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Strategies for Achieving Food Security in Central Asia

Edited by
Hami Alpas
Madeleine Smith
Asylbek Kulmyrzaev

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Strategies for Achieving Food Security in Central Asia

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Series C: Environmental Security

Strategies for Achieving Food Security in Central Asia

edited by

Hami Alpas
Food Engineering Department
Middle East Technical University
Ankara, Turkey

Madeleine Smith
Chemical Engineering
University of Birmingham, Edgbaston
Birmingham, UK

and

Asylbek Kulmyrzaev
Food Engineering Department
Kyrgyz-Turkish Manas University
Bishkek-Kyrgyz Republic

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Preface

The NATO-ATC on "Strategies for Achieving Food Security in Central Asia" considered many topical and timely issues. For a country to be food secure, all areas that contribute to that security must be addressed including issues of access, sufficiency, safety and nutritional quality. These broad areas are themselves comprised of many subdivisions and specialisms. Food Security is a major concern for all countries but the vulnerabilities in the food chain will not be the same for all. The needs of a particular area or country with regard to food security reflect the culture, geography, economics, infrastructure and political characteristics as much as, if not more than, the detail of the food industry in the region. In order to address food insecurities, the first step is to define and assess these factors and that is what the first part of this book begins to do for the participating Central Asian Countries of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Authors provide an overview of the food chain within the participating Republics, focusing on food safety, control and access but including background information on the food industries and other issues for context. The authors describe successful initiatives within their countries and also identify areas which might warrant further development.

Food is now a global commodity and the food supply chains are international. This is significant for food security not just because an incident in one country has the potential to affect other countries, which clearly it does, but also because the globalisation offers an opportunity to share expertise and good practice across the world. Systems which have been effective in one part of the world may be adapted in another part and make a contribution to the food security there. Collective learning from incidents and errors may help avoid similar breaches recurring or occurring elsewhere. The second part of this book includes chapters on a variety of aspects of food security, including HACCP and associated pre-requisite systems, allergies and food intolerances, risk perception and communication, training, food defence and ethics. The subject range is by no means conclusive and was not intended to give complete coverage of the contributions to food security in any one country. Instead they cover selected topics that provide insight into the strengths and weaknesses of common food security approaches. Naturally, given the unique character of each participating country, there is variance in approach. This is an important characteristic.

While sharing experiences can be immensely valuable, wholesale implementation of successful systems developed elsewhere are unlikely to be a complete answer for any country seeking to strengthen its food security. However, the adaptation and development of existing systems can be a helpful and cost effective way of addressing any common vulnerabilities. In addition, the type of collaboration demonstrated by the participants in the NATO-ATC can only serve to strengthen food security for both the individual participating countries and for the planet as a whole as it enhances understanding and reinforces common goals. We hope this book can continue to this process in some small way by providing readers access to the information covered during the course.

We take this opportunity to thank the NATO Emerging Security Challenges Division, Science for Peace and Security Section (SPS), for their unfailing support throughout all phases of this Workshop, in particular Dr. Deniz Beten, Senior Advisor and to Lynne Campbell-Nolan, SPS Programme Assistant.

Hami Alpas
Madeleine Smith
Asylbek Kulmyrzaev

Participants of the NATO-ATC “Strategies for Achieving Food Security in Central Asia”, Antalya, Turkey, March 31–April 2, 2011

Contents

Contributors

Abdybek J. Asanaliev Kyrgyz National Agrarian University, Bishkek, Kyrgyz Republic, asanaly61@mail.ru

Khursheda Bobodzhanova Center of Biotechnology, Tajik National University, Dushanbe 734025, Tajikistan, Khursheda.Bobodzhanova@gmail.com and bobojankh_7@bk.ru

Faruk Bozoglu Department of Food Engineering, Middle East Technical University, Ankara 06531, Turkey, bozoglu@metu.edu.tr

Cory M. Bryant U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Food Defense, Communications and Emergency Response, Food Defense Oversight Team, College Park, MD, USA, cory.bryant@fda.hhs.gov

David Coles Centre for Rural Economy, Newcastle University, Newcastle Upon Tyne, UK, david.coles2@newcastle.ac.uk

Lynn J. Frewer Food and Society Centre for Rural Economy, School of Agriculture, Food and Rural Development, Newcastle University, Agriculture Building, Newcastle Upon Tyne NE1 7RU, UK

MCB Group, Social Sciences, Wageningen University, Hollandseweg 1, 6706KN Wageningen, The Netherlands, Lynn.Frewer@newcastle.ac.uk

Julia C. Guenther U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Food Defense, Communications and Emergency Response, Food Defense Oversight Team, College Park, MD, USA, julia.guenther@fda.hhs.gov

Cameron Hackney College of Agriculture, Natural Resources and Design, West Virginia University, Morgantown, WV 26506, USA, Cameron.hackney@mail.wvu.edu

Asylbek Kulmyrzaev Department of Food Engineering, Kyrgyz-Turkish Manas University, Prospekt Mira, 56, 720044 Bishkek, Kyrgyzstan, kulmyrzaev@yandex.ru

Kelly J. McCormick U.S. Department of Agriculture, Foreign Agricultural Service, Office of Capacity Building and Development, Food Safety Team, Washington, DC, USA, kelly.mccormick@fas.usda.gov

Alymkan Mansurova Department of Food Safety, Ministry of Agriculture, Kievskaya Street, 96‘a’, 720040 Bishkek, Kyrgyzstan, alymkan11@mail.ru

