portion of the forest owners in developing countries to participate in the certification programs, or that there is little knowledge of these programs (Gulbrandsen 2004). In addition, evidence reveals that tropical forest certification, especially for small-scale holdings, is more costly. Certification is more costly for tropical forests than temperate or boreal forest because tropical forests are more complex and thus require more time for audits and preparation of documentation. Tropical forests also tend to have less established management procedures in place. Furthermore, the certification of smaller forests is typically more costly than for larger operations. Compounding the problem for small-scale, tropical land owners is the fact that the costs paid by the producers have generally not been passed on to the buyers in the retail sector (Pattberg 2005).

## 7 Conclusions

### *7.1 Strengths (Opportunities) of Sustainability Standards*

Sustainability standards are attempts to reduce the potential environmental and social harm that occurs in the processes of production to consumption. Rather than CBOs pressuring the state, as occurred during the Reform Era, to regulate food safety and working conditions, the globalization of markets and supply-chains reduces the ability of nation states to derive or enforce standards. CBOs have increasingly become aware of the power of money – both in terms of sources of funding (such as the multinational International Finance Corporation of the World Bank Group) and the purveyors of the end product, particularly name brands that can be selected or boycotted on national and international scales. In the case of sustainable palm oil,

CBOs and indigenous groups worked to develop an "ecological modernization" win-win approach (Hajer 1996; Mol 2001) with at least participation of the state.

The Walmart™ Sustainability Standards, in contrast, do not include the state, or negotiations with CBOs. Instead, multi-national firms work together with academic scientists to develop cost-saving science that also contributes to environmental sustainability. They have a powerful effect, due to the incredible purchasing power of Walmart™.

## *7.2 Limitations (Constraints) of Sustainability Standards*

Sustainability standards are only as good as their enforcement. In globalized value-chains, what happens to indigenous peoples or to peatlands is difficult to monitor and to assess before the cultural or environmental damage is done. The power to limit the funding to start more plantations requires a large investment by diligent CBOs across continents.

In the case of the Walmart™ Sustainability Standards, the costs of enforcement are pushed down on the producer, who must show the appropriate documentation to the corporate buyer. That limits the scale of those who can sell into the value-chain to those with deep pockets and industrialized production systems. Small-scale producers in diverse agroecosystems are particularly negatively impacted and excluded.

**Acknowledgements** The authors would like to acknowledge the intellectual support provided by Solutions from the Land (http://www.sfldialogue.net/) and the International Sociological Association Research Committee on Agriculture and Food.

## References

Ackrill R, Kay A (2011) EU biofuels sustainability standards and certification systems: how to seek WTO-compatibility. J Agric Econ 62:551–564

Bain C, Ransom E, Worosz M (2010) Constructing credibility: using technoscience to legitimate strategies in agrifood governance. J Rural Soc Sci 25:160–192

Barham E (2002) Towards a theory of value-based labeling. Agric Hum Values 19:349–360

Barrientos S, Dolan C (2006) Transformations of global food: opportunities and challenges for fair and ethical trade. In: Barrientos S, Dolan C (eds) Ethical sourcing in the global food system. Earthscan, London, pp 1–33

Bartley T (2010) Transnational private regulation in practice: the limits of forest and labor standards certification in Indonesia. Bus Polit 12(3), Article 7, pp 1–23

Blowfield M (1999) Ethical trade: a review of developments and issues. Third World Q 20(4): 753–770

Boltanski L, Thévenot L (2006) On justification – the economies of worth. Princeton University Press, Princeton

Boström M, Klintman M (2006) State-centered versus nonstate-driven organic food standardization: a comparison of the US and Sweden. Agric Hum Values 23:163–180

Boström M, Klintman M (2011) Eco-standards, product labeling and green consumerism. Palgrave Macmillan, New York
Boucher D (2011) Palm oil and tropical deforestation. Union of Concerned Scientists. http://www.ucsusa.org/global_warming/solutions/forest_solutions/palm-oil-and-forests.html#Palm%20oil%20and%20tropical%20deforestation. Accessed 26 July 2011
Brasher P (2010) Wal-Mart wants Iowans to farm by its principles. Des Moines Register, November 7, D1and D4
Bratt C, Hallstedt S, Robèrt KH, Broman G, Oldmark J (2011) Assessment of eco-labeling criteria development from a strategic sustainability perspective. J Clean Prod 19(14):1631–1638
Bretton Woods Project (2011) Open for business: World Bank to reinvest in palm oil amid criticism. http://www.brettonwoodsproject.org/art-568287. Accessed 26 July 2011
Clayton KC, Preston WP (2003) The political economy of differentiating markets: facing reality inside the U.S. Department of Agriculture. Am J Agric Econ 85:737–741
Consumers Union (2011) Consumer Reports. Greener Choices Eco-labels Center. http://www.greenerchoices.org/eco-labels/eco-home.cfm?redirect=1. Accessed 26 Dec 2011
Daviron B, Vagneron I (2011) From commoditisation to de-commoditisation and back again: discussing the role of sustainability standards for agricultural products. Dev Policy Rev 29:91–113
Espach RH (2009) Private environmental regimes in developing countries: globally sown, locally grown. Palgrave MacMillan, New York
Falkner R (2003) Private environmental governance and international relations: exploring the links. Global Environ Polit 3:72–87
Forest Peoples Programme (2011) World Bank lifts suspension on financing palm oil. http://www.forestpeoples.org/topics/palm-oil-rspo/news/2011/04/world-bank-lifts-suspension-financing-palm-oil. Accessed 26 July 2011
Fox T, Vorley B (2006) Small producers: constraints and challenges in the global food system. In: Barrientos S, Dolan C (eds) Ethical sourcing in the global food system. Earthscan, London, pp 163–177
Freidberg S (2004) The ethical complex of corporate food power: environment and Plan D. Soc Space 22:513–531
Fuchs D, Kalfagianni A, Havinga T (2011) Actors in private food governance: the legitimacy of retail standards and multistakeholder initiatives with civil society participation. Agr Hum Values 28:353–367
Fulponi L (2006) Private voluntary standards in the food system: the perspective of major food retailers in OECD countries. Food Policy 31:1–13
Gage D (2009) Wal-Mart to set sustainability standards. Information Week, July 16. http://www.informationweek.com/news/showArticle.jhtml?articleID=218501046. Accessed June 2011
Galan MB, Peschard D, Boizard H (2007) ISO 14001 at the farm level: analysis of five methods for evaluating the environmental impact of agricultural practices. J Environ Manag 82:341–352
Gereffi G, Garcia-Johnson R, Sasser E (2001) The NGO-industrial complex. Foreign Policy, July/August, pp 56–65. http://www.foreignpolicy.com/articles/2001/07/01/the_ngo_industrial_complex?print=yes&hidecomments=yes&page=full. Accessed 26 Dec 2011
Giovannucci D, Koekoek KJ (2003) The state of sustainable coffee: a study of twelve major markets. International Coffee Organization and International Institute for Sustainable Development, London/Winnipeg
Giovannucci D, Ponte S (2005) Standards as a new form of social contract? Sustainability initiatives in the coffee industry. Food Policy 30:284–301
Glasbergen P (2011) Mechanisms of private meta-governance: an analysis of global private governance for sustainable development. Int J Strateg Bus Alliances 2:189–206
Goodman D (2003) The quality 'turn' and alternative food practices: reflections and agenda. J Rural Stud 19:1–7
Goodman D, Dupuis EM (2002) Knowing food and growing food: beyond the production–consumption debate in the sociology of agriculture. Soc Ruralis 42:5–22

Gulbrandsen LH (2004) Overlapping public and private governance: can forest certification fill the gaps in the global forest regime? Global Environ Polit 4:75–99
Hajer M (1996) Ecological modernisation as cultural politics. In: Lash S, Szersxynski B, Wynne B (eds) Risk, environment, and modernity. Sage, London, pp 246–268
Hatanaka M, Busch L (2008) Third-party certification in the global agrifood system: an objective or socially mediated governance mechanism? Soc Ruralis 48:73–91
Hatanaka M, Bain C, Busch L (2005) Third-party certification in the global agrifood system. Food Policy 30:354–369
Henson S, Reardon T (2005) Private agri-food standards: implications for food policy and the agri-food system. Food Policy 30(3):241–253
Hill LD (1990) Grain grades and standards: historical issues shaping the future. University of Illinois Press, Urbana
ISO (International Standards Organization) (2000) Environmental labels and declarations – general principles. ISO 14020:2000(E), International Standards Organization, Geneva, Switzerland
ISO (2011) ISO 14000 Environmental management – ISO 14000 essentials. http://www.iso.org/iso/iso_14000_essentials. Accessed 26 Dec 2011
Kaplinsky R (2006) Revisiting the revisited terms of trade: will China make a difference? World Dev 34:981–995
Klein N (2009) No logo. Picador, New York
Kummer C (2010) The great grocery smackdown. The Atlantic, March. http://www.theatlantic.com/magazine/archive/2010/03/the-great-grocery-smackdown/7904/. Accessed 26 July 2011
Lewandowski I, Faaij A (2006) Steps towards the development of a certification system for sustainable bio-energy trade. Biomass Bioenerg 30:83–104
Linton A (2005) Partnering for sustainability: business–NGO alliances in the coffee industry. Dev Pract 15:600–614
Little D (2003) The paradox of wealth and poverty. Westview Press, Boulder
Manning S, von Hagen O (2010) Linking local experiments to global standards: how project networks promote global institution-building. Scand J Manag 26:398–416
Manning S, Boons F, von Hagen O, Reinecke J (2011) National contexts matter: the co-evolution of sustainability standards in global value chains. Ecol Econ. http://www.sciencedirect.com/science/article/pii/S0921800911003624
Markevičius A, Katinas V, Perednis E, Tamašauskienė M (2010) Trends and sustainability criteria of the production and use of liquid biofuels. Renew Sust Energy Rev 14:3226–3231
McEvoy M (2003) Organic certification in the United States and Europe. Washington tree fruit postharvest conference, Wenatchee, Washington, DC
McMichael P (2009) The agrofuels project at large. Crit Sociol 35:825–839
Melo CJ, Wolf SA (2005) Empirical assessment of eco-certification – the case of Ecuadorian bananas. Organ Environ 18:287–317
Mol A (2001) Globalization and environmental reform: the ecological modernisation of the global economy. MIT Press, London
Mol A (2010) Environmental authorities and biofuel controversies. Environ Polit 19:61–79
Neilson J, Pritchard B (2009) Value chain struggles: institutions and governance in the plantation districts of South India. Blackwell, Oxford
Nadvi K, Wältring F (2004) Making sense of global standards. In: Schmitz H (ed) Local enterprises in the global economy: issues of governance and upgrading. Edward Elgar, Cheltenham, pp 53–94
National Research Council (2010) Toward sustainable agricultural systems in the 21st century. National Academies Press, Washington, DC
O'Rourke D (2005) Market movements. Nongovernmental organization strategies to influence global production and consumption. J Ind Ecol 9:115–128
Overdevest C (2009) Comparing forest certification schemes: the case of ratcheting standards in the forest sector. Soc Econ Rev 8:47–76
Pattberg P (2004) Private environmental governance and the sustainability transition: functions and impacts of NGO-business partnerships. In: Jacob K, Binder M, Wieczorek A (eds) Governance for industrial transformation. Environmental Policy Research Centre, Berlin, pp 52–66

Pattberg PH (2005) The Forest Stewardship Council: risk and potential of private forest governance. J Environ Dev 14:356–374
Pearson R (2007) Beyond women workers: gendering CSR. Third World Q 28(4):731–749
Rametsteiner E, Simula M (2003) Forest certification – an instrument to promote sustainable forest management? J Environ Manag 67:87–98
Raynolds L (2000) Re-embedding global agriculture: the international organic and fair trade movements. Agric Hum Values 17:297–309
Raynolds L (2002) Consumer/producer links in fair trade coffee networks. Sociol Ruralis 42:404–424
Reardon T, Berdegue J (2002) The rapid rise of supermarkets in Latin America: challenges and opportunities for development. Dev Policy Rev 20:371–388
Reardon T, Codron JM, Busch L, Bingen J, Harris C (2001) Global change in agrifood grades and standards: agribusiness strategic responses in developing countries. Int Food Agribus Manage Rev 2(3):421–435
Robinson WI (2002) Remapping development in light of globalisation: from a territorial to a social cartography. Third World Q 23:1047–1071
Rupert M (2005) Reflections on some lessons learned from a decade of globalisation studies. New Polit Econ 10:457–478
Scarlat N, Dallemand JF (2011) Recent development of biofuels/bioenergy sustainability certification: a global overview. Energy Policy 39:1630–1646
Schouten G, Glasbergen P (2011) Creating legitimacy in global private governance: the case of the roundtable on sustainable palm oil. Ecol Econ 70:1891–1899
Silva Castañeda L (2012) A forest of evidence: third-party certification and multiple forms of proof: a cast study on oil palm plantations in Indonesia. Agr Hum Values (in press)
Stupak I, Lattimore B, Titus BD, Tattersall Smith C (2011) Criteria and indicators for sustainable forest fuel production and harvesting: a review of current standards for sustainable forest management. Biomass Bioenerg 35:3287–3308
The Sustainability Consortium (2011) http://www.sustainabilityconsortium.org Accessed 26 July 2011
Thévenot L (2001) Organized complexity: conventions of coordination and the composition of economic arrangements. Eur J Soc Theory 4:405–425
Utting P (2005) Corporate responsibility and the movement of business. Dev Pract 15:375–388
van Dam J, Junginger M, Faaij A, Jürgens I, Best G, Fritsche U (2008) Overview of recent developments in sustainable biomass certification. Biomass Bioenerg 32:749–780
van Dam J, Junginger M, Faaij APC (2010) From the global efforts on certification of bioenergy towards an integrated approach based on sustainable land use planning. Renew Sust Energ Rev 14:2445–2472
Vandenbergh MP (2007) The new Wal-Mart effect: the role of private contracting in global governance. UCLA Law Rev 54:913
Wall E, Weersink A, Swanton C (2001) Agriculture and ISO 14000. Food Policy 26:35–48
Walmart Corporate (2011) Sustainability index. http://walmartstores.com/sustainability/9292.aspx Accessed 26 July 2011
Wezel A, Jauneau J-C (2011) Agroecology: interpretations, approaches and their links to nature conservation, rural development and ecotourism. In: Campbell WB, Lopez Ortiz S (eds) Issues in agroecology – present status and future prospectus, vol 1, Integrating agriculture, conservation, and ecotourism: examples from the field. Springer Science + Business Media, BV, Dordrecht, pp 1–25
World Bank/International Finance Corporation (2011) World Bank Group framework and IFC strategy for engagement in the palm oil sector. http://www.ifc.org/ifcext/agriconsultation.nsf/AttachmentsByTitle/Jan6_RevisedFramework/$FILE/FactSheet_Revised+WBG+Framework+and+IFC+Strategy_January+2011.pdf. Accessed 26 Dec 2011

# Water Sustainability and Politics – Examples from Latin America and Implications for Agroecology

**Jose Manuel Navarrete, Antonio Augusto Rossotto Ioris, and Julian Granados**

**Abstract** The adoption of agroecological practices entails important changes in several aspects of the allocation and use of natural resources. Improvements in the management of water resources and in the conservation of catchment processes represent crucial requirements for agroecology. The search for more sustainable water management is, therefore, critical for agroecological production. This review initially discusses the connections between agroecology and water sustainability and points out the failures of conventional responses to water management problems that are common in many parts of the North and Global South, particularly among subsistence farmers and vulnerable catchments. The experience of recent years demonstrates that, while most public policies aim to reconcile socioeconomic development with the conservation of aquatic systems, in practice those attempts have often led to the intensification of old and new disputes. In the center of the controversy lays a fierce disagreement about the interpretation of the meaning of sustainability and the practice of sustainable water management. As much as agroecology, water sustainability is a contested concept with principally political repercussions. Sustainable use and conservation of water requires a fair and equitable distribution of opportunities across groups and generations allowing all to benefit

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W.B. Campbell and S.L. Ortíz (eds.), *Integrating Agriculture, Conservation and Ecotourism: Societal Influences*, Issues in Agroecology – Present Status and Future Prospectus 2,
DOI 10.1007/978-94-007-4485-1_4, 

from the shared water environment. Imbalances resulting from anthropogenic water extraction, unfair water distribution and ecosystem deterioration (for example, resulting from the prevailing agribusiness model of agriculture production) are highly politicized questions that have serious implications for the promotion of agroecology. The second part of the review involves a conceptual discussion of a case study in Motul, Yucatan, Mexico. The Mexican example shows that agroecology in the Yucatan Peninsula is still marginalized, primarily because export manufacturing has been preferred over agricultural development in many regions of the Yucatan, and that freshwater for agricultural use (in the state as whole) is of limited quality – in part because of industrial underground water pollution, combined with adverse geology, soil, and hydrological conditions. An in-depth analysis of governmental authority policy will help clarify why such pervasive and limiting conditions for the development of agroecology in the state are likely to remain so, at least for intermediate to long time periods.

**Keywords** Political ecology • Latin America • Integrated Water Resources Management • Mexico • Yucatan • Calcareous soil • Geohydrology • Underground watershed • Water extraction • Water treatment • Water quality • Water governance • Water contamination • Trihalomethanes • Carcinogenic • Hammock plant community

## 1 Introduction: Agroecology, Water and Sustainability

Our goal for this review is to relate the agroecological perspective with the broader debate on sustainable development, water sustainability and environmental politics. The assumption underpinning the text is that the connection between ecological food production and the promotion of sustainability – two of the core objectives of agroecology – also requires coherent and robust responses in terms of sustainable water management. The sustainable and fair allocation, use and conservation of aquatic systems have fundamental consequences for food security, sovereignty and justice, as well as for informing local food movements, innovative activism and education, and the whole range of interactions between urban and rural communities. The concern of agroecologists for the sustainability of agricultural systems and the emerging properties of ecosystems (Gliessman et al. 2007) makes agroecology instrumental in the search for sustainable socionatural interactions, which include decisions about natural resources, socio-economic processes and multiple connections between time, scale and space. Agroecology is an interdisciplinary area of study that not only challenges conventional academic boundaries, but calls for new channels of communication between academics, practitioners and the general public. Given that agroecology is primarily concerned with the removal of conventional technologies and policies that oppose the attainment of more sustainable livelihoods, it is closely associated with the political-ecological critique of prevailing environmental management approaches (Amekawa 2011). Issues such as agrarian reform, organic food production and the political recognition of subsistence farmers

are central elements of the resilience of agroecological systems (Simón Reardon and Pérez 2010).

Political-economic aspects associated with globalization (such as free trade agreements and global corporate power) are determinant in understanding changes in agriculture, particularly in the context of developing countries. Global agricultural markets have certainly benefited large-scale producers (in the Global North and South), but in that process small-scale farming and traditional/subsistence agriculture has been replaced by industrial, urban-type jobs – notably in China, India and Mexico to name a few. Agricultural practices have also extensively changed. Widespread use of modern technologies, fertilizers, pesticides, and genetically modified (GM) crops prove that manufacturing and marketing of inputs for agriculture are a global business with environmental and social consequences of different types. Agroecological concerns have undoubtedly flourished, such as in Latin America (Brandenburg 2008; Cruces 1996), as a reaction to speedy changes in the agricultural sector, changes that seem to be at odds with sustainability principles and ideas. Small-scale farmers in Latin America have historically adopted ecologically sensitive practices that are examples of sustainable production and that can further benefit from agroecological techniques (Altieri and Nicholls 2008).