Rysbek Z. Nurgaziev Kyrgyz National Agrarian University, Bishkek, Kyrgyz Republic

Adkhamjon Paiziev Institute of Electronics Uzbek Academy of Science, Tashkent, Uzbekistan

Shaira Payziyeva Tashkent State Agrarian University, Tashkent, Uzbekistan, shairapayzieva@gmail.com

Madeleine Smith Chemical Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK, m.smith.2@bham.ac.uk

Susan Sumner College of Agriculture and Life Sciences, Virginia Tech, Blacksburg, VA, 24061, USA, sumners@vt.edu

Tamara Tultabaieva LTD “The Kazakh research institute for the food-processing industry”, JSC “KazAgroInnovation”, Almaty 050060, Republic of Kazakhstan, tamara_tch@list.ru

Suriya Turayeva World Economy Department, University of World Economy and Diplomacy, Tashkent, Uzbekistan, suriya3@inbox.ru

Part I
Food Security in Central Asia

Chapter 1
Urgent Measures to Improve Food Quality and Safety Control in the Kyrgyz Republic

Asylbek Kulmyrzaev

Abstract The chapter discusses the food quality and safety control system in the Kyrgyz Republic. Specifically, the chapter introduces current socio-economic situation, characterization of the domestic food market, and elements of the national food control system upon adopting a series of new regulations since 2004. The new food safety system is progressively setting up, but there are a number of problems that holds back the implementation of new approaches to the assurance of food safety. These problems are mainly related to the underdeveloped national economy and poor socio-economic status of the population. As a result, a number of urgent measures are proposed concerning strengthening the discipline and responsibility in controlling food supply chain, implementation of widely practiced food quality and specific food safety management and control systems, enhancing analytical capabilities and capacities, wider involvement of the society into food safety control, and increasing skills and competence.

Keywords Food safety • Food quality • Food supply chain • Kyrgyz Republic

1.1 Introduction

A safe, nutritious, affordable food supply is the first requisite of human well-being. The Kyrgyz Republic as a member of the international community assumed responsibility to ensure that food supplies are safe, physically and economically accessible, appropriate and adequate to meet the energy and nutrient needs of the population. The Kyrgyz Republic is a predominantly agrarian society with two-thirds of its

A. Kulmyrzaev (✉)
Department of Food Engineering, Kyrgyz-Turkish Manas University,
Prospekt Mira, 56, 720044 Bishkek, Kyrgyzstan
e-mail: kulmyrzaev@yandex.ru

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population living in rural areas though the agriculture sector contributes only modestly to the national economy. Since 1991 because of inadequate agricultural policy and lack of funds the effectiveness of the agricultural production in the Kyrgyz Republic has gradually been declining and this trend has finally resulted in the considerable dependence of the food supply on imported food commodities. Although increasing import of foods assists to temporarily close gaps in the national food supply, ultimately, it has a negative impact on both national food security and sustainable development of the domestic agricultural production.

The role of the government as a regulatory authority in assuring safe food supply is crucial in the case of underdeveloped countries as the Kyrgyz Republic. Because of largely missing knowledge and technological changes, institutional development and policy reform in the rural area, the Kyrgyz agricultural sector is still facing great challenges and production of agricultural commodities and processed foods is becoming an unprofitable business. Under these circumstances domestic food producers cannot afford investments to enhance the safety of their products. Therefore, only government by means of its authorized bodies has to adopt a formal responsibility for reducing risks associated with food. As long as considerable part of the Kyrgyz population inhabits rural area and is involved in agricultural production, decisions on food safety impact on the income of farmers and other parties involved in food supply chain, food price, migration of rural population to urban areas, and thus on the political stability in the country. Therefore, food safety is an area of great political sensitivity [3].

Food safety has become an important food quality attribute within the last few decades [4]. Globalization of the food trade has focused attention on strengthening measures to ensure the quality and safety of imported foods [2]. More than a half of needed food commodities is being imported to the Kyrgyz Republic annually. In order to protect domestic food market from imported foods that may cause health problems to consumers the Kyrgyz government must build capacities for the effective control of food quality and safety, strengthen food inspection programs including food import and export inspection and certification systems, and provide appropriate laboratory analytical capacities.

The objective of this chapter is to present and examine the actual status of the food quality and safety control system in the Kyrgyz Republic and to propose measures for advancing reforms currently being implemented.

1.2 Socio-Economic Indicators

Many people in the “developing world” are undernourished by the standards of the World Health Organization (WHO). In 2009, according to the National Statistical Committee of the Kyrgyz Republic 31.7% of the total population of which 75.6% habitants of rural settlements lived under the poverty line. The socio-economic indicators in Table 1.1 show the economic and social conditions in the Kyrgyz Republic in 2010 (as reported by the National Statistical Committee of the Kyrgyz Republic).

Table 1.1 Main socio-economic indicators of the Kyrgyz Republic in 2010

Actual population (thousand)	5418.3
GDP (million USD)	4616.6
Including:	
Agriculture (%)	18.5
Industry and construction (%)	25.1
Services (%)	45.9
GDP per capita (USD)	852
Export (million USD)	1,251
Import (million USD)	3,018
Rate of inflation (%)	19.2
Exchange rate (KGS/USD)	45.96
Average monthly salary (USD)	149
Minimal consumer budget (USD)	76
Number of unemployed (%)	2.6

The outbreak of the world recession in 2009 caused a pronounced negative effect to the economic activities in the Kyrgyz Republic. In 2010 the gross domestic product (GDP) was valued as 4616.6 million USD which decreased by 1.4% comparing to that of 2009 (Table 1.1), the inflation rate was as high as 19.2% (Table 1.1) to which the raised food prices in 2010 contributed significantly. Consequently, the population's welfare was adversely affected and the consumption of those at the lower end of the economic scale has become inadequate to even meet food needs. Although the average monthly salary/minimal consumer budget ratio seems to be fairly enough to assure appropriate access to food (Table 1.1), rapidly increasing prices make major food items (meat, dairy products, fruits and vegetables) inaccessible to poor.