In this sense, water management and water sustainability represent crucial contributors to the wide agroecological debate. Water is an essential input for agricultural production and its properties are related to several catchment features, such as soil properties, land use and climatic conditions. Freshwater allocation, total water consumption, and the need to guarantee freshwater availability and quality (for strategic use) are primary conditions for agroecological systems and among the most discussed development and sustainability issues today. A significant proportion of contemporary water problems are derived from the intensification of agriculture production, particularly due to the increasing use of agrochemicals, heavy mechanisation and irrigation. The continued destruction of ecosystems, the loss of aquatic species, dislocation of human populations, inundation of cultural sites, disruption of sedimentation processes, and contamination of catchments are all evidence of the over-exploitation and poor management of freshwater resources, which has major implications for agroecology and environmental management more generally. Water pollution combined with adverse regional hydrologic and soil conditions, are important factors that can seriously limit agricultural and agroecological possibilities.

Given the recognition of such problems by farmers and official agencies, the management of water systems has been marked, particularly in the last few decades, by a growing complexity and the search for improved responses. Nonetheless, the experience of recent years demonstrates that, while most conventional public policies aim to reconcile socioeconomic development with the conservation of aquatic systems, in practice those attempts have often led to the deepening of old and new disputes around the allocation and use of water resources and have normally achieved only marginal improvements. In the center of the controversy lays a fierce disagreement about the interpretation of the socioecological role of water management and contrasting worldviews on the conservation of aquatic systems. Clashes regarding the priorities and direction of water management are a reflection of

contradictory positions about the value of water stocks and other associated catchment features. Such competing epistemologies of water management have undermined the design of government interventions, the adoption of specific assessment procedures and the formulation of regulatory strategies that are supposed to achieve higher levels of sustainability. Rather than predetermined, centralized approaches, water management associated with the practice of agroecology should be seen as an opportunity for collective social learning, that is, the understanding that water systems are complex, uncertain and disputed, with their management requiring a willingness to engage with other stakeholder sectors in complementary and creative ways (Ison et al. 2007).

As much as the pursuit of agroecological goals, sustainable water management is a valued activity that encapsulates, at different spatial scales and under concrete circumstances, a range of unresolved misunderstandings of the material and symbolic attributes of water systems (Ioris et al. 2006, 2008). The fierce debate on sustainable development, agroecology and sustainable water management in particular, derives from the understanding that mainstream, prevailing patterns of use and allocation of natural resources are no longer ethically, socially, scientifically or economically acceptable. An unsustainable condition is not simply a sum of negative impacts impinged upon nature, but it is a problem rooted in the patterns of development, democracy and production. As a result, the project of translating sustainable development into practice depends upon transformation in the use and conservation of natural resources, as well as redistribution of burdens and benefits from the appropriation of the environment. Sustainable development is a contemporary search for alternatives that redefines human requisition, use and conservation of natural resources under fairer and more egalitarian bases. That makes sustainability not only a scientific but also a normative concept, which can be expressed by two fundamental principles (cf. Ioris 2005). First, the search for sustainability is a continuous process towards responses that appropriately satisfy natural and social demands; responses which should seek to remove contradictions in the relationship between nature and society. This process involves dispute resolution between conflicting interests, and should follow transparent and democratic approaches. Second, a sustainable process or condition is one that can be maintained indefinitely without progressive diminution of valued system qualities. The consequence is that the entire system need not be maintained in order to be sustainable, but that a certain level of change or adjustment is acceptable, as long as the regulatory functions of the system are not interrupted.

The concept of sustainable development has reinvigorated attempts to better manage the water environment through appropriate policy-making and planning strategies, and represents an important extension of the principles integrating water management that permeate the agenda of water governance (Simonovic 1996). According to the Organisation for Economic Cooperation and Development (OECD) (2003:19), “water is the perfect example of a sustainable development challenge – encompassing environmental, economic and social dimensions.” Planning, regulation and management of water resources are examples of human activities that can directly benefit from the paradigm of sustainable development,

which has serious implications for agroecology and sustainable food production. Agenda 21, one of the milestones of the global negotiation on environmental conservation, affirms in its Chapter 18 that water is an integral part of the ecosystem, a natural resource and a social and economic good whose quantity and quality determine the nature of its use (United Nations Conference on Environment and Development [UNCED] 1993). In the same way, the United Nations Millennium Declaration called upon all member states "to stop the unsustainable exploitation of water resources by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies" (United Nations General Assembly [UNGA] 2000). The new ethic of sustainable development reinforces and extends the main principles of water resources management, such as the equitable distribution of costs and benefits, economic efficiency and achievement of non-economic objectives, and environmental integrity and elimination of irreversible effects.

The role of sustainable management of water resources for agroecology, therefore, implies not only the indefinite continuation of physically and biologically stable systems, but also concern for other dimensions of sustainable development, such as the economic efficiency of water use, the equitable distribution of the costs and benefits of water resource developments, and participatory approaches to policy-making and decision-taking. The 'science of sustainability' (O'Riordan 2004) compounds the complexities of understanding hydrological processes by also requiring both a dynamic view of water resources management as a continuous learning process rather than an end-point, and a holistic and integrated appreciation of the interplay between the environmental, economic and social dimensions of sustainability. A broad understanding of sustainability in the context of water resources must draw on both objective science and qualitative judgements regarding progress. Not surprisingly, therefore, sustainable water resources management is, to some extent, an elusive and contested notion (Rydin 1999). Conceptual difficulties may be overcome by 'learning from doing'; that is, by attempting to translate the goals of sustainable development into adaptive management approaches (Fish et al. 2010).

The importance of sustainable development for water management is demonstrated by the escalating impacts created by most of the current forms of exploitation of the water environment (Falkenmark 2001), many of which are related to food production and agriculture modernization, such as the destruction of ecosystems, increased sedimentation, loss of fish species, dislocation of human populations, inundation of cultural sites, and contamination of surface and groundwater sources by agrochemicals. Gleick (2000) calculates that the enormous expansion of water resources infrastructure has led to a nearly seven-fold increase in freshwater withdrawals particularly caused by conventional forms of food production and irrigated agriculture. According to Sophocleous (2004), humankind is projected to appropriate from 70% to 90% of all accessible freshwater by 2025. Agriculture is the dominant component of human water use, accounting for almost 70% of all water withdrawals, but many other factors significantly impact increasing water demand, including population growth, economic growth, technological development, land use and urbanization, rate of environmental degradation, government programs

and climate change. The problem of the exhaustion of renewable resources, such as freshwater, remains critical, because these resources are vulnerable to human overuse and pollution and have serious consequences for local welfare and regional development. As rhetorically observed by Sophocleous (2004), water problems 'at the global scale do not exist', but all problems manifest themselves at smaller local to regional scales.

Swyngedouw (1999) observes that hegemonic, mainstream water management approaches tend to separate the various aspects of the hydrological cycle into discrete and independent processes (such as hydrology, engineering, economics, agronomy, ecology, etc.). This neglects the fact that nature and society are deeply intertwined, which is demonstrated by the 'hybrid character' of the water landscape, made evident by the intense human intervention in the water cycle. The phenomenon of hybridization between society and nature in a river basin is defined as the production of 'socionature' (Swyngedouw 1999). According to this concept, society and nature are metabolically linked, one affecting and being affected by the other. Nature is not the mere substratum for the unfolding of social relations, but is an integral part of the process of production. The use and conservation of water are not unidirectional, but are part of a relational condition shaped by economic and social determinants. Sustainability implies a non-contradictory condition of the 'socionature' relation. In this sense, sustainability means that nature and society are not external to each other, but dialectically transformed. In other words, a sustainable situation for the use and conservation of water depends on society recognizing itself as intimately related to the existence of the water system. The sustainability of water resources is fundamentally constructed through the removal of barriers that prevent the achievement of this unified condition between the demands of human groups and the requirements of the water environment.

The pursuit of more sustainable, long-term management of water is what Postel (1997) defines as the 'last oasis' available for human society and the farming sector in particular. In other words, the management of water should move away from merely expanding supply and move towards adopting a responsible control of demand. According to Tyson (1995), the sustainable management of water particularly depends on responses in critical areas. These critical areas are, for instance, land use planning, water use minimization and recovery techniques, pollution prevention, treatment options, use-related receiving water standards, economic evaluation tools, and capacity-building for professionals and the general public. However, these are only examples of numerous possible responses, as there remain manifold ways in which society can interfere in the water environment. There is a vast range of critical processes that affect the condition of the water system and, in consequence, the achievement of sustainability. Furthermore, the search for water sustainability does not address only environmental questions, but also institutional, financial, distributive and participatory responses. Sustainability has repercussions for both the environmental dimension of water management and for the socio-economic processes related to water availability and allocation (Schreier and Brown 2001). The long-term resolution of local/regional water problems needs to be based within wider strategies, as it could be possible that the adoption of local/regional short-term

remedies may reduce the benefits of the long-term solutions. Water management requires integrated and long-term measures, because up to a certain point, the outcomes of changes in natural resource management practices are not often immediately apparent (Johnson et al. 2001). Svendsen and Meinzen-Dick (1997) add that to cope with contemporary water problems, fundamental changes are necessary in policies and institutions because the controversy involving sustainable water management is, first and foremost, a political challenge that requires the formulation of new bases of management (Hufschmidt and Tejwany 1993).

Due to the complex interaction between human and hydrological processes, it is not easy to put forward a complete definition that summarises the relation between sustainable development and the management of water that could be universally applied to agroecology. As affirmed by Cocklin and Blunden (1998), there are innumerable competing water sustainability interpretations seeking legitimization. This is because more and more authors have attempted to incorporate aspects of sustainability into the formulation of decision support systems for water management. For Jonker (2002:719) a suitable definition for the management of water would be "managing people's activities in a manner that promotes sustainable development". In an attempt to capture the spatial relevance of this debate, Ioris (2001:24) conceptualises sustainable water management at the river basin level as a "continuous process of managing river basin natural and artificial resources, considering the human dependency on the cyclical flow of water as implication for integrated efforts and environmental stewardship". On one hand, there are interpretations of water sustainability that focus on the balance of resources and the mitigation of environmental impacts, without considering political and participatory requirements in the same level of importance. In an example of a definition centred on the environmental dimension of sustainability, Rennings and Wiggering (1997) affirm that, in order to be sustainable, the harvest rates of renewable resources should not exceed regeneration rates, waste emissions should not exceed relevant assimilative capacities of ecosystems, and non-renewable resources should be exploited in a quasi-sustainable manner by limiting their rate of depletion to the rate of creation of renewable substitutes. Another example is provided by Lundin (1999) who claims that a sustainable water system should not have negative environmental effects even over a long time period, while providing required services, protecting human health and the environment with a minimum use of scarce resources. For the American Society of Civil Engineers (ASCE) (1998), sustainable freshwater resource systems are adaptive, robust, and resilient to uncertain changes, fulfilling positive rates of improvement; implying that the frequency and severity of threats to society are decreasing over time, leaving people more prepared to cope with water stresses when they occur.

On the other hand, more holistic interpretations of water sustainability place equivalent emphasis on public participation and on the relation between water management and the overarching aspects of sustainable development. Legge (2000) points out that water sustainability is tied to goods regulation, through access to information, consultation, and participation in decision-making. According to this holistic view, the agenda of water sustainability must include social and

environmental issues that are not regularly considered in the traditional management process. For Bernhardi et al. (2000), sustainable water management should be addressed from a broader perspective than focusing only on the resource, in a way that managers also become acquainted with a broader set of analytical concepts for problem management. Any interpretation of sustainable water management entails the consideration of long-term consequences of present action, as well as the consideration of external pressures, risks and uncertainties. It is relevant to note that, although some level of uncertainty in the understanding of the management of water systems is inescapable, it must not hinder the pursuit of water sustainability (Clark and Gardiner 1994). To cope with complexity and uncertainty, Kay (2000) affirms that it is necessary to choose a dynamic, rather than a static view of the sustainability concept, that is seeing sustainability as a process rather than as an end-point. According to Lee (1992), sustainable watershed management requires knowledge about ecologically effective forms of social organization, and a major reason for the failure of human societies to develop sustainable resource management activities has been the limitations in their ability to acquire and process ecological information. Ecological and socio-political processes that affect collective action and property rights related to water should, thus, be understood at the social-spatial scale of the river basin (Swaloow et al. 2001).

It is important to observe that because of specific local demands, the sustainability condition may not necessarily be uniform throughout the river basin, but in some sub-units a higher level of environmental impact may be acceptable. Within certain limits, the decision to allow negative impacts in certain parts of the catchment is still in accordance with the goals of sustainable development. For instance, a water supply dam can be built in one section of the river basin, thereby producing local negative impacts, but benefiting the rest of the catchment. That is what Brown and Harper (1999) define as the outcome being bigger than the sum of the parts and the construction of sustainable development incorporating a dialogue between local, sectoral demands and the progress of the whole. To be able to make decisions on this balance between conservation and use of the catchment environment, it is essential that stakeholders are democratically involved in the decision-making process. Thus, water management must involve the river basin community in an effective way to promote the sustainable use of water. Democratic approaches to water sustainability are often termed community-based catchment management, which involves an adaptive planning framework that first seeks consensus on environmental planning, its implementation and its operation, maintenance and monitoring (van Horen 2001).

The argument so far is that the sustainability of water systems, as a basic requirement of agroecology, entails good water quality and satisfactory resource availability, equitable allocation of resources, rational and judicious use, public engagement and an adequate institutional framework. The sustainable management of water is a social construction, a gradual, iterative and dialectical revision of dominant trends and disruptive driving-forces. There are social, economic and environmental dimensions that need to be considered together. The sustainability of water resources is constructed through the removal of barriers that prevent the achievement of common

conditions that serve both the demands of human groups and the requirements of the water environment. In order to consolidate our claims, the core requirements of water sustainability can be expressed by the following three principles. First, the search for water sustainability is the application of sustainable development principles to resource allocation and management in order that nature conservation and social demands are concurrently and appropriately satisfied. Second, the sustainable use and conservation of the water environment presupposes the indefinite continuation of resilient catchment systems and the maintenance of critical ecological functions. Third, water sustainability requires a fair and equitable distribution of opportunities across groups and generations allowing all to benefit from the shared water environment, which must be achieved through participatory approaches, adaptive management and a robust institutional framework. In the next section we will apply this conceptual elaboration on water and sustainability to the historical and geographical specificity of environmental management and politics in recent decades. These two sections together will then inform the case studies on water sustainability in Mexico.

## 2 Moving the Agenda Forward: The Political Ecology of Water Sustainability

The meaning of sustainable water management for agroecology, as briefly discussed previously, has evolved since the early years of the debate in the mid-1980s. There is now a stronger emphasis on the dynamic interaction between nature conservation and the demands of different social groups, as well as a realization of the conflicting perceptions of environmental problems and the limits of science to deal with risk and uncertainty. Policy-making moved away from merely meeting quantitative water demands and restoring ecological features into broader concerns about the integration of spatial and temporal scales of multi-dimensional management issues. Water sustainability grew to include a range of interrelated requirements, such as guaranteeing the water necessary to maintain human health and sustain ecosystems, basic protection for the renewability of water resources, and institutional improvements in terms of planning, management and equitable conflict resolution (Gleick 1998). However, it is often the case that the translation of sustainability principles into action has encountered major obstacles that break the link between economic growth and water demand or that hinder effective coordination of sectorial and local interests with political and development pressures. Regulatory institutions have been reformed in an attempt to integrate stakeholders and spatial areas, but have often failed to address a backlog of management distortions and social inequalities (Ioris 2008). There is a growing appreciation nowadays that water sustainability – as much as agroecology – is a profoundly contested concept, which requires concerted efforts towards forming a shared vision about the management of ‘socialized’ water systems.

It should be noted that water problems have become part of everyday news bulletins, which are translated into growing public awareness of issues like climate change and desertification, but also problems more closely related to agriculture production, like water supply, flooding and river pollution. Nonetheless, not all problems are equally urgent to solve, have the same nature or involve the same number of stakeholders. What is more, despite the sheer deluge of information in modern society, the debate on water problems is certainly not new. In fact, the economic and social dimensions of water were already recognised by economists and philosophers in the eighteenth and nineteenth centuries (Tuan 1968). But it was really in the first decades of the twentieth century that a systematic body of knowledge was developed to organise engineering interventions and foster coordinated responses (Linton 2010). The notion of catchment management was initially applied to the development of water infrastructure in the United States during the economic depression in the 1930s (e.g. the Tennessee Valley Authority experience; cf. Lilenthal 1944). The underlying assumption was that water should be connected to economic development and should be the object of technological and financial investments (the major part borne by the national State). The notion that water could facilitate national development influenced the construction of dams and expansion of water infrastructure after the Second World War (e.g. some of the largest engineering works and irrigation schemes were built in the 1960s and 1970s). During this period, however, public policies were mainly restricted to the coordination of economic targets and infrastructure investments. This initial phase of modern water management was characterized by structural interventions and a central focus on economic growth, with environmental conservation as only a very secondary objective.

Before too long, it became evident that the single economic justification for the construction of water projects was leading to operational inefficiencies and widespread negative impacts. Concepts and techniques started to be revisited at the end of the 1970s and benefited from an increasing awareness of the social and environmental consequences of conventional interventions. Market liberalisation and the declining investment capacity of the national State provided the economic reasoning for a shift from structural measures to non-structural responses. The goal of integration was emphasized further and seen as an antidote to a perceived fragmentation of policies and projects, as well as to the lack of dialogue between public agencies and private water users. In theory, instead of the past attempt to integrate economic growth with water engineering, the new approaches advocated a broader integration of water use and environmental conservation, as well as higher management flexibility and direct forms of stakeholder involvement. Similar to the previous phase of water management, the new ideas also emanated from northern countries and have exerted formidable influence on legal and administrative reforms around the world (particularly since the 1990s). The concept that better epitomizes the current attempts to improve water management is probably 'Integrated Water Resources Management' (IWRM), seen by many as a panacea in the face of challenging socioeconomic and environmental demands.

Despite numerous efforts to conceptualise integrated water management in recent years, its epistemological grounds continue to be unclear and uncertain, which

directly affects the contribution of water management to agroecological systems. Most IWRM scholars persistently insist on the abstractedly defined necessity to integrate plans and procedures, but it is not easy to grasp what exactly should be prioritized and integrated. The literature presents IWRM as a vague combination of wishful thinking (i.e., something needs to be done to solve current water problems and integration is the answer) and exhortative measures (i.e., all sectors and groups should be involved in shared problems). Some reactions to the elusiveness of the concept recommend a tacit association of IWRM with other regulatory mechanisms. Notwithstanding the debate, there remains a systematic lack of conceptual accuracy, which has consequently led to the impracticability of the IWRM-inspired regulation. There is an obvious parallel here with similar concepts like sustainability and sustainable development, where only a superficial level of agreement is reached, while the tangible consequences of those expressions are ambiguous and contested.

In the end, the difficulty of operationalizing IWRM, such as in relation to agroecological practices, is a direct consequence of its imprecise conceptualization. Water management is essentially about choosing one between equally important demands, but elusive claims for wide-ranging integration are unable to offer much help. The weakness of the IWRM concept makes it easy prey for fashionable multidisciplinary academic studies, which normally establish a trivial link between variables and processes of the water systems without really understanding the socionatural complexity of water problems. The result is that academic assessments supporting IWRM initiatives are often employed to legitimize pre-established objectives, instead of boosting a transparent and democratic selection of management responses. Furthermore, the limited resources of public agencies responsible for overseeing IWRM restrict the range of regulatory solutions to a relatively short list of 'manageable' options. In practice, that means a continuation of previous approaches and incapacity to produce innovative answers to water problems. The objectives of integration and consistency are often manipulated by higher authorities to overrule the decisions of catchment organizations, despite the fact that the new agenda of water management includes decentralization as one of its central goals.

It is crucial to recognize that the epistemological and operational limits of IWRM have a more elemental cause, which is precisely the political naivety that characterises the ongoing water reforms. Most of the literature on IWRM still fails to acknowledge that political differences between social groups have a striking influence on water allocation and the distribution of negative impacts. That is precisely what political-ecological studies intend to address, as part of the broader contribution to sustainability and agroecology in particular (Alimonda 2006). It has been observed elsewhere that a critical limitation of IWRM is the entrenched mindset of water managers and hydrologists who consider socioeconomic and political demands as deviations from the 'purist' goals of water management (McCulloch and Ioris 2007). For this group of 'purists', the gap between IWRM prescription and practice is sometimes attributed to 'politics', as if it were only a sort of circumstantial nuisance to be overcome or avoided. Such approaches fall short of addressing the full extent of the political nexus between economic growth, environmental degradation and social demands. Nonetheless, social and economic inequalities are

integral features in a politicized environment, such as in Brazil and Mexico, where conflicts over resources are still linked to systems of political and economic control established in the colonial era. The politicization of water resources in Latin America is translated, for example, into an uneven distribution of public water services or the ordinary exclusion of weaker groups from the decision-making process.

In that sense, water management encapsulates the asymmetry of power between different groups of farmers. Large-scale farmers tend to prefer capital intensive technologies and heavy water infrastructure due to their easier accessibility to credit and markets. In contrast, smaller-scale subsistence farmers tend to maintain adapted, less capital intensive water management practices and rely more directly on community collaboration. It means that water management associated with agroecology techniques does not constitute only a technological option, but it is also part of political and cultural identity. Organic farming systems, including more sustainable water management, offer a direct challenge to the monoculture nature of plantations based on external inputs. Sustainable water management is part of the search for food sovereignty and political autonomy, which has relevance for both organic and subsistence farmers in Northern and Southern countries. It should be noted that water management associated with agroecology is highly knowledge-intensive, but it is based on techniques that are developed on the basis of farmers' knowledge, experimentation and creative adaptation. The affirmation of more sustainable water management approaches has, therefore, important synergies with the pursuit of more autonomous agriculture systems through the affirmation of alternatives to the hegemony of narrow economic policies typically based on production for market-export and cash generation.

The fundamental problem with mainstream approaches to water management is the failure to identify the contradiction between the expansion of market-based regulation and the achievement of sustainable and equitable solutions to water problems Vélez et al. (2010). Notwithstanding the persuasive discourse on the aptness of financial incentives and economic instruments of water management, because of its internal rationale, such approaches provide only a very narrow, transitory answer to environmental degradation, while at the same time emboldening further accumulation of capital. There is a long tradition of radical thinking that criticizes the inherent formation of social and environmental crisis due to the pressures of capital accumulation in the hands of a small percentage of the population. Nonetheless, because of their analytical biases, most conventional responses fail to accept that market-based environmental policies (which include both market transactions and governmental interventions that organize the market, e.g. public policies), instead of removing degrading pressures, largely transform nature restoration or conservation into an object of capital accumulation. The exploitation of natural resources has historically been the main process of nature commodification, but the recent attempt to mitigate and prevent environmental impacts using the same market-based rationality constitutes the essence of the 'ecological modernization' of capitalism (Ioris 2010; Swyngedouw et al. 2002).

Furthermore, for mainstream policy-makers, issues of power asymmetry and class, gender and race discrimination have either remained out of the debate or been

contained in a secondary agenda of social compensation. Because of the focus on isolated elements of water systems, mainstream economists have largely ignored power inequalities behind decision-making structures and remain silent to the fact that water management problems are profoundly influenced by cultural circumstances and political disputes. They miss the fact that the expression of social inequalities through water use is not an abstract phenomenon, but directly depends on the biophysical materiality of the nature that is incorporated into capital accumulation, as well as on the cultural context where water is used for the production and exchange of commodities. As a result, the degradation of managed water systems by agribusiness and intensified agriculture production is not simply the outcome of inadequate technologies, but it is rather the consequence of asymmetric social opportunities. For example, socioeconomic injustices have historically shaped access to and availability of water in Latin America, where the uneven impacts caused by droughts and floods reveal the interrelation between water security and political power. In this case, the poor strata of society bear the brunt during adverse periods, while the stronger players can increase the accumulation of capital by the acquisition of land or manipulation of public relief funds.

## 3 The Political Ecology of Water: A Case Study Analysis of the Yucatan Peninsula, Mexico

Water is an essential input for agriculture that, when combined with soil characteristics and climate determine different crop yield possibilities and crop quality. As discussed in the previous sections, a serious limitation for agriculture (for developing contexts in particular) is the relative scarcity of clean freshwater for agricultural use. Water pollution combined with 'adverse' regional hydrologic and soil conditions are also important factors that can seriously limit agricultural and agroecological possibilities. Apart from being one of the sectors that consumes more water than others, agriculture is a strategic sector for the economies of developing countries and a means of survival for large numbers of small-scale farmers. Thus, freshwater allocation, total water consumption, and the need to guarantee freshwater availability and quality (for strategic use) are primary conditions for agroecology – and among the most discussed development and sustainability issues today.

In a free market context (such as NAFTA), competing developing strategies (notably export manufacturing), and increasing openings of agricultural markets, seem to limit agroecology possibilities even further. Cheaper agricultural imports invade local markets, thus impeding local producers from competing locally or regionally *via* pricing. Further, unlike 30–40 years ago, urban type jobs (i.e., manufacturing or organized crime) proved to be a more popular way out of poverty than *via* agriculture (see Gwynne and Kay 2004; Barkin 1998; Gilbert 1994). The following case study will show how in Motul, Yucatan, Mexico – just like in many other regions within the state (see Gravel 2006, and Biles 2004 for more detail), government planners chose to introduce assembly plants in rural areas, looking

to foster economic development and provide jobs for otherwise young agricultural workers (or potential migrants). Maquila activities there are water-consuming and relatively pollutant. The geology and hydrology of the Yucatan Peninsula magnify risks of underground water extraction and pollution from different sources. All these factors contribute to explaining the limited agroecology practices and options in rural Yucatan and the poor water quality for agriculture.

Studies on the quality of water for agricultural use (in the state of Yucatan) show serious constraints determined by natural conditions and water pollution from different sources (Delgado et al. 2010). Yet they fail to explain: (a) why such a situation is long-standing and pervasive, (b) who are the principal actors responsible for that situation, and (c) the dynamics behind these actors' actions and relations between them. An in-depth analysis of Mexican federal and state (environmental and agricultural) policies will help provide clarification, and provide further insight into the role governments play to foment or limit more sustainable solutions for agriculture and agroecological development.

Based on topographic, hydrological and geological data, and a case study analysis (Y Industries, Motul, Yucatan, 2003), the following sections analyze the Yucatan Peninsula topographic and geologic conditions and underground water dynamics, Y Industries'[1] environmental impact and Mexican government environmental and development policy capacities. Digital Elevation Model (DEM) images and selected schemes from different sources were used to develop topography and geohydrology maps and other related figures. Government files on Y Industries and 20 in-depth interviews with government officials (and Y Industries management) provide the main data sources for the case study. Data and discussions partially deal with water management issues, but emphasis is placed on government development policy designed to replace agricultural activity, government environmental monitoring capacities (for industry), and the risks associated with water extraction (for agriculture and urban use), water treatment practices (i.e., chlorination), and Y Industries' polluting activities (i.e., wastewater disposal and improper grey water management).

Section 3.1 deals with the Yucatan's water cycle complexities and water extraction practices. We intend to show that the oversimplified version put forward by government officials contrasts with a more complex interpretation of Yucatan watershed dynamics, water treatment and extraction practices. Before showing data, analyses and case study discussions (Section 3.2 onwards), we propose a more informed view on the economic history of Motul and surrounding municipalities. This information will show how determinant government development policy has been promoting economic and social change (by favoring manufacturing), and how it deals with environmental issues derived from industrial activity.

The urban and demographic growth, agriculture and cattle ranching, and more recently the maquila industry, place increasing environmental pressure on underground water stocks in the peninsula. Extraction of good quality water for agricultural use does not seem to coincide with the most productive agricultural and cattle regions, yet it is essential to secure healthy ecosystems for agroecological practice.

[1] Y Industries is a garment maquiladora producing jeans for export to the American market. Y Industries employees are rural Mayans living in the Ex-Henequen Region.

### *3.1 A Synthetic View of Yucatan Peninsula Watershed Dynamics*

The geology and hydrology of the Yucatan Peninsula have been widely studied (Bauer-Gottwein et al. 2011; Batllori-Sampedro et al. 2006; CNA 2001; Perry et al. 1989, 1995, 2002; Lugo-Hubp et al. 1992; Villasuso 1992; Marín 1990; Marín et al. 1990; SARH 1989). It is known that at the end of the Cretaceous Period (66 million years ago) a meteorite hit the earth next to the Yucatan, producing a cloud of dust thick enough to prevent solar energy from heating the earth (Morgan et al. 1997; Sharpton et al. 1992, 1993; Hildebrand et al. 1991; Pope et al. 1991, 1996; Penfield and Camargo 1981; Alvarez et al. 1980). This phenomenon eventually resulted in one of the biggest extinction events in the history of life on Earth; changing the geologic substratum over a vast area, and reshaping geological processes under new conditions in what is today the Yucatan Peninsula (Perry et al. 2009; Sharpton et al. 1993; Pope et al. 1991) and the Caribbean Basin (i.e., Florida-United States and Cuba). More generally, the Yucatan Peninsula's geological substratum is relatively young, particularly in the North and Northeast areas where Pleistocene and Mio-Pliocene substrata are found (Fig. 1a). These types of parental material are highly porous, and made of calcium carbonate. High soil permeability and proximity to the sea determine the Yucatan's complex underground water dynamics (Perry et al. 2002; Steinich and Marín 1996; Back 1992; Back and Lesser 1981; Back and Hanshaw 1970). South and Center of the peninsula, older and less porous geological substrata are found, belonging to the Cretaceous-Pliocene periods (Fig. 1a). Thus, on most of the peninsula's North and Center surface, and despite low precipitation and high water evaporation rates (Orellana et al. 1999; García 1988), vast stocks of freshwater accumulate underground during the rainy season. These types of geohydrological phenomena are shared by Caribbean Basin countries – notably the Florida peninsula and Cuba.

Saline water intrusion is relatively common, at least within an approximate 8 km fringe from the seashore, and is determined by periods of high and low tide. Intrusion of saline water during high tides results in freshwater salinization, and in freshwater heads increasing in the mainland (Graniel et al. 2004) (Figs. 2a, 3a). During low tides, larger volumes of inland freshwater are expelled as a result of differences in water pressure from the sea (see underground caves complex in Fig. 3b).[2] Inland

[2]The Peten plant community (typical edaphic known as a 'hammock plant community' in English) results from freshwater streams running underground to areas close to the seashore, where saline and freshwater mix. Some plants there (particularly tropical green and semi-evergreen forest species) benefit from freshwater streams coming from inland areas (see Febles-Patrón and Batllori-Sampedro 1995; Trejo-Torres 1993; Miranda 1958, for more details). The Peten is unique in that the geohydrology (of the North, Northeast and West) of the peninsula generates ideal conditions for the growth of tropical rain forest species despite adverse climatic conditions (i.e., low precipitation and extremely high water evaporation rates – $Bs_0$ type climate).

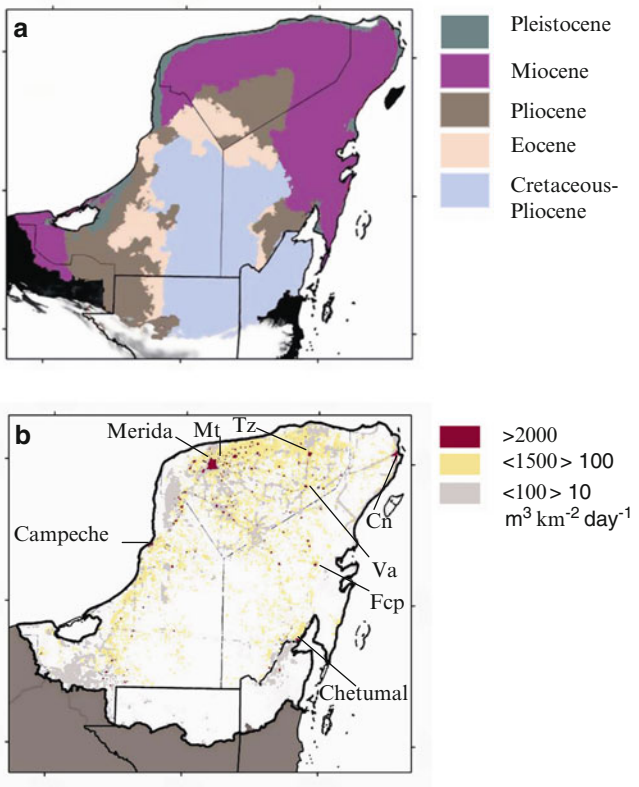


**Fig. 1** Watershed features of the Yucatan peninsula. **Map a** Geological substratum. **Map b** Freshwater extraction (All maps modified from Bauer-Gottwein et al. 2011; Gondwe 2010; Charvet 2009; SGM 2007; ASK 2003; Perry et al. 2002; NASA/JPL/NIMA 2000; Marín et al. 1990). **Map b** *Tz* Tizimin: *Va* Valladolid: *Fcp* Felipe Carrillo Puerto, *Mt* Motul, *Cn* Cancun

freshwater heads then decrease. In addition, and as a result of high soil porosity, inundations are common during the hurricane period. Yet, topographic elevations running in a Southwest/Southeast direction ('*Sierra de Ticul*') that coincide with Southern geological characteristics (less porous geological substrata) seem to determine the distinctive superficial and underground water streams between North and South (Figs. 1a, 2b). These most probably show that North and South underground aquifers might not be necessarily connected (Fig. 2b). However, government officials often put forward the idea that the Yucatan Peninsula is a single unit with interconnected underground streams, as if a single reservoir would cyclically provide (clean) freshwater for different uses. Perhaps that is why government data usually show that large amounts of freshwater are available in the peninsula, and officials argue that regional water cycles guarantee freshwater demand. After all,

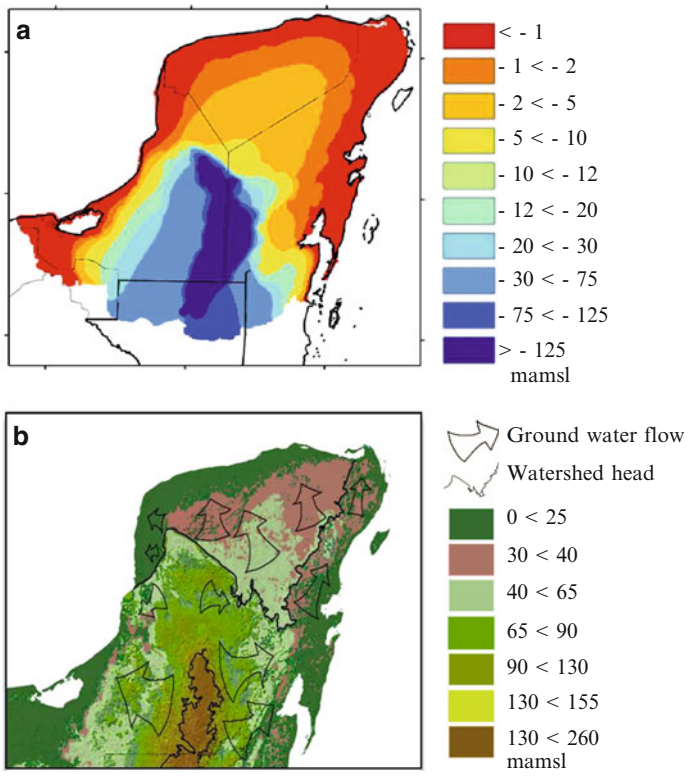


**Fig. 2** Watershed features of the Yucatan peninsula. **Map a** Phreatic water heads. **Map b** Topography and main underground freshwater currents (All maps modified from Bauer-Gottwein et al. 2011; Gondwe 2010; Charvet 2009; SGM 2007; ASK 2003; Perry et al. 2002; NASA/JPL/NIMA 2000; Marín et al. 1990) (*mamsl* meters above mean sea level)

it is known that the Yucatan Peninsula is among the largest watersheds in the world (Gondwe et al. 2010).