1.3 Characterization of the Food Market

At the moment the Kyrgyz Republic's agricultural and food processing sector produces nearly a half of the food needed for internal consumption and the gap is filled by the imported foods. In 2010 domestic food manufacturers produced 518192.3 tons of foods and 553,200 tons were imported. Meat and meat products, wheat and wheat flour, fruits and sugar were the major imported food commodities in 2010 (Table 1.2) (as reported by the National Statistical Committee of the Kyrgyz Republic).

The international trade of the Kyrgyz Republic in 2010 is characterized by the dominated share of Russia (35.6%), China (17.3%) and Kazakhstan (14.6%) in export-import activities. The predominant part of the imported foods also comes from the countries mentioned above. Fruits and vegetables not farmed in the Kyrgyz Republic and some rice are supplied from Iran, Turkey, and Pakistan. Since the

Table 1.2 Food commodities imported into the Kyrgyz republic in 2010

Imported foods	Tons	USD
Milk and dairy products	7,400	13,323,400
Meat and meat products	87,000	66,937,500
Wheat	328,400	56,709,600
Wheat flour	21,800	6,423,300
Fruits	37,100	1,721,700
Sugar	58,600	43,938,900
Chocolate and cacao products	12,900	41,131,800
Beer (liters)	18,700,000	13,714,100
Total		259,395,600

share of imported foods in the domestic market is relatively large adequate control of quality and safety of the imported foods becomes an important issue to be addressed. Food quality assurance systems and regulations within the Commonwealth of Independent States (CIS), of which the Kyrgyz Republic is a member, are similar and in the most cases trading arrangements among these countries as well as food quality requirements are established and understandable. On the contrary, much attention and effort is currently needed to implement an appropriate quality control system to eliminate food-born health risks associated with foods supplied by those countries whose food supply chains, national food legislation and trading policies are less familiar to the Kyrgyz authorities and consumers. Lack of information on the agricultural practices, food processing technologies and food control policies of the countries newly entering the Kyrgyz market make the local consumers uncertain concerning the quality and safety of the imported foods. During last decade China's share in the Kyrgyz food market has significantly increased. At the same time the consumer's concern about the safety of some Chinese food products such as meat, eggs, vegetables, fruits, wheat flour, and dried milk is becoming critical. This distrust is readily fed by the frequent outbreaks of food-born disease in China. According to the China's Ministry of Health from 2001 to 2004 4,874 food poisoning cases were reported in which 104,172 persons were involved and 728 persons died [1]. Consequently, the Kyrgyz consumers prefer domestic, Russian or Kazakh food products to those imported from China.

1.4 Elements of the Food Control System in the Kyrgyz Republic

A well structured, effective and efficiently administered national food control system provides the necessary assurances to consumers that health and safety risks are minimized or prevented. Consumers expect the official food control system to set acceptable levels of risk and to monitor the food supply to ensure that these levels are not exceeded [6]. The key elements of the national food

control system are food law, national food control strategy, and food control agencies and there services [6].

Up to 2004 a food control system organized similar to the system adopted in the USSR was operating in the Kyrgyz Republic. Food safety control was conducted by the Department of Sanitary and Hygienic Control of the Ministry of Health, the National Institute for Standardization, and the Department of Veterinary and Department of Plant Chemization, Protection and Quarantine both attached to the Ministry of Agriculture and Processing Industry. These state agencies developed agricultural and food products standards and regulations and controlled the whole food supply chain from farm to market.

Since adoption of law "On the principles of technical regulation in the Kyrgyz Republic" on May 22, 2004 a new national system for controlling and certification of products (including foods) and services has been introduced. The law sets up the legal basis for (i) development, adoption, implementation, and execution of mandatory and voluntary requirements to products, manufacturing operations, storage, transportation, distribution, utilization and recycling, and services, (ii) compliance assessment, (iii) liabilities of parties. This law along with subsequent government decrees expresses the political will of the Kyrgyz Government to assure product quality and to carry out consumer protection measures.

According to the Kyrgyz Government Decree dated 29.06.2005 the Ministry of Economical Development, Industry, and Trade (present Ministry of Economic Regulation) was assigned the Authorized Agency for Technical Regulation (AATR) in the Kyrgyz Republic (www.uotr.kg). AATR coordinates development of technical regulations and submits them to the Government for approval. It makes arrangements for preparation, adoption, implementation and revision of technical regulations, sets up expert commissions to analyze new technical regulations, develops programs for international cooperation in technical regulation. AATR also ensures compliance of the commitments of the Kyrgyz Republic in accordance with the Agreement on Technical Barriers to Trade and the Agreement on the Application of Sanitary and Phytosanitary Measures of the World Trade Organization (WTO). The technical regulations are the documents adopted to protect human-beings, environment, animals and plants, and to prevent fraud against consumers. In 2006 the Kyrgyz Government established a national body for accreditation, the Kyrgyz Centre for Accreditation (KCA), which is authorized to conduct accreditation in the Kyrgyz Republic and to represent the Kyrgyz Republic at the regional and international accreditation organizations. Figure 1.1 presents the Kyrgyz national system for accreditation. KCA conducts accreditation and authorization of the bodies for compliance assessment operating in the Kyrgyz Republic. The bodies for compliance assessment granted accreditation are recognized to be competent to certify products and services, systems of quality management, personal, testing and calibrating laboratories, and inspecting bodies. In order to ensure impartiality and equity during accreditation procedure and maintain the principles and policy of the national accreditation system the Council for Accreditation of Compliance Assessment Bodies was established (Fig. 1.1). Technical Boards for Accreditation composed of the experts highly qualified in a