In fact, water extraction volumes and sites correspond to the areas/regions with higher water refill dynamics and seawater infiltration (Figs. 1b, 3a). In addition, water treatment practices (i.e., chlorination) together with a lack of proper sewage systems actually result in underground walls of contamination by adsorption (Fig. 3a, Table 1), suggesting that underground water stocks close to urban areas are being increasingly contaminated. The fact that extraction of water (and water treatment) coincides with demographic areas of concentration shows that there is effectively no Water and Sanitation Service (WSS) provision policy in the state (Fig. 1b), and that risk of exposure to polluted water actually exists, and will significantly increase over time. In more detail, Figs. 1a and 2b show that topography and geological substrata differ from North to South, most probably dividing

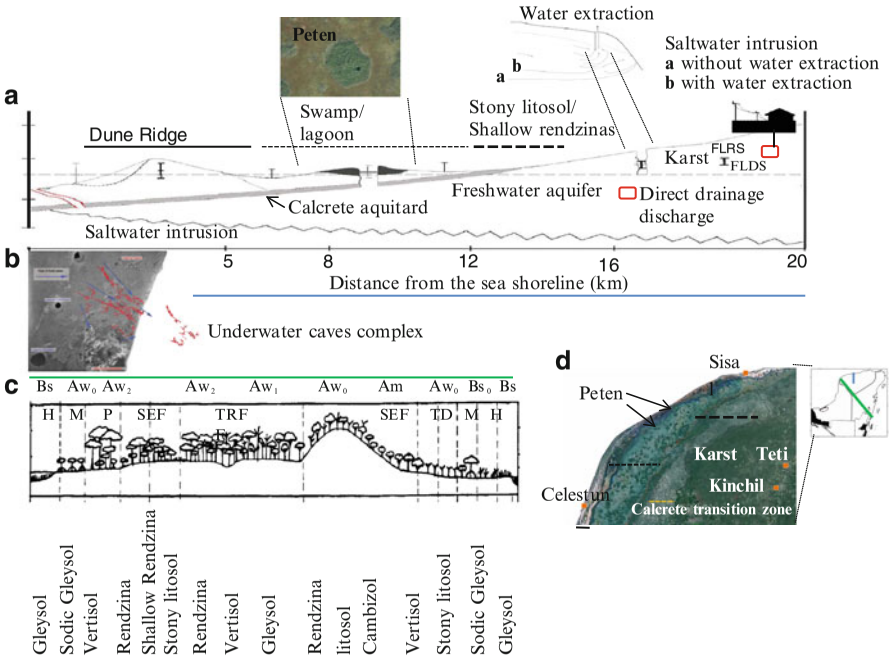


**Fig. 3** Physiography of the Yucatan Peninsula watershed. (**a**) Coastal hydrological operation. (**b**) Underwater caves complex. (**c**) Cross-transversal section of the Yucatan Peninsula physiographic features. (**d**) Landscape perspective of the coastal Yucatan Peninsula watershed. PLRS: Phreatic Level during the Rainy Season, PLDS: Phreatic Level during the Dry Season, H: Hydrophytes, M: Mangroves, P: Peten, TRF, TRF: Tropical Rain Forest, SEF: Semi-evergreen Forest, TDF: Tropical Dry Forest. Climatic types: Bs, $Aw_0$, $Aw_2$, $Aw_1$, $Aw_0$, Am, $Bs_0$ (All schemes are based or modified from Bauer-Gottwein et al. 2011; Gondwe 2010; Bautista et al. 2007; Batllori-Sampedro et al. 2006; Graniel et al. 2004; Perry et al. 2002; Olmsted et al. 1999; Marín et al. 1990; García 1988)

**Table 1** Main pollutants and reactive compounds present in the Yucatan Peninsula aquifer

| Compound | Source |
|---|---|
| Arsenic | Solid waste |
| Bacteria | Waste water |
| Cadmium | Solid waste |
| Caffeine | Waste water |
| Chloride (Cl) | Waste water |
| Chromium | Solid waste |
| Copper | Solid waste |
| Cocaine | Waste water |
| DDTs | Pesticide |
| Detergent | Waste water |
| Dissolved solids | Waste water |
| Drines | Pesticide |
| Endo-sulphates | Pesticide |
| Fecal Coliform Bacteria | Waste water |
| Fungi | Waste water |
| HCHs | Pesticide |
| Heptachlor | Pesticide |
| Iron | Solid waste |
| Lead | Solid waste |
| $NO_2$ | Waste water |
| $NO_3$ | Waste water |
| $PO_4$ | Waste water |
| Protozoa | Waste water |
| Sulfate ($SO_4$) | Waste water |
| Viruses | Waste water |
| Zinc | Solid waste |

Sources: Graniel et al. (2004), Pacheco et al. (2004), Pérez and Pacheco (2004), Alvarez Legorreta (2002), Escolero et al. (2000), Gonzáles Herrera (1996), Villasuso (1992), Pacheco and Cabrera (1977)

underground watersheds. We observed that more elevated topographic regions coinciding with older geologic substrata showed superficial (and most probably underground) freshwater streams in the form of rivers (i.e., 'Río Hondo' in the Southeast and 'Río Champotón' in the Southwest) (Fig. 2b). A clear topographic and geological border could be drawn to divide Northern from Southern and Eastern watersheds (Fig. 2b). Moreover, the Peten plant community phenomenon (in the North, flat-land coastal areas) shows that underground freshwater dynamics respond to an underground delta river pattern (Figs. 3a, d). Peten localization corresponds to underground freshwater streams running toward the coast (Figs. 3a, d). In contrast, areas having older geological substrata and those with more pronounced orographic features lack hammock vegetation communities.

Differences in topographic and geological substrata between North, East, and South, suggest that underground freshwater residence time varies between watersheds. In the North, coastal areas and East, higher porosity and low flat-lands determine more dynamic water fluxes from rainfall and sea tides (Figs. 1a, 3a). These conditions translate into higher phreatic vulnerability. Despite heavy rainfall in the Northeast region (Orellana et al. 1999), underground freshwater residence time is short. Higher precipitation zones in the South coincide with geological substrata characteristics that facilitate freshwater stocks – evaporation rates are secondary because they are relatively homogenous over the whole peninsula (Lerer 2008; Orellana et al. 1999) (Figs. 1a, 2a). Thus, coastal areas and North-Central regions show higher freshwater heads (with great seasonal variations; Graniel et al. 2004) (Fig. 2a). South-Central regions coincide with lower (less variable) freshwater heads (Fig. 2a), and extended water residence time. Underground watershed dynamics vary seasonally in relation to cyclical sea tides and the rainy season – extreme water head variations in the North are due to a combination of high precipitation volumes during hurricane events[3] and extreme changes in atmospheric pressure that result in abrupt changes of sea tides. The most intense hurricane period runs from September to October, in which saltwater intrusion is more common and increases freshwater stock vulnerability. North and Northeastern coastal areas are particularly vulnerable to such cyclical extreme events.

Interestingly, urban areas, where more freshwater is extracted, are located closer to the coast (notably Merida and Cancun, the two biggest cities on the peninsula) and in the North-Central part of the peninsula (i.e., Valladolid, the second biggest city in the state of Yucatan) (Fig. 1b). These regions correspond to young geological substrata; to locations where water fluxes are more dynamic. Thus, vulnerability resulting from water extraction, water pollution (derived predominantly from grey waters[4] and chlorination) and saltwater intrusion increases exposure of underground water stocks when they are close to major urban settlements. Water extraction for agriculture and cattle ranching (mostly yellow areas on Fig. 1b) also are concentrated in the North-Central region. Demographic dispersion on the peninsula further increases the risk of freshwater stock pollution. Urban and rural anthropogenic activities are central to identifying potential pollutants, but the environment in which these activities interact also plays a crucial role. Water chlorination, for example, is a common practice to obtain drinking water. Hypochlorite is the most common compound used in this process. Chemical reactions between hypochlorite and dissolved organic acids (contained in the water extracted from underground water sources) eventually produce trihalomethane compounds (Alvarez 2002; Gooddy et al. 1997; Alawi et al. 1994; Foster et al. 1994). These reactions usually take place (on a large scale) in water treatment plants known to lack ultra-filtration capacities, and are used to eliminate dissolved organic acids. Therefore, piped water often contains carcinogenic

[3]Hurricanes can carry volumes of water up to ten times higher than those registered during normal rain periods (Rosengaus Moshinsky et al. 2003).

[4]Lack of sewage systems in the Yucatan increases underground water exposure to coliform pathogens. Widespread use of latrines has been regarded as a serious infrastructural health issue (Gooddy et al. 1997).

trihalomethane compounds to varying degrees. Thus, areas where extracted water contains more dissolved organic acids (i.e., soils rich in organic matter, such as Luvisol, Cambisol, Vertisol, Histosol and Gleysol – see Bautista et al. 2007; Harrington et al. 1996) are more prone to trihalomethane water contamination (i.e., the cities of Valladolid, Felipe Carrillo Puerto, Chetumal, and Cancun to name a few) (Fig. 3c). Chlorination of water derived from household activities (i.e., washing), and industry, contribute even further to trihalomethane water contamination. Although government officials argue that chlorination is the most cost-effective solution to provide drinkable water, few studies have evaluated trihalomethane impacts to human health on the Yucatan Peninsula.

Wastewaters derived from households, industry and agro-industry, also are important sources of pollutants and reactive compounds that can contaminate water. These 'grey waters' are rich in bacteria, protozoa and fungi among other pathogens (Perez and Pacheco 2004; Pacheco et al. 2004; Tapia-Gonzalez 2008; Gonzáles Herrera 1996; Marín and Perry 1994; Casares 1983), and usually end up in underground streams (Fig. 3a). Similarly, the high nitrogen levels found in fertilizers, agrochemicals and foods, add to wastewater nitrogen content, facilitating reproduction of pathogenic organisms and eutrophication processes. Coastal red-tides (large to excessive and rapid algal blooms that can cause health and water quality issues, and often cause water discoloration) around the peninsula are associated with the high nitrogen content of wastewaters flowing into the sea (Morales-Ojeda et al. 2010; Herrera-Silveira et al. 2005) (Fig. 3b). It is important to note that, on one hand, underground water streams carry wastewaters of different types towards the sea (Fig. 3b), but on the other hand, porous geological substrata adsorb pollutants of different types (Table 1), and retain wastewater for longer periods of time than larger underground water systems (e.g., caves). Coliform contamination levels are directly related with urban settlements, but dilution processes often mask high concentration levels of pollution in a given location at a given time. Demographic and economic activity dispersion on the peninsula (excepting the central natural reserve of Kalak'-mul) result in underground watersheds contaminated over the entire peninsula (Figs. 1b, 3b) (Escolero et al. 2000, 2005; Marín et al. 2000).

Soil characteristics also play an important role in Yucatan hydrogeology processes and more particularly determine freshwater aquifer quality. Dune ridges, swamps, stony litosols and karsts are found from the coast to the interior, producing different types of flora (Figs. 3a, d). Calcrete aquitard (also known as *Tsekel* when superficial, or *Caliche,* when underground) runs from the continental platform up to the interior mainland, superficially emerging in what is known as the stony litosol soil type (Figs. 3a, d). Calcrete aquitard results from seawater and freshwater interactions with calcareous sediment and is relatively compact. Given its extension (all along the coast from the sea to 10–14 km inland) and physical properties, it has often been described as a watershed frontier between seawater and inland freshwater aquifers (Perry et al. 1989, 1995, 2002; Villasuso 1992; Marín 1990; Marín et al. 1990). It is known that calcrete aquitard partially determines underground aquifer flows from the mainland to the sea. Inland freshwater pressure and calcareous dilution actually break the calcrete aquitard in specific places, usually close to the sea shore. This results in underground freshwater streams that enable the Peten plant

communities (Figs. 3a, d) to exist. In certain areas, where calcrete aquitard reaches the surface, tropical lowland swamp forests develop as a result of calcrete aquitard impermeability (Fig. 3d). A transitional zone between the calcrete aquitard and the Karst (calcrete transition) underlies an area of tropical dry *Candelabri*-form cactus forest (and shallow rendzinas). Such areas are characterised by fragmented old calcrete aquitard combined with organic matter (i.e., stony litosol) (Figs. 3a, d). The above described transition zone is what is commonly known as the *Tsekel.*

Salt concentration levels found in freshwater extracted from wells varies depending on water extraction volumes, location, sea tides and the rainy season (Fig. 3a). Prolonged periods of water extraction are related with higher salt concentration (though water is still drinkable), most probably due to changes in pressure – salt concentration levels rapidly decline when water extraction is stopped. No literature, though, shows whether salt concentration has increased over long periods of time over the whole peninsula. Yet it is believed that apart from cyclical changes (i.e., hurricane events) the relation between seawater and inland freshwater remains relatively stable. In addition to the hydrological complexities described before, large amounts of treated water (using chlorination) are periodically returned to the underground watersheds without sufficient supervision or control from state authorities.

Delgado et al. (2010) revealed freshwater samples to show higher than recommended chloride concentrations and salinity in different locations. High concentrations of sulphates, and sodium adsorption were highlighted as potentially undermining underground freshwater quality for agriculture. Agricultural development divided by sectors (i.e., citrus, maize, and cattle ranching) and regions (Northwest, South and Southeast, and Northeast regions) show that the most exploited areas are not necessarily using optimum underground water found in the state (i.e., Delgado et al. 2010, region VI in Fig. 8:1431). In summary, the simplified vision put forward by government officials to explain the Yucatan Peninsula watershed dynamics seems to be consequent with allowing water extraction from virtually any location – a historical practice on the peninsula (Bauer-Gottwein et al. 2011; Gondwe 2010; Charvet 2009; ASK 2003; CNA 2001; SARH 1989). We share the view that a more elaborate diagnosis of the peninsula's watershed dynamics is necessary to design a more comprehensive WSS provision policy for the region. Unlike the Yucatan Peninsula and Cuba, Florida state authorities have been implementing a comprehensive water extraction and water management policy for some time (Back and Hanshaw 1970). The Y Industries case study will provide further evidence to show the functioning of Mexico's environmental offices and their institutional weaknesses (see Mumme 1992; Mumme and Duncan 1997).

## *3.2 The Henequen Industry in the Yucatan*

From the early colonial days and for the next three centuries, Motul's main economic activity was agriculture and cattle ranching (JM Dzul 2006, unpublished

data; Castilla and Torres 1999). Production of honey, cotton (to craft *mantas*), sugar and wax was also common and remains part of Yucatan exports (notably honey). Mayan Indians were exploited under the *hacienda* system during the colonial period and long after the independence of Mexico was achieved. Prior to the henequen boom, the Indian Mayas used (and cultivated on a small scale) henequen (*Agave fourcroydes* Lem.) to make the ropes for use in the building process of Mayan houses and to produce sandals, hammocks and other house-crafts.

By the mid-1800s, henequen ropes became an indispensable part of McCormick's reaper machine – used to cut and collect harvested grain, which substantially increased demand for henequen ropes (Castilla 2004; Vela 2002; Canto 2001). As American demand for henequen ropes grew, the *hacendados* (mainly located in the Northwest of the peninsula) rapidly abandoned agriculture and cattle ranching, and concentrated on the production and processing of henequen (to turn it into a manageable fiber) on an industrial scale (Gabbert 2004; Reed 2001; Restall 1997; Patch 1993; MacLeod and Wasserstrom 1983; Moseley 1980).

The henequen industry had a significant impact on Yucatan wealth. The Yucatan became one of the richest states in Mexico within just a few decades, having been one of its poorest states for a long time (Vela 2002; Canto 2001). However, demand for henequen products remained cyclical and depended on the size of the United States harvest. Cyclical demand, price fluctuations and competition between producers made the henequen market extremely unstable throughout its history. As henequen became an important source of income, state and federal intervention grew (Brannon and Baklanoff 1987; Wells 1985). Gradually, demand for henequen fiber faded and the United States economic recession of the 1930s led to a massive decline in henequen prices. The extent of the crisis between 1926 and 1936 forced the 'Mexican Bank for Agricultural Credits' to subsidize henequen producers (large and small) and workers, who had no other source of income (Vela 2002; Brannon and Baklanoff 1987). Neither henequen prices nor Mexico's share of the world market ever recovered to the levels of 1916. Mexico's share of global production had fallen further to 15% in 1950. Supplying such a small share of the world henequen market signified that the golden era of Mexican henequen was over, and that revenues for small producers and *ejidos* would never reach the expected targets (Brannon and Gilbert 1991; Várguez Pasos 1999). From the 1950s onwards, the market prices of henequen fell constantly, in part due to production increases in Brazil, African and Asian countries, but also because henequen ropes were replaced by synthetic fibers. By the 1970s it was clear that henequen could not sustain the Yucatan economy for long. A line of credit from the rural Mexican bank was opened to try to develop agriculture and cattle ranching in the henequen region, a measure that had very limited results (Vela 2002).

By the mid-1980s it was clear that Mexico intended to integrate into the world production chain by favoring free trade and Foreign Direct Investments (FDI) and by promoting an export-led development strategy. Although by that time the Export Maquila Industry (EMI) had developed considerably in the North of the country, Yucatan's experience with maquila was minimal and was concentrated in Merida's only industrial park (Canto and Cruz 2004; Canto 2001; García de Fuentes et al.

2000; Wilson 1996). In an effort to design a development program that suited Yucatan's economic interests and fit the New Economic Model (NEM), the state government consulted private United States consultancy firms (Interview data, 2003, State Office of Industrial and Commercial Development, J. Torre, A. Pérez). An investment plan was then constructed recommending the promotion of (mainly) clothing maquiladoras in the state (and particularly in the Ex-Henequen Region), given the fact that clothing maquiladoras are considered to be among the least polluting and most labor-intensive of clothing industries.

### *3.3 Y Industries in Motul, Yucatan*

Most of the industry in Yucatan is concentrated in or around Merida, the capital and principal city, in which around 50% of the state's population lives. Although the maquila policy in the state started out as an industrial and urban program and most plants were installed around Merida,[5] the policy was gradually reoriented to encourage development in more rural locations. The objective was to create more jobs in rural communities, so as to slow the movement of people to bigger cities in the Yucatan and in the neighboring state of Quintana Roo. The policy was also a reaction to the final demise of the henequen industry in the mid-1980s. The government tried to attract maquila plants to the so-called 'Ex-Henequen Region' since it was both (relatively) densely populated and economically depressed. A series of incentives were offered to international investors, and these were successful in attracting maquiladoras to the area. Investment in the clothing industry responded positively to the incentives and plants proliferated in the former henequen area after 1995.

In selecting a case study we were particularly concerned with choosing plants that had created significant numbers of jobs and significant pollution. Although the clothing industry is not particularly renowned for its polluting activities, some clothing maquiladoras were of particular interest, insofar as they were very large, used methods that consumed a great deal of water and were potentially polluting the watercourses. A process used to discolor jeans (known as 'sand-blasting') appeared to pollute considerable amounts of water, which was later deposited underground, 'at a certain depth'. The geological and hydrological structure of the Yucatan Peninsula appeared to magnify the danger. Two companies, Lee Corporation and Y Industries, dominate the clothing export scene in Yucatan. Both had several plants in different rural locations: Izamal, Maxcanu, Motul, Acanceh, Hunucma and Tekax (Albornoz 2000) (see Fig. 4).[6]

[5] Initially (1970s), development policy in the state considered varied industrial processes and built an industrial park for 'polluting' industries and later a second industrial park for 'non-polluting' industries, both located in Merida.

[6] Accounting for 9% of the total population in the state with an average of 24,000 inhabitants in each (INEGI 2011).

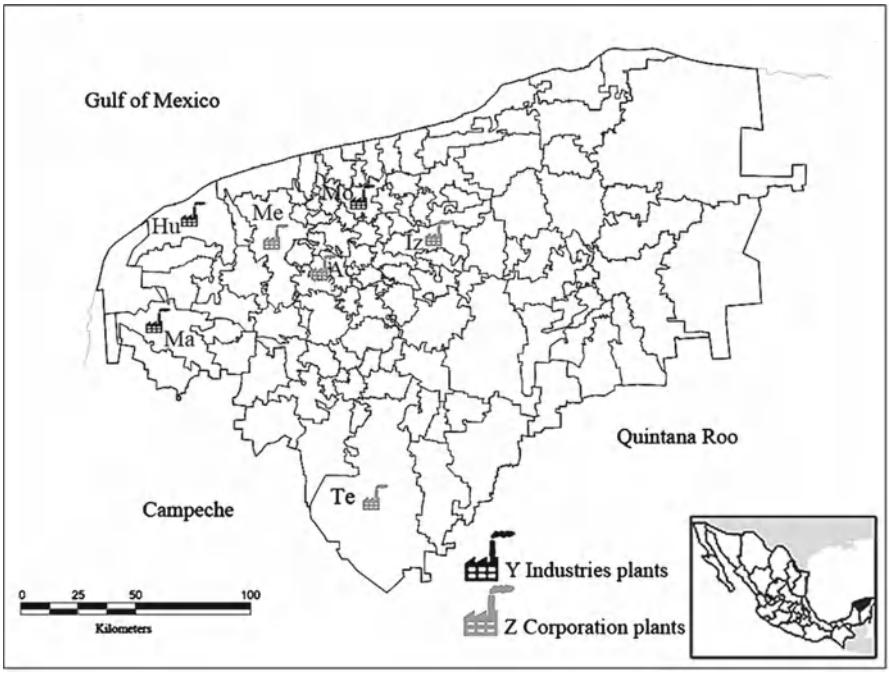


**Fig. 4** Yucatan's main maquiladora cities in the year 2000 (municipalities are: *Hu* Hunucma, *Ma* Maxcanu, *Mo* Motul, *Me* Merida, *Iz* Izamal, *Ac* Acanceh, *Te* Tekax)

Motul is an important city in the Yucatan. Although now ranking 15th in terms of population size, it was the center of the henequen industry for almost a century. Its location favored the commercial distribution of the fiber, since it was close to the old port of Progreso from where the merchandise was exported to the United States (and, to a lesser extent, Europe). Yet Motul is also very close to Merida, the capital city, where the legal and financial administration of the henequen industry took place (Fig. 4). At the beginning of the twentieth century, Motul was the second most important city in the Yucatan. It was not only the center of henequen distribution, but also a financial center that was home to some of the richest families in the state, and later the country (JM Dzul, 2006, unpublished data). Long before the henequen industry was finally liquidated in the mid-1980s, Motul's main function had changed. It became a dormitory suburb of the capital, while continuing its role as a retail and administrative center for the surrounding district. The municipality of Motul reflects perfectly the social and economic problems of the state that resulted from the decline of the henequen industry. Unemployment, a surplus of unskilled labor, out-migration and lack of infrastructure are among the principal difficulties. More generally, governmental agricultural policies have for a long time been limited and ineffective; the quality of the land is poor, and hurricanes and tropical storms are commonplace. Y Industries is a very competitive company worldwide, that successfully relocated twice (once within Honduras) to reduce production costs and to implement Just In

Time (JIT) production processes. Y Industries steadily expanded (in the Yucatan and recently to China) to supply its clients' needs, surviving the Mexican maquila crisis of 2001. The owners of Y Industries are from Hong Kong, and the company produces denim trousers principally for the United States market. All of its production is exported to top quality American brands such as Polo®, Tommy Hilfiger®, Gap® and Eddie Bauer®, among others.

### *3.4 Development Policy and the Protection of the Environment in the Yucatan*

One important aspect of Yucatecan industrial development policy is that it sought to concentrate polluting industries (including a few maquiladoras) in one of Merida's industrial parks, and keep another industrial park solely for non-polluting 'industries' (Interview data, 2003, State Office of Industrial and Commercial Development, J. Torre, M. Gutiérrez, A. Pérez, J. Durán; García de Fuentes et al. 2000; Expansión: Special Report 1984). The Ex-Henequen Region would only host 'non-polluting' maquiladoras, thus eliminating the possibility that electrical/electronics, and certainly transportation maquila activities, would be installed there. These are known to be among the most polluting maquiladoras and are mainly located in the northern border cities (Bowen et al. 1995; Perry et al. 1990).

Therefore, since its inception, the Maquiladora Programme for the Ex-Henequen Region actually incorporated an important element of sustainability, notably the protection of the environment. The development of the EMI in the north of the country was most certainly not accompanied by efficient environmental and urban policies (De la O 2000; García de Fuentes et al. 2000; Gilbert 1994; Young 1986). Although the Yucatecan government was keen to avoid the errors of the north, there were also additional reasons why the government of the Yucatan sought to keep polluting maquiladoras out of the Ex-Henequen Region. In addition to the fact that geological and climatic conditions there combine to produce a fragile environment, the natural environment is a key asset for keeping underground water stocks safe.

The key aspect of the clothing maquila industry (for state authorities) is that it does not use hazardous materials in its production processes nor does it involve significant combustion activities or produce particularly hazardous waste (Interview data, 2003, State Office for the Environment and of Industrial and Commercial Development, A. Domínguez, L. Yah, R. Medina, G. Valladares, J. Torre, M. Gutiérrez, M. Poot). Most polluting maquiladoras use: '(1) a wide range of solvents (i.e., 1,1,1-trichloroethane, acetone or methylene chloride); (2) acidic and alkaline substances (i.e., sulphuric and hydrochloric acids or sodium hydrate); and (3) heavy metals (i.e., lead, nickel or copper)' (Perry et al. 1990: 443). Although the basic input to Y Industries does not create any external pollution, some of the company's production processes are harmful. Two processes, decoloring and tinting both produce waste. Decoloring the jeans is achieved through 'sand-blasting' (Interview data, 2003,

State Office for the Environment, M. Moo, G. Valladares, M. Gutiérrez, C. Medina). This process uses considerable amounts of water and the wastewater is colored deep blue. Residual chemicals are in the form of blue indigo powder. The powder is put in plastic bags before it is periodically thrown away in the municipal waste dump (Interview data, 2003, SEMARNAT-Yucatan, Environmental Impact Office, Interview data, 2003, M. Gutiérrez, Municipal Government, M. Moo). Cloth remnants and human waste (sewage waters) are also major pollutant residuals from Y Industries' activities. These are also periodically thrown in an open-air waste dump. Motul's waste dump is not subject to any environmental regulation and is located relatively close to residential areas (Interview data, 2003, SEMARNAT-Yucatan, Environmental Impact Office, M. Gutiérrez, Municipal Government, M. Moo).

## *3.5 Government Monitoring of Y Industries*

Under Mexican environmental law, some environmental agencies operate under federal jurisdiction (SEMARNAT, PROFEPA and CNA)[7] while others operate at the state and local levels (State Secretariats of the Environment and municipal governments, respectively). SEMARNAT is responsible for drawing up the law (notably the Mexican environmental norms) designing environmental policy and for monitoring federal environmental resources and territories. Through state representations SEMARNAT is responsible for monitoring the production, use, treatment and disposal of hazardous waste. These fall under federal jurisdiction due their dangerous nature. Given that water is considered a federal resource, CNA is responsible for monitoring water extraction and consumption as well as wastewater disposal techniques and sites. PROFEPA penalizes agents that do not comply with the Mexican environmental norms, and has the responsibility to follow up on citizens' environmental complaints. In turn, state environmental agencies are responsible for authorising industries to operate. Their decision is based on an appraisal of the 'Environmental Impact Study' presented by all companies that wish to operate in the state. 'Environmental Impact Studies' are regulated by SEMARNAT and are generally carried out by private (Mexican) consulting firms (Interview data, 2003, SEMARNAT-Yucatan, Environmental Impact Office, C. Medina, A. Domínguez, J. Torre, G. Valladares). It is the responsibility of the state environmental agencies to ensure that industries operate in accordance with the Environmental Impact Study that they initially presented.

In the case of Y Industries, the relatively recently created Secretariat of Ecology (1989) for Yucatan State was responsible for authorizing Y Industries to begin

[7] SEMARNAT, Secretaría del Medio Ambiente y Recursos Naturales (environment and natural resources agency); PROFEPA, Procuraduría Federal de Protección al Ambiente (federal law enforcement agency for environmental protection); CNA, Comisión Nacional del Agua (national water commission).

operating in the state. The State Secretariat of Ecology also monitors Y Industries' atmospheric pollution and water contamination levels, given that these are not 'particularly' polluting (Interview data, 2003, State Office for the Environment, L. Yah, G. Valladares). SEMARNAT-Yucatan monitors Y Industries' 'scarce' hazardous waste, which is mainly in the form of oils and greases from its machinery. CNA-Yucatan monitors water consumption and wastewater disposal. PROFEPA-Yucatan is responsible for responding to citizens' complaints and for sanctioning Y Industries if any of the Mexican norms are violated. Interviews with the heads of the Department of Environmental Control, Environmental Prevention and Environmental Management of the State Secretariat of Ecology made it clear that state and federal environmental agencies were familiar with the Y Industries plant (Interview data, 2003, State Office for the Environment, L. Yah, R. Medina, G. Valladares). Not only was Y Industries one of the pioneering firms that presented 'all the required documentation before installing', but it was also a very large plant that grew significantly and developed its industrial activities in a short period of time (Interview data, 2003, State Office for the Environment, L. Yah, G. Valladares).

Y Industries, like all industries in the state, submitted an 'Environmental Impact Study' to be granted permission to operate. It also periodically (every 6 months to 1 year) submits records on: (1) its atmospheric emissions; (2) quantities of 'solid' and hazardous waste; (3) the amount of water consumed; (4) levels of contaminated water; and (5) water disposal techniques and volumes (Interview data, 2003, State Office for the Environment and SEMARNAT-Yucatan). Thus, all industrial activities performed at Y Industries have to be reported and evaluated. Y Industries' cloth leftovers, 'blue dust bags' and human waste are not considered hazardous materials according to Mexican norms. These are considered to be solid municipal waste, and thus have to be 'treated' by the local government (Interview data, 2003, State Office for the Environment and Municipal Government, R. Medina).

### *3.6 Interview Data and the Environmental Performance of Y Industries*

According to G. Valladares, head of the Environmental Management office of the Secretariat of Ecology, Lee Corporation seemed to pollute water on a significantly larger scale than Y Industries. The contamination indices of these two companies differed greatly, yet Lee Corporation brought state of the art technology to treat their residual waters and thus fully complied with the Mexican environmental norms. Apparently Lee uses the most advanced techniques to treat contaminated water, 'to the extent that the water they have treated is even cleaner than the water that they initially used.' Unfortunately, G. Valladares did not 'remember' whether Y Industries also needed to treat their residual waters or even if 'they had a water treatment plant'. L. Balam, director of industrial monitoring at PROFEPA, stated that 'a few years ago' Motuleño (people living in Motul) locals filed a complaint against Y Industries for throwing 'clearly' polluted water into 'one of their wells'. PROFEPA and CNA

personnel went to inspect the Y Industries installations. Both issued a series of recommendations that were 'taken very seriously' by the Y Industries administration. L. Balam did not seem to assign much importance to the incident, but rather concentrated on the fact that Y Industries followed government guidelines – which he did not specify in detail. The extent to which Y Industries polluted the underground watercourses and the magnitude of the pollution also was not specified. To find out more about Y Industries' records on water consumption and wastewater disposal we interviewed CNA officials (Interview data, 2003, PROFEPA-Yucatan, L. Balam).

M. Poot, head of Planning at CNA, remembered the Y Industries case. After PROFEPA's intervention (in 1995) CNA was requested to verify Y Industries' wastewater deposits. In fact, the water that Y Industries was throwing into 'one of their receptive wells' was contaminated with hazardous materials. Analyses demonstrated that the water used by Y Industries had a higher than acceptable concentration of chlorine. Therefore, Y Industries had to treat the wastewater before depositing it so that the water quality would meet the standards laid down by the Mexican norms (Interview data, 2003, CNA, M. Poot). As far as M. Poot could remember, Y Industries operations were not stopped at any time. While they solved the problem, CNA personnel could only make sure that the wells were deep enough, which they were, so that the contaminated water would not reach the upper layers of water stocks and cause problems for the consumers. In M. Poot's opinion this was not a major problem because Y Industries immediately reacted and changed their processes to respect the norms. M. Poot specified that CNA had fined Y Industries on two occasions; once for not reporting the extraction of additional volumes of water, and the other for not requesting permission to build a second series of wells to deposit wastewater.

## *3.7 The Government Files on the Y Industries Plant*

Government files revealed that apart from the citizens' complaints, Y Industries had been involved several times in irregularities regarding their disposal and treatment of industrial oils and grease. This is a particularly sensitive issue for the authorities, given that just a liter of oil can contaminate one thousand liters of drinkable water (Interview data, 2003, CNA, M. Poot). In addition, the permeability of the soil makes it an extremely delicate matter. Hence, PROFEPA and SEMARNAT are focused on checking all document records that target industries must submit to prove that they are dealing with their hazardous waste properly. As a general rule, most industries using industrial oils and greases have to report it and stock their waste under certain conditions for subsequent collection by specialized (private) hazardous waste management firms (Interview data, 2003, CNA, M. Poot). Even if it remains unclear how Y Industries treats the industrial oils and greases that are used in its operations, for at least 1 year, we know that PROFEPA eventually took notice and called Y Industries to account. The damage to the environment caused by such negligence is unknown, although we do know that Y Industries

eventually came under stricter surveillance (Interview data, 2003, M. Poot, M. Gutiérrez, L. Balam).

The CNA documentation provided by M. Poot was also very revealing. First, Y Industries engaged in the proper administrative paperwork with CNA only after they had built (and used for some time) two 'deep wells' to extract water and five 'receptive wells' (for contaminated water). The authorization to continue using that infrastructure was given in October 1996 by CNA. In December 2001, Y Industries, again, asked for permission to operate two additional deep wells for water extraction and five additional wells for wastewater deposits, which were already built and in use. In both cases Y Industries regularized its situation only after paying a rather small fine (around US $6,000) and after 'illegally' using the wells for some time. At no time were Y Industries' activities stopped (Interview data, 2003, M. Poot). Y Industries' 'first' water permit granted them the right to use 432,000 $m^3$ of water per year for 25 years. That right was extended to 908,000 cubic meters per year in December 2001. Similarly, in 1996 Y Industries was authorised to deposit 212,000 $m^3$ per year of wastewater. That amount was increased to 544,000 $m^3$ per year in December 2001. In 2003, Y Industries was operating four wells for water extraction and ten wells for wastewater deposits. The technical conditions for water extraction, wastewater deposit and the levels of contaminated water seemed to be within the parameters set by the Mexican environmental norms. No mention of Y Industries' higher than permitted concentrations of chlorine was made in these documents, or of how they eventually solved that problem.

Most of the officials interviewed did not know for sure whether Y Industries had a water treatment plant (such as with Lee Industries). Y Industries appeared to have used part of the clean water that they extracted to mix with the contaminated water, thus diluting the chlorine to an acceptable concentration level. Water in the Yucatan is quite cheap (Interview data, 2003, M. Poot), but treatment plants are not (Interview data, 2003, G. Valladares). Moreover, such practices seem to be relatively common in certain industries, particularly when enough water is available (Interview data, 2002, UCL-Geography, R. Taylor).

Add to the PROFEPA and CNA environmental files, those from the director of municipal services of the local government of Motul, M. Moo, who also provided information on the municipal waste dump. Since the PAN political party had won the election and M. Moo was offered the position that she occupied at that time, she knew she had responsibilities. It is common knowledge that Motul's waste dump has deteriorated dramatically since Y Industries began operations. Several Motuleños living southwest of the city center had complained about the waste dump for a long time (Interview data, 2003, M. Moo). Although the area next to the waste dump is not densely populated, several families do live there. Not only had the families living on the other side of the road, next to the waste dump, complained, but also people living in more distant neighborhoods. Strong winds carried the volatile particles of zinc trioxide a considerable distance away from the waste dump (Interview data, 2003, M. Moo). More importantly, winds also bring very bad odors. M. Moo had more concern for the amount of fecal and urinary waste concentrated in the waste dump than for any other contaminant, and stipulated that receiving fecal and urinary waste (from Y Industries) was not the usual function of the

municipal waste dump. People in most of rural Yucatan use latrines that are 'sealed' once they are full and a new one is rebuilt a few meters away from the previous one. Very few houses and government buildings in Motul empty their latrines and treat such waste – and none concentrates as many workers as Y Industries does. Latrines are usually emptied by state government personnel and the water is treated elsewhere (Interview data, 2003, M. Poot and all interviewees from SEMARNAT-Yucatan). However, given the amount of people working at Y Industries, the company had to apply a different system. They periodically empty their latrines and dump the waste in the municipal waste dump.

Mexican law seems to give Y Industries that right, although fecal and urinary waste could be considered biological-infectious waste, and thus could well fall into the category of hazardous waste. If that was the case, all fecal and urinary waste in the state would have to be treated as hazardous waste. That, of course, is not the case, but state agencies place particular emphasis on the potential contamination such waste can cause to subterranean waters (Interview data, 2003, M. Poot and all interviewees from SEMARNAT-Yucatan). A solution at the state level is still in the design phase, and as Merida (and other tourist resorts) grows, the state authorities are increasingly concerned with providing a 'real', 'long term' 'infrastructural' solution to this serious problem (Interview data, 2003, M. Poot and all interviewees from SEMARNAT-Yucatan). Certainly, the prior local PRI administration (a political party under the administration of L. Castillo) did not take the necessary precautions to provide a solution to Y Industries' human waste. Perhaps the lack of industrial experience in the region and Y Industries' unexpected growth prevented the local authorities from envisaging such a concentration of employees and human waste. After all, the scale of Y Industries' operations is huge and the Y Industries plant grew at an impressive pace (interview data, 2003, M. Moo). The PAN administration complained that PRI did not anticipate any long-term solutions to this crucial aspect of the maquila industry in Motul. M. Moo insisted that if more information had been shared in the past, perhaps more measures would have been taken to avoid the present waste management problems (Interview data, 2003, M. Moo, L. Castillo, R. Medina).

Data on the volumes and types of waste show that Y Industries is, in fact, one of the major producers of waste in the Ex-Henequen Region, followed by waste from houses and markets (Table 2). Y Industries' waste is mainly in the form of cloth remains, zinc trioxide, pumice stone (used in the 'sand-blasting' process) and human waste (so-called 'mud') (Table 2). At that time, the PAN administration was only able to 'control' the waste thrown in the municipal waste dump. It was under their administration that 'checks' and controls on the types and volumes of waste became common practice after October 2001 (Interview data, 2003, R. Medina). However, Motul's waste dump remains an 'open air' waste dump, without any anti-contamination infrastructural device. It is what the authorities call a 'controlled, open-air waste dump'.

Perhaps to show that the PAN administration did not ignore this problem, a meeting was attended with several municipal presidents from the region to discuss the building of a land-fill site. The meeting was in the form of a presentation by a private (European) company that sold environmental services. Some ten municipal presidents of neighboring municipalities were present to hear the company's offer.

**Table 2** Statistics on the municipal waste dump in Motul (types and volumes of waste)

| | Y Industries | | | | Markets | Flea market | Houses | Parks | Other |
|---|---|---|---|---|---|---|---|---|---|
| | Pumice stone | Zinc trioxide | Cloth leftovers | Mud | Solid municipal waste | Solid municipal waste | Solid municipal waste | Solid municipal waste | Solid municipal waste |
| Producer | $m^3$ | kg | kg | L | kg | kg | kg | kg | kg |
| Oct.-2001 | 52,500 | 79,000 | 217,500 | 327,000 | 133,000 | 1,700 | 64,375 | 4,740 | 35,000 |
| Nov.-2001 | 18,560 | 37,500 | 174,000 | 309,000 | 47,500 | 3,100 | 89,220 | 2,810 | 13,450 |
| Dec.-2001 | 34,500 | 32,200 | 121,703 | 1.00E+06 | 57,700 | 800 | 125,280 | 4,850 | 7,070 |
| Jan.-2002 | 56 | 13,104 | 322.5 | 94,000 | 58,300 | 32 | 127,850 | 3,640 | 10,130 |
| Feb.-2002 | 98 | 14,000 | 323 | 408,000 | 102,300 | 5,032 | 112,800 | 6,500 | 13,950 |
| Mar.-2002 | 187 | 31,500 | 418 | 32,000 | 78,300 | 483.5 | 256,550 | 5,050 | 14,115 |
| Apr.-2002 | 6,042 | n.a. | 318 | 810,000 | n.a. | 2 | 71,500 | n.a. | n.a. |
| May.-2002 | 114 | 14,000 | 373 | 773,000 | 600 | n.a. | 19,000 | 400 | n.a. |
| Jun.-2002 | 18,288 | 24,500 | 566 | 1.00E+06 | 21,600 | 37 | 122,012 | 6,600 | 2,900 |
| Jul.-2002 | 213 | 20,000 | 288 | 294,000 | 25,000 | n.a. | 258,012 | 300 | 4,800 |
| **Average** | **13,056** | **29,534** | **51,581** | **530,060** | **58,256** | **1,398** | **124,660** | **3,877** | **12,677** |

n.a.: not applicable
Source: M. Moo, local government official (2003)

The building of the sanitary land-fill was envisaged within 5–7 years after 2003, which is more than 10 years after Y Industries started to operate in Motul. M. Moo refuted the idea that Y Industries was going to contribute the expenses needed to build the sanitary land-fill, but instead several municipalities were invited to accept responsibility for parts of the project and, thus, were likely to pay part of the costs. To date, no sanitary land-fill site has been built in Motul.