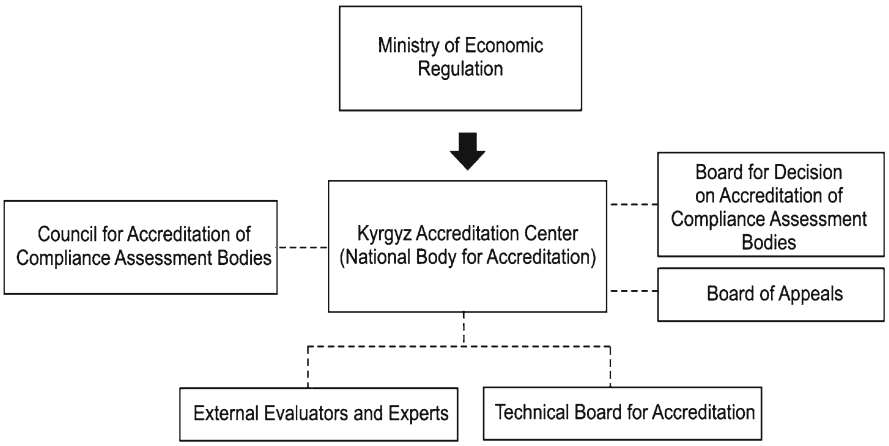

Fig. 1.1 The national system of accreditation in the Kyrgyz Republic

given area of accreditation are set up as well. External evaluators and experts can also be involved in the accreditation procedure. The final decision on granting accreditation is made by the Board for Decisions on Accreditation of Compliance Assessment Bodies. The Board for Appeals examines the complaints submitted concerning decisions made on an application for accreditation. KCA manages the accreditation procedure and reports to the Ministry of Economic Regulation, Authorized Agency for Technical Regulation (AATR).

Food control functions and inspection are assigned to the corresponding departments of the Ministry of Health, the Ministry of Agriculture and Processing Industry, National Centre for Standardization, and the accredited bodies for compliance assessment and testing laboratories.

An effective national food control strategy plays the key role in maintaining safe food supply chain [6]. A comprehensive and systematic national food control strategy has not been developed yet in the Kyrgyz Republic. In fact, adoption of law "On the principles of technical regulation in the Kyrgyz Republic" in 2004 has triggered a number of conceptual changes shaping modern national food control system. For instance, now development of new and revision of existing technical regulations is a responsibility of the Ministry of Economic Regulation, Authorized Agency for Technical Regulation (AATR), only. Earlier this function was assigned to a number of state agencies and it was difficult to conduct well coordinated and effective national food control policy. At the moment the new food control system is progressively being constructed, which is evidenced by the reorganization of the state agencies responsible for the food control, active development of the technical regulations, implementation of the international quality management systems, and harmonization of the national food safety regulations with the regional and international regulations. In developing own food control strategy the Kyrgyz Government should give considerations to agricultural and

husbandry practices, food production, storage, transportation, handling, and marketing practices. Special attention has to be given to the control of the imported foods especially from those regions which frequently experiences food safety issues due to problems related to harmful residues in foods. The experience of other developing and developed countries and recommendation of the international organizations (FAO, WHO) should also be analyzed and used in the development of the Kyrgyz food control strategy.

1.5 Measures to Improve Food Safety Control in the Kyrgyz Republic

The main issue for the Kyrgyz Republic along with assuring food security is food safety and the need to keep food prices at affordable levels. Full compliance to food safety rules significantly increases costs and could exclude a significant part of the population from access to some components in their food basket [5]. Immediate introduction of the food safety standards into agricultural production and food industry in the Kyrgyz Republic is not an effective measure at the present socio-economic and political situation. Moreover this kind of unreasoned and populistic action may increase the social tension. According to the National Statistical Committee the agricultural sector of the Kyrgyz Republic in 2010 was composed of 263.7 thousands small-scale farms and 435 (in 2009) predominantly small-scale food manufacturing enterprises (Statcom). Most of these producers have small-scale operations, use traditional techniques, depend on family labor, and have little capital to invest. Having such a large number of small farms and producers it is difficult to standardize production practices, because they cannot afford high costs of implementation of these standards and the majority of the farmers and food processors do not adequately understand the key points of standardization. Therefore, the Kyrgyz Government should first, develop the economic instruments encouraging small farms and enterprises to consolidate into larger ones. Large-scale producers have access to capital, technology and logistics and better positioned to reap benefits of domestic and international marketing. To date, the Kyrgyz Government in cooperation with donors has already started a program supporting large-scale agricultural associations and cooperatives with bank loans at affordable interest rates, agricultural inputs (seeds, fertilizers and fuel), and leasing of machines. Second, education of farmers and food producers about better production methods, quality management systems, food safety standards and regulations should be conducted. The educational programs could be developed with the international organizations operating in the Kyrgyz Republic (FAO, WHO, World Bank, Asian Development Bank).