## *3.8 Interpreting the Interviews and Government Files on the Environmental Impact of Y Industries*

Although state authorities insisted that the Maquiladora Program for the Ex-Henequen Region was designed to avoid pollution, it is clear that Y Industries is far from being a harmless non-polluting plant. Given the size of the Y Industries plant and the amount of waste it generates, state and local authorities have been rather lenient towards the company. The most significant aspect is perhaps that Y Industries was allowed to operate without the necessary permits for the management and disposal of industrial oils and greases, but also with regard to water consumption and wastewater treatment. Y Industries was negligent and presumably took advantage of the situation. Usually, private consulting firms are paid by the companies themselves to carry out periodic analyses which are then surrendered to the State Secretariat of Ecology for evaluation. When such analyses 'are not presented' or do not meet the stated requirements, state personnel pay a visit. Analyses of different kinds imply a cost that Y Industries avoided for some years. More importantly, Y Industries avoided constructing the necessary infrastructure to stock hazardous waste and did not pay for its collection for some time. Furthermore, Y Industries paid only 'minor fines' when called to account (Interview data, 2003, M. Poot, L. Balam).

The same situation occurred for CNA and the water permits granted to Y Industries. Although with some delay, Y Industries finally notified the authorities of the volumes of water consumed at the plant and the water deposits they made. In this case too, it is impossible to know the amount of pollution caused by the deposition of chlorinated waters in deep wells – or for how long they continued with that practice. But given that no cases of contamination and poisoning were mentioned, it is likely that the depth of the wells somehow ensured a minimum level of safety, just as M. Poot had suggested. In both cases, CNA and PROFEPA 'reacted' to correct problems that had been going on for some time and that had been noticed by local citizens. Local authorities also had a 'corrective' attitude towards Y Industries. Motul's 'open-air' municipal waste dump was clearly not suited to taking Y Industries' human and industrial waste. Trusting that CRETIB's[8] analysis might be reasonable from

[8]CRETIB refers to the chemical and physical properties of the waste. In Spanish it is: *Corrosivo, Reactivo, Explosivo, Tóxico, Inflamable, Biológico infeccioso*. These categories are similar to those used by the Environmental Protection Agency (EPA) in the United States, with the only exception that Mexican legislation added biological infectious waste (see Kopinak and Barajas 2002:223).

the legal point of view, the fact that the new PAN administration engaged in building a sanitary landfill 'as soon as possible' shows how concerned local authorities were. In general, federal, state and local authorities seem to have been 'permissive' with the environmental practices at the Y Industries plant, but not necessarily compliant or negligent. The Y Industries case perhaps illustrates well Mexico's approach to industrial environmental regulation and monitoring (under the so-called 'Law Enforcement Mechanism'). On one hand, industry appears to be allowed to install and operate relatively easily as long as an Environmental Impact Study is presented. On the other hand, state environmental monitoring and citizen's complaints are taken relatively seriously.

As the interviews have demonstrated, communication between agencies regarding Y Industries' environmental performance seemed to flow effectively. State and federal agencies reacted quickly to citizen's complaints and engaged in proper monitoring. Although Y Industries was not severely fined at any time, nor obliged to stop their activities, a series of institutional recommendations and 'threats' did make Y Industries change some of their practices or at least regularize their situation. What this shows is that economic activity in the state of Yucatan seems to be prioritized over environmental regulations, and it would appear that governmental authorities try to make sure that companies feel relatively 'comfortable', but are not left 'unwatched'. The representatives of Yucatan's environmental agencies often emphasized the need to 'invite' entrepreneurs to 'cooperate over the environment' rather than to 'oblige them' to change their production processes by 'sanctioning them' (Interview data, 2003, all interviewees from SEMARNAT-Yucatan, CNA-Yucatan, PROFEPA-Yucatan and the State Office for the Environment). In many cases, too much emphasis was put on the positive aspects of certain production processes that helped to care for the environment (so called 'success stories'), and only discrete mention was made of the problems (Interview data, 2003, all interviewees from SEMARNAT-Yucatan, CNA-Yucatan, PROFEPA-Yucatan and the State Office for the Environment). Several times, interviewees emphasised Y Industries' quick reaction to solve problems, rather than the gravity of the problems or the risks such irregularities could have presented for local citizens. Perhaps quite significantly, most state environmental officials came from the private sector and were experienced in the management of industrial processes. To many, their experience in government 'was recent' and has allowed them 'to clearly see both sides of the problem' (Interview data, 2003, all interviewees from SEMARNAT-Yucatan, CNA-Yucatan, PROFEPA-Yucatan and the State Office for the Environment).

In general, the case of Y Industries shows that government agencies are 'reactive' rather than 'preventive', and that significantly more environmental damage could have resulted if Y Industries had carried out more polluting activities. In summation, risk was not minimized to its lowest level. What is more, Y Industries' self-regulation could be called into question. Clearly, Y Industries engaged in building and using the infrastructure that they needed long before they notified the authorities. Perhaps with the knowledge that permits would be granted anyway, and that fines were relatively low (otherwise Y Industries would not have repeated their misdemeanors twice), Y Industries ignored the legislation and paid little for it. It seems that Y Industries was

driven by their need to grow and produce more jeans – which certainly implied more jobs – regardless of the legal requirements to comply with the Mexican environmental norms. Had it not been for the intervention of the State Secretariat of Ecology, the CNA and PROFEPA, perhaps Y Industries would have continued to operate as they did in their early years. Perhaps such corporate (and institutional) behavior should not be surprising at all. In fact, the Y Industries case actually provides empirical evidence to support Grossman's (2000) claims that Trans-National Corporations (TNCs) tend to always take (economic and environmental) advantage when they can, particularly when local governments do not have enough capacity to enforce the law. More importantly, NAFTA agreements seem to have assured TNCs a legal framework that clearly subordinates environmental protection to economic growth and trade (Grossman 2000; Marchack 1998).

On the local government's part, it seems that only a major investment can solve Y Industries' waste management problems. Y Industries' human and industrial waste does not fall into the category of hazardous waste, for which reason the municipality has to deal with it. The amount of investment needed to build a sanitary land-fill site certainly represents a considerable cost for the local authorities, a cost they cannot avoid. What all this shows is that: (1) even the least polluting maquiladoras can be dangerously polluting; (2) state and local governments have to monitor maquiladora activities and invest in a minimal environmental infrastructure to prevent major environmental threats; (3) Environmental Impact Studies do not ensure that companies operate within Mexico's environmental norms; and (4) the penalties do not seem to be stiff enough to oblige industries to comply with the Mexican environmental norms once they go into operation, nor do they prevent industries from committing the same offense for a second time.

## *3.9 The State Government's Approach to Sustainable Development*

Every economic policy-maker spoken with at the state level emphasized the need for state environmental controls. It was felt that all economic activities must be properly regulated, monitored and sanctioned 'if needed'. The policy of encouraging clothing maquiladoras mainly, 'was an example of the state's concern for sustainable development' (Interview data, 2003, M. Poot, I. Tamayo, L. Guillermo, A. Domínguez). 'From the planning point of view, nothing more could have been done. It is the responsibility of environmental agencies to take care of the environment. We ["developers"] concentrate on the economy – that is, on generating investment opportunities for the state' (Interview data, 2003, M. Gutiérrez). On the other hand, policy-makers were not aware of the potential environmental risks brought by a plant like Y Industries. Very few raised the most common (economic and social) concerns with regard to the Export Maquiladora Industry (EMI). L. Castillo was the only one to acknowledge that in many respects the installation of Y Industries was 'an experiment', and that 'adjustments had to be made as problems

would appear'. It was very clear that Yucatan's henequen past was very much present in state and local development policy-makers' speeches and arguments. To many interviewees, the prospect of bringing maquiladoras to the state was clearly an opportunity to create jobs, with the knowledge that those jobs would not necessarily improve things dramatically (Interview data, 2003, M. Poot, I. Tamayo, L. Guillermo, A. Domínguez, R. Medina, D. Loria). The quality of the jobs was definitely not an issue. More than once, maquila employment was compared with building or agricultural work, usually to signal that the job opportunities in the state were no better than maquila employment. The same was true for the salaries offered at the maquila plants and other local jobs. The distinction between the northern maquila industry and that in the Yucatan was made mainly from the environmental perspective.

The fact that the Maquiladora Program for the Ex-Henequen Region was unanimously seen as a success (by state policy-makers, local officials and Motuleños in general) conclusively proves how important maquila jobs are for the state and the region (Interview data, 2003, all interviewees from the State Office for Rural, Industrial and Commercial Development, State Office for the Environment and local shop-keepers, traders and transport drivers). Indeed, all state officials were proud to show employment statistics and emphasized the economic recovery that followed the installation of the maquiladoras. More critically, the maquilas in the Ex-Henequen Region clearly seem to have been a way out of poverty. R. Medina stated that the aim of the rural development policy was to provide the means for rural households to earn at least two minimum salaries. There is evidence to suggest that it is highly likely that the Maquiladora Program for the Ex-Henequen Region had a similar goal. Although a number of projects to promote rural development have been set in motion (such as lime production, sheep breeding and aquaculture), these have always been taken (by state policy-makers themselves) as small-scale, primary sector businesses that can improve revenues for some families (Interview data, 2003, I. Tamayo, L. Guillermo, A. Domínguez, R. Medina, D. Loria). Officials at the state's agency for Rural Development showed that their programs were innovative, diverse and adapted to specific locations and people, but remained tentative and usually limited in scope (representing only around 5% of the state's GDP). As one official put it: 'We are very conscious that our development programs will never reach the competitive levels of the agroindustry in the north of the country, let alone the USA, but that does not mean that people do not benefit and take advantage of them.' (Interview data, 2003, M. Gutiérrez).

From the environmental point of view, many interviewees acknowledged that the Mexican environmental legislation was 'young', and that it was 'inspired by the American model' and even written at a certain 'speed'. For most of them though, it was 'fairly complete' and 'if implemented properly it would not meet with any problems' (Interview data, 2003, most interviewees from the State Government Office for the Environment, SEMARNAT-Yucatan, CNA-Yucatan and PROFEPA-Yucatan). The weaknesses came from its implementation, and thus from the budget, as well as the human and technical resources allocated to state environmental agencies. All the state environmental officials recognized that even if government efforts were important and many cases yielded very positive results, 'a lot still had to be done'

(Interview data, 2003, most interviewees from the State Government Office for the Environment, SEMARNAT-Yucatan, CNA-Yucatan and PROFEPA-Yucatan). The pace at which environmental threats advance does not seem to have been matched by the resources officials have at their disposal. Officials claim to do their very best, but insisted they are generally below the requirements. Moreover, even if promoting the participation of private firms in providing environmental services was universally seen as a good strategy, the work carried out by those private companies was seen as 'not even'.

Several interviewees commented how different the Environmental Impact Studies can be, as well as the sampling techniques and the quality of tests. More importantly, a few interviewees indicated that it was very easy for a private environmental consulting firm to register and that these were not regulated by any federal or state government authority (Interview data, 2003, I. Tamayo, C. Medina, among others). In many cases, SEMARNAT-Yucatan 'had to advise' companies wishing to operate in the state on the requirements of the Environmental Impact Study so that companies would not present an incomplete and low-standard study that potentially could be rejected (Interview data, 2003, I. Tamayo, C. Medina, among others). More importantly, state environmental officials unanimously acknowledged that priorities in the state were clear. Getting jobs and developing the economy were the most pressing needs. The environment came second (Interview data, 2003, all interviewees from the State Government Office for the Environment, SEMARNAT-Yucatan, CNA-Yucatan and PROFEPA-Yucatan). It follows that with no exception, all state environmental officials insisted that their job consisted of getting private entrepreneurs to 'join-in' with better environmental practices, but that they did not believe that sanctioning and penalizing them was the best strategy. As L. Balam succinctly put it: 'It is also in our interest that these companies continue to operate and continue to come to Yucatan.'

## *3.10 Federal Government and Sustainable Development*

Prior to the creation of SEMARNAT, the SEDUE[9] (*Secretaría de Desarrollo Urbano y Ecología*) was in charge of evaluating industrial activities in the country and of granting permits for factories to operate. Generally speaking, the literature does not give much credit to SEDUE activities, given the rapid and uncontrolled industrialization in Mexico City and Guadalajara – principally during the 1970s and 1980s (Mumme 1992; Mumme et al. 1988). Given that much of Mexico's industry is owned by the government (e.g. PEMEX, CFE, TELMEX), and that under the ISI program[10] industrializing the country was a priority, SEDUE's activities seemed to

[9]Created in 1983 and replaced in 1992 by the INE and SEDESOL (see http://www.ine.gob.mx/ueajei/publicaciones/libros/132/evolucion.html)

[10]Import Substitution Industrialisation Program.

guarantee a minimum standard of safety for the population, but little care was given to the environment. After NAFTA was signed – and certainly fearing the environmental impacts that more maquiladoras could have on the environment – the INE-SEMARNAT (together with other state offices) became responsible for evaluating new industrial projects, authorizing their activities and then monitoring them to make sure they operated under the recently created Mexican environmental norms (Kopinak and Barajas 2002; Grossman 2000; Logsdon and Husted 2000; Marchack 1998; Mumme and Duncan 1997; Bowen et al. 1995; Gillbreath 1992; Perry et al. 1990). By that time the environmental situation in Mexico had considerably worsened – particularly along the northern border, and environmental groups had organized to put pressure on the government to incorporate environmental law and policy in their agenda (Liverman et al. 2002; Marchack 1998; Simon 1997; Gilbert 1994). At an international level, sustainable development principles and objectives had reached their height. A commercial treaty such as NAFTA could not simply ignore the importance of considering environmental aspects in its texts. Moreover, a series of 'accidents' related to government-owned industries made it clear that Mexico needed to tackle the risks to the environment at an institutional level (see Table 3).

As these institutions developed, the participation of state agencies was promoted. The incorporation of the private sector was seen as a coherent strategy to help the government build environmental institutions while opening a market that would guarantee 'objectivity' and lower the level of governmental responsibility. These measures are in line with the World Bank's guidelines on modernizing and developing strategic sectors and strengthening government institutions – so-called capacity-building (Navarrete and León 2005). There is no doubt that the Mexican environmental institutions were designed following the scheme of the EPA in the United States and taking into consideration neoliberal policy guidelines (Grossman 2000; Logsdon and Husted 2000; Marchack 1998). Although the federal budget allocated to SEMARNAP[11] was considerably larger prior to the crisis of 1995, between 1995 and 1999 it seems to have stabilized near 6% of the total federal budget (Logsdon and Husted 2000: 380). Available data for the period 2004–2009 show that only around 1% of federal government expenses account for SEMARNAT's budget (Table 4).

Interviews with federal environmental officials (SEMARNAT) revealed that their concerns are very similar to those expressed by officials at the state level. Although the diagnosis of the environmental and developmental challenges faced by Mexico in its efforts to achieve sustainable development portrayed these challenges as extremely varied and complex, all interviewees agreed that efforts had to be

[11]The SEMARNAP (*Secretaría del Medio Ambiente Recursos Naturales y Pesca*) became SEMARNAT (*Secretaria del Medio Ambiente y Recursos Naturales*) in the year 2000. The Fisheries department (*Pesca*) was transfered to the newly created SAGARPA (*Secretaría de Agricultura. Ganadería, Desarrollo Rural, Pesca y Alimentación*).

**Table 3** Evolution of Mexico's environmental agencies over time

| Year | Event |
|---|---|
| 1983 | (a) Creation of the *Secretaría de Desarrollo Urbano y Ecología* (*SEDUE*)<br>(b) The Federal Law on Environmental Impact introduces 'risk studies' as part of the administrative requirements for permits to be granted |
| 1984 | Gas explosion in San Juan Ixhuatepec |
| 1986 | (a) Creation of the Sub Risk Management Office at SEDUE<br>(b) Procedures are put in place to evaluate projects that handle and use hazardous materials |
| 1988 | (a) Publication of the *Ley General del Equilibrio Ecológico y la Protección al Ambiente* (*LGEEPA*)<br>(b) Publication of the rules on Environmental Impact, which take into account Risk Studies and Programmes to Prevent Accidents<br>(c) A committee on Highly Dangerous Activities is created |
| 1989 | A committee for the Analysis and Approval of Programmes to Prevent Accidents is created |
| 1990 | The first list on High Risk Activities (according to the use of toxic substances) is published |
| 1992 | (a) Creation of the *Instituto Nacional de Ecología* (*INE*) and the *Secretaría de Desarrollo Social* (*SEDESOL*)<br>(b) Creation of the *Procuraduría Federal de Protección al Ambiente* (*PROFEPA*)<br>(c) Environmental Auditing is introduced<br>(d) Explosion in the Guadalajara City sewage system<br>(e) The *Programa Nacional para la Prevención de Accidentes de Alto Riesgo Ambiental* (*PRONAPAARA*) is launched<br>(f) The *Comités Ciudadanos de Información y Apoyo para Casos de Prevención y Atención de Riesgos Ambientales* are established |
| 1992 | The second list on High Risk Activities (according to the use of toxic substances) is published |
| 1994 | The *Secretaría de Medio Ambiente, Recursos Naturales y Pesca* (*SEMARNAP*) is created |
| 1996 | Publication of the new *Ley General del Equilibrio Ecológico y la Protección al Ambiente* (*LGEEPA*) |

Source: http://www.ine.gob.mx/ueajei/publicaciones/libros/132/evolucion.html

**Table 4** Federal budget allocated to SEMARNAT (2004–2009)

| | SEMARNAT'S Federal Budget (millions of pesos) | MEXICAN GOVERNMENT Expenses (millions of pesos) | SEMARNAT'S Budget as a % of Federal Expenses |
|---|---|---|---|
| 2004 | 16008.2 | 1,810,831.6 | 0.9 |
| 2005 | 24482.9 | 1,988,304.3 | 1.2 |
| 2006 | 21352.4 | 2,374,303.1 | 0.9 |
| 2007 | 29006.3 | 2,852,546.8 | 1.0 |
| 2008 | 39064.6 | 3,619,563.2 | 1.1 |
| 2009 | 45059.8 | 3,538,968.1 | 1.3 |

Source: SEMARNAT and INEGI (2011)

made in different directions (Interview data, 2003, G. Román, R. Juárez, M. Niño, L. Gutiérrez, G. Valladares). For instance, more cooperation between agencies was needed; most notably between those agencies that draw up development policies and protect the environment (e.g. SEDESOL and INE-SEMARNAT). Similarly, even though many more channels of communication had been opened up with NGOs, civil society and rural communities under that administration, more had to be opened to consult with people before drawing up policy (Interview data, 2003, G. Román, R. Juárez, M. Niño, L. Gutiérrez, G. Valladares). Furthermore, one major problem was the lack of resources in relation to the goals established by SEMARNAT. A lack of financial, human and technical resources made it difficult to make a complete and informed diagnosis, but most of all 'to act' (Interview data, 2003, G. Román, R. Juárez, M. Niño, L. Gutiérrez, E. Vega). Often the databases of different agencies and those of the federal and state agencies were contradictory and included significant margins of error. According to the past PAN administration, the major challenge 'to start the thinking process to draw up sustainable development policies' was to set a 'land use plan' at the federal, state and local levels (Interview data, 2003, M. Niño, L. Gutiérrez, E. Vega). Although Mexican environmental law was generally seen as 'quite complete' and 'in the process of adaptation to the Mexican reality', it seemed to be 'too general', and did not always favor the 'action of the authorities'. The contradiction in competencies made it urgent that state and local governments draw up their own land use criteria, following the major principles laid down in the Federal environmental law (Interview data, 2003, all interviewees from SEMARNAT).