The quality control and marketing in the Kyrgyz Republic are still hindered by poor contractual discipline and enforcement, by non-transparent transactions, and by lack of trust in public institutions. These issues also encourage corruption in the food safety control and certification system. There is a great concern regarding

inspection of the imported foods by the authorized state agencies that do not always honestly and strictly fulfill their duties. Consequently, food items of unknown quality and safety appear in the domestic market and expose consumers to the additional health risks. To eliminate these negative facts the Kyrgyz Government has to undertake urgent actions in order to strengthen the implementation practice in the food control system and to make the system transparent and understandable to the society. Involvement of the associations of consumers and non-governmental organizations in the food safety control significantly increases the trust of consumers in public institutions.

Emphasis should also be placed on providing appropriate laboratory analytical capacities and quality assurance system to ensure the effectiveness of food sampling and analysis programs. Adequate laboratory facilities strengthen food inspection programs including food import and export inspection and certification systems. To date 21 accredited analytical laboratories participate in the food quality and safety control programs in the Kyrgyz Republic. 12 out of 21 laboratories are located in Bishkek City, the capital of the Kyrgyz Republic, and its neighborhood. The other laboratories are distributed in the regions. Because of poor instrumental facilities and lack of qualified staff the analytical laboratories, especially those in the regions, do not fully meet the analytical needs of the food quality and safety inspection programs. For instance, some highly specialized food contaminant detections, such melamine, pesticide and veterinary chemical residues, as well as examination of genetically modified foods can be failed. Consequently, urgent measures are needed to provide appropriate equipment, supplies and trained staff in order to satisfy the needs for analytical work.

Finally, there is a pressing need for precise and objective information on the levels of risks related to food and food-born illness statistics. An information and surveillance system for food-born diseases should be built to promptly and properly address food safety issues and to effectively use limited resources. The Ministry of Health and the Ministry of Agriculture and Processing Industry continually monitor the epidemiologic and epizootic situations, respectively; the data is then analyzed and reported to the Government. The epidemiologic and epizootic indicators are also published in the official documents of the National Statistical Committee (www.stat.kg). Typhoid and paratyphoid fevers, brucellosis, echinococcus, salmonellosis infections, and anthrax originated from water and sick animals are periodically registered in the Kyrgyz Republic and Central Asia. These diseases are carefully monitored and preventive measures are taken by the Ministry of Health and the Ministry of Agriculture and Processing Industry. However, the statistical data lacks of information on the health risks associated with foods contaminated with dangerous chemical residues and toxins. The inspection agencies periodically report high contents of such agents in many food samples obtained from local markets, but the consequences of consuming such foods are not reflected in the food-born disease statistics. In the meantime, the public concern about poisoning caused by harmful chemical residues in foods is increasing and therefore adequate information on such risks should be communicated to the public. Associations of consumers, non-governmental organizations, and mass media

should also be involved in building information system on the food related risks and measures to prevent food-born diseases.

1.6 Conclusion

Recent data on the food quality and safety control system from the Kyrgyz Republic were analyzed to provide an overview of the problems and identify measures to improve food quality and safety inspection. The Kyrgyz Government adopts a food safety assurance system directed at the internationally recognized quality management systems and standards. Although present analysis shows that the Kyrgyz food safety control system is gradually changing in a positive direction, the Government still faces serious challenges. Lack of knowledge, limited investment resources, underdeveloped national food supply chain, poor facilities for the food safety control, and inadequate awareness of consumers on the risk levels related to food hold back the implementation of an effective and reliable food quality and safety control system. In our opinion facilitating further advancement of the food control system reforms would require a number of policy and technical interventions that include:

- authorized national food control agencies have to strengthen discipline and responsibility in its function on controlling the compliance of activities in the food supply chain with the national food legislation and have to make food control system transparent and understandable to consumers;
- adapting and implementation in the food industry of widely practiced food quality and specific food safety management and control systems based on HACCP, TQM, and ISO;
- the Kyrgyz Government should enhance its analytical laboratories, especially those operating in the provinces, using state resources and resources of international donors; organizational considerations should be given to coordination of the laboratory functions of different food control agencies in order to effectively use and maintain their technical capabilities; projects aimed at improving national food safety control system should be proposed to and developed with the international institutions operating in the Kyrgyz Republic (UNDP, WB, EBRD, ADB);
- the food safety control agencies should involve consumers, non-governmental organizations, and mass media in increasing consumer awareness of existing food related risks and building a national information system on food quality and safety;
- increasing skills and competence at all levels from farmers to university trained agricultural and food science experts.

In conclusion, the Kyrgyz Republic should also play a more active role in the international organizations such as WTO and regional bodies in order to benefit from the membership in these organizations.

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Chapter 2
Issues of Food Safety in the Kyrgyz Republic

Alymkan Mansurova

Abstract This chapter examines the food security status of the Kyrgyz Republic from 2005 to 2010. The statistics consider production of agricultural commodities, share of imported foods in the domestic market, production of foods per capita, and availability of food in the market in accordance with physiological rates of consumption. The critical dependence of the national food supply on the imported food has been indicated. Special attention has been given to the analysis of the food crisis the Kyrgyz Republic experienced in 2008. A brief analysis has also been conducted to define measures to provide food security in the Kyrgyz Republic. It has been highlighted that sustainable food security can be achieved by the development of the domestic agricultural production. The Kyrgyz Government has undertaken a number of measures to secure appropriate national food supply. The chapter also examines reasons of poor productivity and quality of domestic agricultural commodities and measures to benefit from the membership of the World Trade Organization (WTO). The measures to improve quality and safety of the domestic foods have been discussed in the chapter.

Keywords Physiological levels of consumption • Minimal levels of food consumption • Physical availability of food • Food safety • Food quality • Kyrgyz Republic

Foods – the first vital need of the human on which satisfaction of his life depends. Therefore each family and the human separately concerns issues of the food safety, as to especially important and paramount issues of the vital activity of the person, families and the states as a whole.

A. Mansurova (✉)
Department of Food Safety, Ministry of Agriculture, Kievskaya Street, 96‘a’, 720040 Bishkek, Kyrgyzstan
e-mail: alymkan11@mail.ru

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Today it is necessary to recognize that, the less bread remains in the internal food market and in the state reserve, the more policy in it. When the country balances on the verge of food crisis, the most part of the population doesn't eat up or reduces consumption of meat and dairy products. In such situation policymakers and journalists operate with concept of food safety of the country more often.

The concept about food safety of the state and nation has appeared for the first time in our reference in connection with the economic and social changes occurring in developing republics of the former Soviet Union.

In the conditions of democratization of the development, the civil society began to be interested in what defines one of the bases of its existence, a condition of food security in the internal food market.

For our republic, as well as for all republics of the post-Soviet territory the term "food safety" is a rather new term used by the United Nations Organization (United Nations).

Earlier, in our country, the problem of food safety was considered in a system of terms connected basically with strategic state security.

As a food problem, concerning total production of food raw materials and economic availability of the foodstuffs to all categories of the population, a foundation of the state food reserve, crisis maintenance of the population with the vital products are solved sufficiently and accurately.

At the same time, the last decades of the Soviet economy are characterized by an extreme imbalance of the consumer food market, connected with a policy of freezing of the state retail prices for foodstuff that as a result has led to disappearance of food products from a counter.

Kyrgyzstan – historically active participant of foreign economic relations, including in food sphere. During the pre-reform period, at the peak of agroindustrial sector development of economy, in 1980–1990s, the republic was completely self-provided relative to the volumes of sugar, milk, eggs, vegetable oil, vegetables and fruits, macaroni, confectionery and smoking products, alcoholic and soft drinks output. Thus, for satisfaction of home market needs in bakeries, about 300,000 tons in a year of food wheat were bought. For this period, the tendency of aspiration to self-sufficiency on the basis of constant escalating of areas under crops, a livestock of cattle, increase in capacities on processing of agricultural raw materials, growth of relative density of budgetary investments for development of agrarian sector of economy is characteristic.

The Government put budgetary funds upto 16% of Gross National Product annually for development of agriculture, material base of land improvement and chemicalization, and also for increase of an export potential of the republic.

It is necessary to notice that those years, Kyrgyzstan not only provided requirements of the internal food market, but also in considerable volumes exported annually to republics of Central Asia and Kazakhstan more than 150–200 thousand tons of sugar, 50–100 thousand tons of vegetables and fruit, 25–30 thousand tons meat, 50–80 thousand tons fruit-and-vegetable preserved продукци, 30–45 thousand tons of the fermented tobacco, 1,000,000 pieces of smoking products, 5–10 thousand tons of dried milk, firm grades of various cheeses and is much another.

The error of the economic plan of that period-was purchase of production from rural commodity producers at low state-set prices, at all increasing cost price of agricultural products. It has led motivation losses to produce food products both at the enterprises-agro processors, and at producers of agricultural crops, because of period of payback increase of the considerable investment expenses put into the agrarian sector, for provision of the balanced food and support to consumer ability.

It's the liberal model including refusal of the state from active participation in economic developments of agriculture were imposed to Kyrgyzstan. For agriculture of Kyrgyzstan, it has turned back the most severe crisis, decrease in volumes of output of the basic positions of food production.

Thereupon, in the internal food market of republic, since 1993 it began to be felt sharply a problem of cost production increase, and also a number of positions of domestic food products began to disappear from market counters, as a result of reduction of output volumes. In their places there were food products of imported manufacture.

In situations of domestic products volume reduction, large transnational food corporations have persistently taken root into the food market of the republic. Kyrgyzstan has lost control over manufacture of the basic positions of foodstuff, hoping that the market itself will define, as in what quantity to produce.

The food market became dependent on import under many names of foodstuff, including wheat, sugar, vegetable oil, fish, confectioner's shops and pasta, cigarettes, soft drinks and mineral waters, and also meat and dairy products, fruit and berries. That is, home market became import dependent for products which Kyrgyzstan could make and provide itself at levels appropriate for consumption volumes on physiological norms of a food.

The Government of the Republic blindly believed that the foreign companies will support economic development in a new direction.

As a result, global transnational companies, having certain support from a republic management, have got with little effort and capital investments into the internal food market of the Republic. Thus, it was not perceived that transnational companies aren't interested in ensuring availability of the competitor, both in home market at itself, and in the world markets. This shows the negative influence of globalization on development of economy of the Kyrgyzstan.

The transnational companies see in the food markets of the post-Soviet territory commodity markets for the food production which is made at high level of technological processing.

It became clear that the weak economic state is incapable to provide access of a great bulk of the population to foodstuff at the prices operating in their domestic market. As a result, the food safety of the country becomes a problem connected with efficiency of a social production, level of incomes of the population. Thereupon, it is necessary to recognize that food safety means the level of availability of foodstuff for all population. And in turn, physical and material availability of foodstuff promotes maintenance of normal vital activity of the human. Therefore the food safety is a problem connected with efficiency of a social production, level and differentiation of population incomes.