The general feeling was that Mexico's environmental culture (governmental and civil) was slowly developing and that the economic situation 'was not favourable at all' (Interview data, 2003, M. Niño, L. Gutiérrez, E. Vega). The processes of urbanization were a major challenge, given the lack of planning and the relatively uncontrolled demographic and economic forces behind urban growth. Moreover, resource depletion and consumption on a massive scale were very difficult to control. All interviewees emphasized that poverty was a major issue at the root of environmental degradation and depredation of natural resources, but prosperous sectors of the Mexican economy – such as tourism and the oil industry, certainly played very important roles. Urban growth, deforestation, air, land and water pollution, the protection and regeneration of ecosystems and the promotion of sustainable use of natural resources (particularly water) all had to be attended to in different ways in different places (Interview data, 2003, G. Román, R. Juárez, M. Niño, L. Gutiérrez, E. Vega). A new vision based on *'cuencas hidrológicas'* (watersheds) promised a more effective definition of objectives than 'the traditional one, based on political and administrative boundaries'. However, the challenges seem to be immense. As M. Niño put it, it all looked very well on paper, but when things have to get done officials realize how complicated and costly an effective policy can be. Officials spend their time solving very urgent, immediate problems, even though a very ambitious and well prepared agenda actually exists. To draw up and apply a "truly sustainable development policy", one must be a public servant, a negotiator and an environmental expert – 'How difficult can that be'? (Interview data, 2003, M. Niño).

Interestingly, and consistent with the Y Industries case, the officials responsible for hazardous waste management and industrial control made it clear that government environmental policy was 'reactive' rather than 'preventive' and that such an approach had clearly negative consequences (Interview data, 2003, G. Román, R. Juárez). Moreover, the CRETIB analyses were called into question by G. Román, who believed that these were not adapted to Mexican reality, but were mainly a copy of United States environmental legislation. Mentioned several times was that inclusion of the private sector was 'positive' and certainly 'very welcome', but that proliferation of environmental consulting firms was not necessarily a good thing (Interview data, 2003, G. Román, R. Juárez, M. Niño, L. Gutiérrez, E. Vega). As at the state level, federal officers of SEMARNAT complained about the quality of the Environmental Impact Studies in general and stressed that these can represent in some cases a business opportunity for some people and a simple formality for entrepreneurs in others. G. Román pointed out that the environment is often taken as a business opportunity and that legislation supports these types of businesses, but not necessarily to the benefit of the environment. M. Niño went further and ironically suggested that an environmental consulting firm is a good business, easy to set and register, and seldom regulated or monitored by government institutions. As at the state level, the federal officials of SEMARNAT believed that economic development was a priority that simply could not be ignored (Interview data, 2003, M. Niño).

Interviews with PROFEPA officials confirmed the views of SEMARNAT officials (at a state and federal levels) on the Mexican legislation, the definition of competencies, goals and means to reach them. For instance, all PROFEPA officials agreed that Mexican environmental law was 'relatively new', and thus in the process of adaptation and redefinition to respond to 'Mexican reality'. Most interviewees emphasised that some sectors clearly had legal flaws (notably the area of waste management, for example) and that often the competencies of agencies and offices at different levels of government were not properly defined (Interview data, 2003, L. Hernández). For some, the legal framework was too general and did not help in the elaboration of policies, nor did it help to improve the government's action (Interview data, 2003, D. Ponce, L. Hernández, J. Támez, E. del Villar). L. Hernández clearly stated that sometimes it is not clear whether PROFEPA officials are supposed to review the evidence and sanction according to the law, or whether they are charged with vigilance and control. PROFEPA officials concurred with the view that the budget allocated to environmental activities was far too limited – the salaries at PROFEPA are among the lowest of any environmental agency (Interview data, 2003, D. Ponce, L. Hernández, J. Támez, E. del Villar). Human and technical resources were also overstretched, which obliged them to allocate their resources very strategically. It was clearly very important to have the support of other agencies at the state and local levels of government in order to assure a decent level of coverage across the country. Subcontracting to private companies or universities was also very helpful. Private and international donations helped them to invest in monitoring devices (Interview data, 2003, D. Ponce). Moreover, coordination with other agencies, although it does occur, is not systematic and conflicting interests often have debilitating interactions (Interview data, 2003, L. Hernández).

PROFEPA also had the support of NGOs and civil society who 'little by little' are showing more interest in participating, together with government authorities. On a positive note, E. del Villar stated that citizen's complaints have risen dramatically in the last 3 years – by thousands of percentage points. PROFEPA's goal is to respond to 100% of these complaints; in the year 2002 at least 90% of all complaints were attended. The priority areas for PROFEPA were similar to those of SEMARNAT. Forestry is the most important area, followed by the protection of biodiversity and marine resources. Tourism is one of the most important economic sectors that PROFEPA must monitor, mainly because it is concentrated in coastal areas (Interview data, 2003, D. Ponce, E. del Villar). Furthermore, poverty was defined as a major cause of environmental damage and resource overexploitation. As D. Ponce explained: '60% of all offenders are indigenous people who find themselves in poverty or extreme poverty. For example, they usually cut a tree or kill iguanas for survival. Some 30% of total offenders are companies that have a permit to exploit natural resources but exceed the quotas we grant them. The timber industry, fishing and paper industries are the most damaging. Around 5% is organised crime. Indigenous peoples are often exploited to cut trees or catch exotic animals for sale'. D. Ponce did not specify who was responsible for the remaining 5% of environmental damage.

Although the priority areas for PROFEPA seem to be clear, L. Hernández affirmed that the law puts too much emphasis on waste management and industrial monitoring. Moreover, PROFEPA's registers of polluting industries have several limitations. Only big plants are properly accounted for, mainly because it is easier to trace their activities (Interview data, 2003, D. Ponce, L. Hernández). These (5,000 units) concentrate around 80% of all polluting activities. The rest (30,000 plants) remain relatively uncontrolled. PROFEPA does not have a complete register of small to medium-size plants, because they are not registered as tax payers (Interview data, 2003, D. Ponce, L. Hernández). This results in serious margins of error (of more than 100%) when it comes to the estimations of the total volumes of hazardous waste managed in the country (Interview data, 2003, L. Hernández). The fact that big industries are relatively easy to trace and monitor is reflected in their willingness to cooperate and to get international environmental certification ('such as ISO 9000 and the like'). 'We are trying to make industries care about the environment so that they seek certification instead of us having to keep an eye on them and penalize them when they violate the law' (Interview data, 2003, L. Hernández). When industries are certified (either by the International Standard Organisation or PROFEPA itself), PROFEPA's job is considerably easier. However, when penalties have to be imposed it seems clear that the fines are too modest to ensure that the transgressions will not be repeated again (Interview data, 2003, D. Ponce, L. Hernández, J. Támez, E. del Villar). D. Ponce specified that the worst administrative fines are around 20,000 minimum salaries (US $60,000). The largest fines imposed to protect wildlife are around 50,000 minimum salaries (1.5 million pesos or around US $150,000).

This aspect of the law is so important that it calls into question the whole approach of PROFEPA towards environmental protection. For L. Hernández, the sanctions

are not adequate to prevent those who have broken the law from breaking it again, let alone to repair the damage that they have caused. Sometimes agents seem to actually have an economic incentive to break the law. In the opinion of L. Hernández, such small fines do not help at all; PROFEPA's law enforcement approach is not an adequate strategy for Mexico, simply because the country is too big and the government too small, thus requiring more incentives for participation to be put in place. Like SEMARNAT officials, those at PROFEPA acknowledged that the participation of the private sector was not always as good as they would have liked. Officials claimed that some of the administrative processes to assure environmental protection have to be revised. In many cases these processes seem to have become a bureaucratic mechanism that does not achieve very much. In their view, SEMARNAT authorizes industries to operate, but they do not always make sure that the industries they register operate in accordance with the impact studies. Thus, PROFEPA officials often have to verify how industries work and often find that authorizations should not have been granted in the first place. When that happens, tensions and even competition between agencies emerges. PROFEPA officials said they do not trust SEMARNAT officials' judgement and that SEMARNAT officials in turn, do not trust their way of working (Interview data, 2003, L. Hernández).

L. Hernández pointed out that foreign corporations react very differently than the national ones. When foreign corporations are sanctioned they develop a series of legal actions to avoid penalties, not because they cannot pay the fines, but because they have to justify that payment to their parent firms. Corporations seem to defend themselves to avoid corporate sanctions. The national firms, however, try to comply with the very minimum standard, so that they are not constantly visited by PROFEPA officials. Given the nature of PROFEPA activities, all interviewees acknowledged that corruption was a major problem that had been worryingly common in the previous administration. They explained that it was easy to bribe an inspector, because inspectors at PROFEPA were the worst paid employees in all of the government environmental institutions. Officials in higher positions were also caught and immediately sanctioned (Interview data, 2003, L. Hernández, E. del Villar). Most interviewees associated cases of corruption with the PRI political party and explained that, in part, the new PAN administration had won the elections because citizens were tired of corruption. An interviewee told us: 'Corruption exists, but a recent rise in salaries to combat it has had positive results. For example, inspectors now earn three times more than they used to earn, although unfortunately salaries remain low' (Interview data, 2003, E. del Villar).

## 4 Conclusions

The three parts of this review – the discussion on water sustainability, water politics, and the case study in Mexico – have demonstrated the significant repercussions of the reform of water management for the agroecological debate. First, the use of water by farmers and other rural sectors is part of the wider pursuit of water

sustainability by all catchment stakeholders. There are many complex connections between upstream and downstream activities, as well as between rural and urban sectors and between the local, catchment and global dimensions of environmental management. Although the focus of agroecology is typically on agricultural systems, there are no boundaries between the urban and rural terrains of ecosystems. Water management is a mediator between the demands of social groups in multiple catchment locations and the performance of a variety of different activities. Second, the examples from Mexico provide a regional illustration of the challenging nature of water institutional reforms and the political obstacles to achieving higher levels of water sustainability. Despite changes in discourse and the introduction of new mechanisms of environmental regulation, the allocation and use of water continues to follow the balance of power between spatial areas and groups of interest. This review also shows how the exacerbation of the economic dimension of water management has permeated the entire experience, serving as a political filter for the assessment of impacts and formulation of solutions. In that context, the use of water by small-scale farmers and peasants normally receives only secondary attention. The new regulatory framework, which should be creating synergisms between state and society, has paradoxically widened the gap between public agencies and society as a whole, because water policy has been dominated and manipulated by the stronger political players. Third, and related to the previous points, agroecology experts and practitioners need to be aware that the contemporary debate over technological improvements and institutional reforms in the water sector has been excessively concentrated on scientific assessments and management techniques, with insufficient consideration of the underlying politics of decision-making and socio-economic asymmetries.

The ultimate conclusion is that, notwithstanding a rhetorical construction around sustainability and public participation, contemporary policy-making has so far failed to improve long-term patterns of water use and conservation. In the end, lack of water sustainability is not only related to the poor conditions of hydrological systems and the precariousness of public services, but is deeply embedded in the patterns of water use and conservation that reflect a highly asymmetric power struggle between the local communities and the political and economic priorities of regional development. The agroecology agenda cannot ignore the fact that at the core of water sustainability is the formulation of more effective and democratic channels of public engagement, not only as an element of improved decision-making, but as the cornerstone of active citizenship and environmental justice.

## References

Alawi MA, Khalill F, Sahili I (1994) Determination of trihalomethanes produced from the chlorination of water as a function of humic acid content. Arch Environ Con Tox 26:381–386

Albornoz L (2000) El comportamiento ambiental de las maquiladoras en Yucatán. Bachelor's thesis, Departamento de Manejo y Conservación de Recursos Naturales, Universidad Autónoma de Yucatán (UADY)

Alimonda H (2006) Una herencia en manaos (anotaciones sobre historia ambiental, ecología política y agroecología en una perspectiva latinoamericana). Horizontes Antropológicos 12(25):237–255

Altieri MA, Nicholls CI (2008) Scaling up agroecological approaches for food sovereignty in Latin America. Development 51(4):472–480

Alvarez Legorreta MT (2002) Plaguicidas organoclorados en sedimentos de la Bahía de Chetumal y del Río Hondo. Una revisión de los estudios realizados de 1993 a 1999. In: Rosado-May FJ, Romero Mayo R, De Jesús Navarrete A (eds) Contribuciones de la ciencia al manejo costero integrado de la Bahía de Chetumal y su área de influencia. Serie Bahía de Chetumal No. 2. Universidad de Quintana Roo, México City, pp 171–178

Alvarez LW, Alvarez W, Asaro F, Michel HV (1980) Extraterrestrial cause for the Cretaceous–Tertiary extinction: experimental results and theoretical interpretation. Science 208(4448):1095–1108

Amekawa Y (2011) Agroecology and sustainable livelihoods: towards an integrated approach to rural development. J Sustain Agric 35(2):118–162

ASCE (1998) Sustainability criteria for water resource systems. American Society of Civil Engineers, Reston

ASK (Amigos de Sian Ka'an) (2003) Tratamiento de Aguas Residuales: construyendo las Bases Para la Conservación del Agua y su Biodiversidad Asociada en la Península de Yucatan. [Wastewater treatment: constructing the basis for the conservation of water and the associated biodiversity on the Yucatan Peninsula]. CD-ROM, Amigos de Sian Ka'an, The Nature Conservancy y la Comisión de Áreas Naturales Protegidas, Cancún, Quintana Roo, Mexico

Back W (1992) Coastal karst formed by ground-water discharge, Yucatan, Mexico. Int Contrib Hydrogeol 13:57–65

Back W, Hanshaw B (1970) Comparison of chemical hydrogeology of the carbonate peninsulas of Florida and Yucatan. J Hydrol 10:330–368

Back W, Lesser JM (1981) Chemical constraints of groundwater management in the Yucatan Peninsula, Mexico. J Hydrol 51:119–130

Barkin D (1998) Sustainability: the political economy of autonomous development. Organ Environ 11:5–32

Batllori-Sampedro E, González-Piedra JI, Díaz-Sosa J, Febles-Patrón JL (2006) Caracterización hidrológica de la región costera noroccidental del estado de Yucatán. Investigaciones Geográficas, Boletín, México, 59

Bauer-Gottwein P, Gondwe BRN, Charvet G, Marín LE, Rebolledo-Vieyra M, Merediz-Alonso G (2011) Review: the Yucatán Peninsula karst aquifer, Mexico. Hydrogeol J 19:507–524

Bautista F, Aguilar Y, Rivas y Páez H (2007) Los suelos del Estado de Yucatán. In: Martínez M, Cabañas D (eds) Importancia del binomio suelo-materia en el desarrollo sostenible. Agencia Española de Cooperación Internacional y el Centro de Edafología y Biología Aplicada del Segura de Murcia, España, pp 11–42

Bernhardi L, Beroggi GEG, Moens MR (2000) Sustainable water management through flexible method management. Water Resour Manag 14:473–495

Biles J (2004) Export-oriented industrialization and regional development: a case study of maquiladora production in Yucatán, Mexico. Reg Stud 38(5):517–532

Bowen M, Kontuly T, Hepner G (1995) Environmental auditing: estimating maquiladora hazardous waste generation on the U.S./Mexico border. Environ Manage 19:281–296

Brandenburg A (2008) Mouvement agroécologique au Brésil: trajectoire, contradictions et perspectives. Natures Sciences Sociétés 16:142–147

Brannon J, Baklanoff E (1987) Agrarian reform and public enterprise in Mexico. The University of Alabama Press, Tuscaloosa

Brannon J, Gilbert J (1991) Land labor and capital in modern Yucatán: essays in regional history and political economy. The University of Alabama Press, Tuscaloosa

Brown T, Harper D (1999) Sustainability in the context of tropical catchments. In: Harper D, Brown T (eds) The sustainable management of tropical catchments. Wiley, Chichester, pp 3–17

Canto SR (2001) Del henequén a las maquiladoras – la política industrial en Yucatán 1984–2001, 1st edn. Instituto Nacional de Administración Pública-UADY, Mexico City
Canto SR, Cruz PE (2004) Las maquiladoras en Yucatán y el Plan Puebla-Panamá. Comercio Exterior 54(4):328–335
Casares OJ (1983) Estudio estadístico de la relación de enfermedades gastrointestinales con el ambiente natural (Statistics survey on the relationship between gastrointestinal diseases and natural environment, in Spanish). Master degree thesis on engineering environmental, Autonomous University of Yucatan, 50 p
Castilla B (2004) Mujeres Mayas en la robótica y líderes de la comunidad: tejiendo la modernidad. CEPSA, Mérida
Castilla B, Torres B (1999) Las relaciones laborales en Yucatán. In: Cambios en las relaciones laborales. Enfoque sectorial y regional, vol II. UNAM/UAM, Mexico City/Xochimilco, pp 565–589
Charvet G (2009) Exploration, modeling and management of groundwater resources in northern Quintana Roo, Mexico. MSc thesis, Technical University of Denmark, Denmark
Clark MJ, Gardiner J (1994) Strategies for handling uncertainty in integrated river basin planning. In: Kirby C, White WR, Wallingford HR, Institute of Hydrology (eds) Integrated river basin development. Wiley, Chichester, pp 437–445
CNA (2001) Plan nacional hidráulico, 2000-2006. Comisión Nacional del Agua, Mexico City, Mexico. (www.cna.gob.mx/Espaniol/Directorio/Default.aspx)
Cocklin C, Blunden G (1998) Sustainability, water resources and regulation. Geoforum 29:51–68
Cruces JM (1996) Desarrollo, sustentabilidad y agroecología: una visión desde América Latina. Ecotropicos 9(2):61–70
De la OM (2000) Ciudad Juárez: la conformación de una ciudad maquiladora. In: Morales J (ed) El eslabón industrial: cuatro imágenes de la maquila en México. Nuestro Tiempo, Mexico City
Delgado C, Pacheco J, Cabrera A, Batllori E, Orellana R, Bautista F (2010) Quality of groundwater for irrigation in tropical karst environment: the case of Yucatan, Mexico. Agr Water Manag 97:1423–1433
Escolero O, Marin LE, Steinich B, Pacheco J (2000) Delimitation of a hydrogeological reserve for a city within a karstic aquifer: the Merida, Yucatan, example. Landscape Urban Plan 51:53–62
Escolero O, Marín LE, Steinich B, Pacheco JA, Molina-Maldonado A, Anzaldo JM (2005) Geochemistry of the hydrogeological reserve of Mérida, Yucatán, Mexico. Geofísica Internacional 44(3):301–314
Expansión Special Report (1984) Yucatán: la otra frontera maquiladora. Expansión 47–64
Falkenmark M (2001) The greatest water problem: the inability to link environmental security, water security and food security. Water Resour Develop 17:539–554
Febles Patrón JL, Batllori SE (1995) Fluctuación diurna del nivel hidrostático en petenes de la cuenca costera noroccidental del estado de Yucatán: efecto del desazolve y la canalización de manantiales. Ingeniería Hidráulica en México 2:30–37
Fish RD, Ioris AAR, Watson NM (2010) Integrating water and agricultural management: collaborative governance for a complex policy problem. Sci Total Environ 408(23):5623–5630
Foster SSD, Gale IN, Hespanhol I (1994) Impacts of wastewater reuse and disposal on groundwater. British Geological Survey Technical Report WD/94/55, Keyworth
Gabbert W (2004) Becoming Maya: ethnicity and social inequality in Yucatán since 1500. The University of Arizona Press, Tucson
García E (1988) Modificaciones al sistema climático de Köppen, 2nd edn. Instituto de Geografía, UNAM, Mexico City
García de Fuentes A, De La OM, Quintero C, Morales J (2000) La maquila en la península de Yucatán. In: Morales J (ed) El eslabón industrial cuatro imágenes de la maquila en México. Nuestro Tiempo, Mexico City
Gilbert A (1994) Third world cities: poverty, employment, gender roles and the environment in a time of restructuring. Urban Stud 31(4):605–633

Gillbreath J (1992) Financing environmental and infrastructure needs on the Texas-Mexico border: will the Mexican-U.S. integrated border plan help? J Environ Develop 1:151–175
Gleick PH (1998) Water in crisis: paths to sustainable water use. Ecol Appl 8(3):571–579
Gleick PH (2000) The changing water paradigm: a look at twenty-first century water resources development. Water Int 25:127–138
Gliessman SR, Rosado-May FJ, Guadarrama-Zugasti C, Jedlicka J, Cohn A, Mendez VE, Cohen R, Trujillo L, Bacon C, Jaffe R (2007) Agroecología: promoviendo una transición hacia la sostenibilidad. Ecosistemas 16(1):13–23
Gondwe B (2010) Exploration, modelling and management of groundwater-dependent ecosystems in karst: the Sian Ka'an case study, Yucatan, Mexico. PhD thesis, Technical University of Denmark, Denmark
Gondwe BRN, Lerer S, Stisen S, Marin L, Rebolledo-Vieyra M, Merediz-Alonso G, Bauer-Gottwein P (2010) Hydrogeology of the south-eastern Yucatan Peninsula: new insights from water level measurements, geochemistry, geophysics and remote sensing. J Hydrol 389:1–17
Gonzáles Herrera RA (1996) Evaluación de la contaminación del agua subterránea en relación con el basuero municipal de Mérida, Yucatán. Faculty of Engineering, Autonomous University of Yucatán, Report 498100-5-1864-T9212, Mexico
Gooddy DC, Lawrence AR, Morris BL, Chilton PJ (1997) Chemical transformations beneath unsewered cities. In: Chilton J, Alley W, Brun A (eds) Groundwater in the urban environment. Balkema, Rotterdam, pp 405–410
Graniel EI, Vera MYL, Hita G (2004) Dinámica de la interfase salina y calidad del agua en la costa nororiental de Yucatán. Ingeniería Revista Académica 8(003):15–25 (UADY, Merida, Mexico)
Gravel N (2006) Los factores de retención de la maquila: lección de Yucatán (1995–2005). Desacatos 21:51–66
Grossman P (2000) Corporate interest and trade liberalization: the North American Free Trade Agreement and environmental protection. Organ Environ 13:61–85
Gwynne R, Kay C (2004) Latin America transformed: globalization and modernity. Hodder Arnold, London
Harrington GW, Bruchet A, Rybacki D, Singer PC (1996) Characterization of natural organic matter and its reactivity with chlorine. In: Minear RA, Amy GL (eds) Water disinfection and natural organic matter. American Chemical Society, Washington, DC, pp 138–158
Herrera-Silveira JA, Aranda Cirerol N, Troccoli Ghinaglia L, Comín FA, Madden C (2005) Eutroficacion costera en la Peninsula de Yucatan. In: Pisanty I, Ezcurra E (eds) Diagnóstico ambiental del Golfo de México. Caso M, Secretaria de Medio Ambiente y Recursos Naturales. Instituto Nacional de Ecologia, Instituto de Ecologia, A.C., Harte Research Institute for Gulf of Mexico Studies
Hildebrand AR, Penfield GT, Kring DA, Pilkington M, Camargo A, Jacobsen SB, Boynton WV (1991) Chicxulub crater: a possible cretaceous tertiary boundary impact crater on the Yucatan Peninsula, Mexico. Geology 19(9):867–871
Hufschmidt MM, Tejwany KG (1993) Integrated Water Resources Management: meeting the sustainability challenge, IHP Humid Tropics Programme Series No. 5. UNESCO, Paris
INEGI (2011) El Ingreso y el Gasto Publico en 2010: Series estadísticas sectoriales. http://www.inegi.gob.mx/prod_serv/contenidos/espanol/bvinegi/productos/integracion/sociodemografico/igpm/2010/IGPM-2010.pdf. Accessed Oct 2011
Ioris AAR (2001) Water resources development in the São Francisco River Basin (Brazil): conflicts and management perspectives. Water Int 26:24–39
Ioris AAR (2005) A framework for assessing freshwater sustainability at the river basin scale. PhD thesis, Aberdeen University, Scotland
Ioris AAR (2008) The limits of integrated water resources management: a case study of Brazil's Paraíba do Sul River Basin. Sustain Sci Pract Policy 4(2):4–11
Ioris A (2010) The political nexus between water and economics in Brazil: a critique of recent policy reforms. Rev Radic Pol Econ 42(2):231–250

Ioris AAR, Hunter C, Walker S (2006) A framework of indicators to assess the sustainability of freshwater systems. Phys Geogr 27(5):396–410
Ioris AAR, Hunter C, Walker S (2008) The development of water sustainability indicators in Scotland and Brazil. J Environ Manag 88(4):1190–1201
Ison R, Roling N, Watson D (2007) Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. Environ Sci Policy 10:499–511
Johnson N, Ravnborg HM, Westermann O, Probst K (2001) User participation in watershed management and research. Water Policy 3:507–520
Jonker L (2002) Preface. Integrated Water Resources Management: theory, practice, cases. Phys Chem Earth 27:719–720
Kay PA (2000) Measuring sustainability in Israel's water system. Water Int 25:617–623
Kopinak K, Barajas M (2002) Too close for comfort? The proximity of industrial hazardous wastes to local populations in Tijuana, Baja California. J Environ Dev 11:215–246
Lee RG (1992) Ecologically effective social organisation as a requirement for sustaining watershed ecosystems. In: Naiman RJ (ed) Watershed management: balancing sustainability and environmental change. Springer, New York, pp 73–90
Legge D (2000) The sustainability of the water industry in a regulated environment. J Environ Law 12:3–19
Lerer S (2008) Estimation of actual evapotranspiration using remote sensing data for the Yucatan Peninsula, Mexico. MSc thesis. Program in Environmental Engineering at the Technical University of Denmark, 101 pp
Lilenthal DE (1944) Tennessee valley authority: democracy on the march. Penguin, Harmondsworth
Linton J (2010) What is water? The history of a modern abstraction. UBC Press, Vancouver
Liverman D, Varady R, Chávez O, Sánchez R (2002) Temas ambientales a lo largo de la frontera entre estados unidos y Mexico: impulsores de cambio y respuestas de ciudadanos e instituciones. El Colegio de Mexico, Mexico City
Logsdon J, Husted B (2000) Mexico's environmental performance under NAFTA: the first 5 years. J Environ Dev 9:370–383
Lugo-Hubp J, Aceves-Quesada JF, Espinosa-Perena R (1992) Rasgos geomorfologicos mayores de la peninsula de Yucatán. Universidad Nacional Autonoma de Mexico, Instituto de Geologia, Revista 10(2):143–150
Lundin M (1999) Assessment of the environmental sustainability of urban water systems. Department of Technical Environmental Planning, Chalmers University of Technology, Göteborg
MacLeod M, Wasserstrom R (1983) Spaniards and Indians in southern Mesoamerica. University of Nebraska Press, Nebraska
Marchack P (1998) Environment and resource protection: does NAFTA make a difference? Organ Environ 11:133–154
Marín LE (1990) Field investigations and numerical simulation of groundwater flow in the karstic aquifer of northwestern Yucatan, Mexico. PhD thesis, Northern Illinois University, Dekalb, IL, 183 pp
Marín LE, Perry EC (1994) The hydrogeology and contamination potential of northwestern Yucatán, Mexico. Geofís Int 33(4):619–623
Marín LE, Perry E, Pope KO, Duller CE, Booth CJ, Villasuso M (1990) Hurricane Gilbert: its effects on the aquifer in northern Yucatan, Mexico. In: Simpson ES, Sharp JM (eds) Selected papers on hydrogeology from the 28th International Geological Congress, Washington, DC. Verlag Heinz Heise, Hannover, pp 111–128
Marín LE, Steinich B, Pacheco J, Escolero OA (2000) Hydrogeology of a contaminated sole-source karst aquifer, Mérida, Yucatán, Mexico. Instituto de Geofisica, Universidad Nacional Autónoma de México, Mexico City, México. Geofísica Internacional 39(4):359–365
McCulloch CS, Ioris AAR (2007) Putting politics into IWRM. In: Proceedings of the General Assembly of the European Geosciences Union, 15–20 April 2007, Vienna. Geophysical Research Abstracts, vol 9, 02981, 2007; SRef-ID: 1607-7962/gra/EGU2007-A-02981

Miranda F (1958) Estudios acerca de la vegetación. In: Beltran E (ed) Los Recursos Naturales del Sureste y su Aprovechamiento, vol II. Instituto Mexicano de Recursos Naturales Renovables, Mexico City

Morales-Ojeda SM, Herrera-Silveira JA, Montero J (2010) Terrestrial and oceanic influence on spatial hydrochemistry and trophic status in subtropical marine near-shore waters. Water Res 44(20):5949–5964

Morgan J, Warner M, Brittan J, Buffler R, Camargo A, Christeson G, Denton P, Hildebrand A, Hobbs R, Macintyre H, Mackenzie G, Maguire P, Marin L, Nakamura Y, Pilkington M, Sharpton V, Snyder D, Suarez G, Trejo A (1997) Size and morphology of the Chicxulub impact crater. Nature 390(6659):472–476

Moseley E (1980) Yucatán: a world apart. The University of Alabama Press, Alabama

Mumme S (1992) System maintenance and environmental reform in Mexico: Salina's preemptive strategy. Lat Am Perspect 19(1):123–143

Mumme S, Duncan P (1997) The Commission for Environmental Cooperation and Environmental Management in the Americas. J Interam Stud World Aff 39(4):41–62

Mumme S, Bath R, Assetto V (1988) Political development and environmental policy in Mexico. Lat Am Res Rev 23(1):7–34

National Aeronautic and Space Administration/Jet Propulsion Laboratory/National Imagery and Mapping Agency of the US Department of Defense (NASA/JPL/NIMA) (2000) Shuttle Radar Topography Mission (SRTM) C-Band Interferometric Radar. 9600 x 9000 pixels (width x height). Orientation: North toward the top Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR)

Navarrete JM, León C (2005) La participación municipal en programas federales medio ambientales. El caso de los residuos sólidos municipales Comercio Exterior 55(4):348–361

OECD (2003) Improving water management: recent OECD experience. Organisation for Economic Cooperation and Development, Paris

Olmsted I, Duran R, Gonzalez-Iturbe JA, Granados J, Tun F (1999) Vegetacion. In: Cordova J (ed) Garcia de Fuentes A. Atlas de Procesos Territoriales de Yucatan. Facultad de Arquitectura. Universidad Autonoma de Yucatán, Merida, pp 163–182

Orellana R, Balam I, Bañuelos M (1999) Evaluación climátic. In: García de Fuentes A, Córdoba J, Ponce de León PCO (eds) Atlas de procesos territoriales de Yucatán. Universidad Autónoma de Yucatán, Mérida, pp 174–175

O'Riordan T (2004) Environmental science, sustainability and politics. Trans Inst Br Geogr 29:234–247

Pacheco AJ, Cabrera A (1977) Groundwater contamination by nitrates in the Yucatan Peninsula, Mexico. Hydrogeol J 5(2):47–53

Pacheco AJ, Cabrera A, Pérez R (2004) Diagnóstico de la calidad del agua subterránea en los sistemas municipales de abastecimiento en el Estado de Yucatán, México. Ingeniería 8(2):165–179

Patch R (1993) Maya and Spaniard in Yucatan, 1648–1812. Stanford University Press, Stanford

Penfield GT, Camargo A (1981) Definition of a major igneous zone in the central Yucatan platform with aeromagnetics and gravity. Society of Geophysics Exploration, annual meeting, Houston, TX

Pérez R, Pacheco J (2004) Vulnerabilidad del agua subterránea a la contaminación por nitratos en el Estado de Yucatán. Ingeniería 8(1):33–42

Perry EC, Swift J, Gamboa J, Reeve A, Sanborn R, Marin L, Villasuso M (1989) Geologic and environmental aspects of surface cementation, north coast Yucatan, Mexico. Geology 17:818–821

Perry D, Sanchez R, Glaze W, Mazarp M (1990) Binational management of hazardous waste: the maquiladora industry at the US-Mexico Border. Environ Manag 14:441–450

Perry EC, Marin L, McClain J, Velazquez G (1995) The ring of cenotes (sinkholes), northwest Yucatan, Mexico: its hydrogeologic characteristics and possible association with the Chicxulub impact crater. Geology 23:17–20

Perry E, Velazquez-Oliman G, Marín L (2002) The hydrogeochemistry of the karst aquifer system of the northern Yucatan Peninsula, Mexico. Int Geol Rev 44(3):191–221

Perry E, Paytan A, Pedersen B, Velazquez-Oliman G (2009) Groundwater geochemistry of the Yucatan Peninsula, Mexico: constraints on stratigraphy and hydrogeology. J Hydrol 367:27–40

Pope KO, Ocampo C, Duller CE (1991) Mexican site for K/T impact crater? Nature 351:105

Pope KO, Ocampo AC, Kinsland GL, Smith R (1996) Surface expression of the Chicxulub crater. Geology 24:527–530

Postel S (1997) Last oasis: facing water scarcity. Norton and WorldWatch Institute, New York/London

Reed N (2001) The caste war of Yucatán. Stanford University Press, Stanford

Rennings K, Wiggering H (1997) Steps towards indicators of sustainable development: linking economic and ecological concepts. Ecol Econ 20:25–36

Restall M (1997) The Maya world: Yucatec culture and society, 1550–1850. Stanford University Press, Stanford

Rosengaus Moshinsky M, Jiménez Espinosa M, Vázquez Conde MT (2003) Atlas climatológico de ciclones tropicales en Mexico. In: Vázquez Sánchez DGD, González Martínez S (eds) Secretaría de Gobernación, México. Centro Nacional de Prevension de Desastres (CENAPRED). Instituto Nacional de Tecnologia del Agua (INTA)

Rydin Y (1999) Can we talk ourselves into sustainability? The role of discourse in the environmental policy process. Environ Value 8:467–484

SARH (Secretaría de Agricultura y Recursos Hidráulicos) (1989) Sinopsis hidrogeológica de la Península de Yucatán, México

Schreier H, Brown S (2001) Scaling issues in watershed assessment. Water Policy 3:475–489

SEMARNAT (2011) Presupuesto asignado a la SEMARNAT por unidad administrativa. http://aplicaciones.semarnat.gob.mx/estadisticas/compendio2010/archivos/03_gastos/D4_GASTOS01_03.pdf. Accessed Oct 2011

SGM (2007) Carta geológica de México [Geological map of Mexico]. Escala 1:2,000,000, 6th edn. Servicio Geológico Mexicano (SGM), Pachuca

Sharpton VL, Dalrymple GB, Marín LE, Ryder G, Schuraytz BC, Urrutía Fucugauchi J (1992) New links between the Chicxulub impact structure and the Cretaceous-Tertiary Boundary. Nature 359:819–821

Sharpton VL, Burke K, Camargo A, Hall SA, Marín LE, Suárez G, Quezada JM, Spudis PD, Urrutía Fucugauchi J (1993) The gravity expression of the Chicxulub multiring impact basin: size, morphology, and basement characteristics. Science 261:1564–1567

Simon J (1997) Endangered Mexico: an environment on the edge. The Latin American Bureau (Research and Action), London

Simón Reardon JA, Pérez RA (2010) Agroecology and the development of indicators of food sovereignty in Cuban Food Systems. J Sustain Agric 34(8):907–922

Simonovic SP (1996) Decision support systems for sustainable management of water resources. 1. General principles. Water Int 21:223–232

Sophocleous M (2004) Global and regional water availability and demand: prospects for the future. Nat Resour Res 13:61–75

Steinich B, Marín LE (1996) Hydrological investigations in northwestern Yucatan, Mexico, using resistivity surveys. Ground Water 34(4):640–646

Svendsen M, Meinzen-Dick R (1997) Irrigation management institutions in transition: a look back, a look forward. Irrig Drain Syst 11:139–156

Swaloow BM, Garrity DP, van Noordwijk M (2001) The effects of scales, flows and filters on property rights and collective action in watershed management. Water Policy 3:457–474

Swyngedouw E (1999) Modernity and hybridity: nature, regeneracionismo, and the production of the Spanish waterscape, 1890–1930. Ann Assoc Am Geogr 89:443–465

Swyngedouw E, Kaika M, Castro JE (2002) Urban water: a political-ecology perspective. Built Environ 28(2):124–137

Tapia-Gonzalez FU, Herrera-Silveira JA, Aguirre-Macedo ML (2008) Water quality variability and eutrophic trends in karstic tropical coastal lagoons of the Yucatan Peninsula. Estuar Coast Shelf S 76:418–430

Trejo Torres JC (1993) Vegetación, suelo e hidrodinámica de dos petenes de la reserva de Ozilam. Universidad Autónoma de Yucatán, Facultad de Medicina Veterinaria y Zootecnia, Tesis (Licienciado en Biología), Universidad Autónoma de Yucatán, Mexico, Yucatán

Tuan Y-F (1968) The hydrological cycle and the wisdom of God: a theme in geoteleogology. University of Toronto Press, Toronto

Tyson JM (1995) Quo vadis – sustainability? Water Sci Technol 32:1–5

UNCED (1993) Agenda 21: programme of action for sustainable development. United Nations Conference on Environment and Development, New York

UNGA (2000) United Nations Millennium Declaration. Resolution 55/2. United Nations General Assembly, New York

van Horen B (2001) Developing community-based watershed management in greater São Paulo: the case of Santo André. Environ Urban 13:209–222

Várguez Pasos L (1999) Identitad, henequén y trabajo: los desfibradores de Yucatán. El Colegio de México, Mexico City

Vela SR (2002) Breve reseña de la industria henequenera y sus relaciones con el exterior (apuntes para el estudio de la historia económica de Yucatán). Universidad Tecnológica Metropolitana, Maldonado editores del Mayab, Mexico, Mérida

Vélez H, Budds J, Colmenares R, Perreault T, Correa HD, Isch E, Guerrero L (2010) Justicia hidrica: 7 ensayos como aportes para articular las luchas, CENSAT AGUA VIVA. Amigos de la Tierra, Colombia

Villasuso PM (1992) Geohidrología e hidrogeoquímica del acuífero de la Península de Yucatán. Mecanismos de contaminación. Seminario de Investigación de la Facultad de Ingeniería de la Universidad Autónoma de Yucatán, México

Wells A (1985) Yucatán's gilded age: haciendas, henequen, and international harvester, 1860–1915. University of New Mexico Press, New Mexico

Wilson P (1996) Las nuevas maquiladoras de México: exportación y desarrollo local. Universidad de Guadalajara, Guadalajara

Young G (1986) The development of Ciudad Juárez: urbanization, migration, industrialization. In: Young G (ed) The social ecology and economic development of Ciudad Juárez. Westview, Boulder

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W.B. Campbell and S.L. Ortíz (eds.), *Integrating Agriculture, Conservation and Ecotourism: Societal Influences*, Issues in Agroecology – Present Status and Future Prospectus 2,
DOI 10.1007/978-94-007-4485-1, © Springer Science+Business Media Dordrecht 2012