Kyrgyzstan according to the Roman declaration adopted on November, 17th, 1996 during the world summit on foodstuffs problems has incurred obligations "… to pursue a policy, directed on poverty and inequality eradication, maintenance of physical and economic access of the population to a sufficient and high-grade food".

In this connection, issues of food maintenance of domestic market needs became the main problem of the national economic safety, taking a leading place in the policy of the state and the main task in a field of activity of the Ministry of Agriculture of the Kyrgyz Republic.

In the decision food safety issues of the Republic the legislative base is the Law of the Kyrgyz Republic "About food safety of the Kyrgyz Republic" (№ 183 from August, 4th, 2008), opening the concept about food safety as a necessary condition of maintenance of the basic constitutional laws and freedom of the person and the citizen, and also obliging executive power to provide food safety of the Kyrgyz Republic in a prime and obligatory order.

According to point 4 of article 8 of the Law "About food safety of the Kyrgyz Republic" the working body of Council on food safety is the authorized state structure in agriculture sphere – the Ministry of Agriculture of the Kyrgyz Republic.

In executing the specified Law, the Government of the Kyrgyz Republic accepted the decision from March, 3rd, 2009 № 138 "About the Position statement on monitoring and indicators of food safety of the Kyrgyz Republic". This entrusted to the Ministry of Agriculture the provision of gathering and the analysis of the information on food safety of the Kyrgyz Republic, with their subsequent representation in the Government and Council about food safety of the Kyrgyz Republic.

According to Regulation approved by the governmental order of the Kyrgyz Republic № 138 from March, 3rd, 2009, the ministry carries out monitoring and an assessment of food security of the internal food market on nine positions of the basic foodstuff. These are bakeries in recalculation on grain, a potato, vegetables, fruits and berries, meat in recalculation on lethal weight, raw milk, sugar, egg, oil vegetative.

Long-term search for a new economic strategy of development with a support on primary development of relations with the countries abroad haven't brought essential results in food safety of the country, the domestic enterprises have ceased to influence the economy and condition of the internal food market.

So, following the results of 2007 relative density of import in home market volume on bakeries has made – 43.7%, to sugar – of 79.6%, oil vegetative – 54.8%, to cigarettes – of 114.4%, confectionery-87.4%, to beer – of 62.0%

In 2008 dependence of the internal food market on import, also was considerable and corresponded on bakeries-44.3%, to sugar of 86.2%, oil of vegetative 58.1%, to confectionery-84.6%, to beer – of 66.8%, juice-73.3 of %, to cigarettes-51.9%.

In world practice the degree of food safety of the state is estimated on three levels:

– Optimum when requirements of the internal food market, are provided by the own manufacture at level of 80–85%, it is imported thus no more – 15–20% of requirements of the market;

– Insufficient – when at the expense of own manufacture it is provided more than 60% of requirements, the internal food market;
– Critical – the domestic production provides requirements of the internal food market within no more than 80% below which there comes dependence on import.

Kyrgyzstan, having considerable ground and a manpower being capable to provide not only own requirements of the internal food market for the basic products of agriculture and for products of its processing, and also to export considerable volumes on the world markets, it has appeared in such situation when degree of food safety of the state has reached level above the critical. The blind belief that the market itself will define and itself will adjust the requirements according to market laws hasn't been justified.

Indicators of unit weight of import in volume of the internal food market for 2005–2010 on main types of foodstuff in %

Years	Bakeries (wheat)	Potato	Vegetables	Fruits and berries	Meat	Raw milk	Sugar	Eggs, thousand	Vegetable oil
2005	18.5	0	0.1	25.6	6.6	0	52.6	0.2	44.7
2006	27.5	0.2	0.01	31.8	18.9	0	57.6	18.5	54.6
2007	43.7	0.47	0.53	3.65	2.7	0	79.6	3.3	54.8
2008	44.3	0.1	0.6	51.2	21.0	0	86.2	5.8	58.0
2009	34.0	0.2	0.8	26.4	23.8	0	93.2	10.6	62.0
2010	27.1	0.1	0.3	14.3	28.6	0	80.0	11.7	62.5

A notable blow from the food crisis has had an effect for the first time at the end of 2007 by increase in two times of retail prices for a flour and bread that was the shock phenomenon for all population of the Republic

The reason for that is that for a long time since 2003 there have been decreased volumes of output in manufacture of agricultural food products including production of food wheat, and sugar beet. Decrease in volumes of output of wheat was promoted by absence of due support and stimulation of producers of wheat from the state. Farmers had low productivity, low procurement price, as has led to threat of food safety of republic.

With food crisis of 2007–2008, the Ministry of Agriculture made an analysis of the internal food market, and the reasons for the sharp rise in prices for foodstuff are found out.

The analysis of the reasons of food crisis of the internal food market has convinced us that a market mechanism not in a condition to provide balance of supply and demand in the foodstuffs and raw materials market. Without support and creation of equal conditions for home producers with conditions of manufacturers of more developed countries, it is impossible to satisfy requirements of the market.

It became clear that in maintenance of food independence of the state an important point is planning of output volumes of the basic foodstuff. Without our own domestic foodstuffs all components of national safety come to naught.

Thereupon, it is recognized that maintenance of the state and food independence is possible only on the basis of a sustainable development of domestic agricultural production that in turn, demands acceptance of certain measures of the agrarian protectionism meeting the requirements of the market economy conditions.

Before the first shock blows of food crisis by the state the complete food policy wasn't carried out. Questions of development of agrarian sector economy were considered separately, with reference to one branch of agriculture, or to the food-processing industry enterprises.

Because of financial assets outflow stagnation process, delay of economic development of branches of the food-processing industry and agriculture (sugar, flour-grinding, meat processing, tobacco, fruits and vegetable etc.) has begun.

Food crisis with a rise in prices for the basic foodstuff has forced the Government to pay attention to agroindustrial sector of the economy and to convince it that steady food maintenance is defined on the basis of a sustainable development of domestic agriculture.

The Ministry of Agriculture, on the basis of objective economic processes, a consumption level of the foodstuffs, its structure, centuries-old national traditions, an environment, scientific and technical level of agrarian manufacture, the sizes of fixed capital and their capacity, has developed the long-term Program of food maintenance of the country for 2009–2015 with definition of concrete measures of economic support and regulation of agro food sector of economy.

The program food safety of the Kyrgyz Republic is developed to execute point 3 of the Decree of the President of the Kyrgyz Republic dated February, 18th, 2009 № 115.

In the Program the special place is given to measures on creation of competitive production of agriculture and the food-processing industry. Also measures on reduction of dependence of the domestic food market from import of foodstuff and material resources, on the basis of increase in volumes of output that will provide conditions for preservation of the sovereignty and independence of the country, and also a measure on effective control realization behind quality of raw materials and foodstuff, at a stage of their manufacture, realization and storage are provided.

According to the governmental order of the Kyrgyz Republic "Regulation about monitoring and indicators of food safety of the Kyrgyz Republic" the ministry carries out monthly monitoring of the internal food market within the regions. On the basis of the monitoring data the quarterly information on a condition of the internal food market is prepared. Depending on a condition and security level of the basic foodstuff, makes offers on how improvement may be made in the internal food market.

With the acceptance of "The Program of the food maintenance of the Kyrgyz Republic for 2009–2015" with the support of the Kyrgyz Government, the World Bank and other donor organizations the spring field agricultural works in 2009–2010 were conducted better comparing to previous years. On all agricultural crops in full requirement seed and landing materials also are in due time solved. Before the planned terms the agricultural machinery is repaired, mineral fertilizers and combustive-lubricating materials are delivered. Financial support in a kind of allocation of credits on favorable terms crediting has been rendered to rural commodity producers.

As a result indicators have surpassed expected results in manufacture of agricultural production. Following the results of 2009 wheat crop has exceeded 1.056 million tons, rate of increase of 141.7%, by comparison to the crop of 2008, For oil cultures is made – 74.2 thousand tons, a rate of increase-110.7%, a potato of-1,393 thousand tons., rate of increase-106.3%, vegetables and cucurbitaceous cultures rate of growth makes –969.7 thousand tons, rate of increase-104%, fruits and berries of-212.8 thousand tons, rate of increase-112.1%. Positive rates of production increase are available and in meat production – 101.5%, milk – of 103.3%, eggs – of 100.3%.

Indicators of a level of production of the basic foodstuff per capita on republic (kg/year)

Years	Wheat	Potato	Veg-es	Fruit	Meat	Milk	Egg	Sugar	Veg/oil
2005	184.7	221.9	143.2	28.5	35.0	233.0	62.0	8.7	2.9
2006	161.8	241.7	146.6	35.9	35.0	233.0	66.0	11.2	3.3
2007	135.4	262.4	150.9	34.5	35.0	235.0	71.0	7.6	3.4
2008	113.5	178.8	166.1	35.7	35.2	240.1	71.4	2.1	3.0
2009	198.0	261.0	182.0	40.0	38.0	246.0	69.0	2.0	4.0
2010	151.0	248.0	180.0	37.0	36.0	252.0	69.0	3.0	4.0

For today, internal food market is being provided at the expense of import on five positions of main food products such as berries and fruits, meat, egg, sugar and vegetables.

Indicators of main types agricultural food production for 2006–2010 years

Name of products	2006	2007	2008	2009	2010
Production of wheat products in tons including	1562.2	1491.1	1559.2	1929.2	1583.7
Granules of wheat	840.3	708.9	850.0	1056.0	813.9
Potato	1254.7	1373.8	1381.5	1393.00	1339.4
Vegetable and melon cultures	859.0	908.9	899.1	969.7	969.4
Fruits and berries	186.7	180.5	182.7	212.2	197.6
Milk	1212.1	1240.0	1273.5	1315.6	1357.3
Meat	182.0	183.1	185.0	185.4	192.1
Egg	343.2	373.7	369.3	369.4	373.0
Sugar	58.4	39.5	10.9	5.9	13.9

Today the increase in volumes of output products in the agriculture doesn't mean directly growth of consumption of foodstuff.

Food safety is not so much a branch problem, but more the macroeconomic problem connected with efficiency of real industrial production, level and differentiation of incomes of the population, a level of infrastructure development of the agro industrial complex. Therefore growth and perfection of structure of food consumption is possible only at macroeconomic stability and steady growth of real incomes of the population.

Food safety is understood as two equal components, the first – provision of requirements of the internal food market by own production and provision of physical

and economic availability of foodstuff for any person, according to physiological norms of a food. The second is a high quality and safety of consumed foodstuff.

Besides, we understand that now it is impossible to guarantee food safety of the republic population alone without formation of more powerful regional Formations. Only within the limits of such formations it is possible to provide collective food safety reliably. As an example of such approach is the European Union both in initial structure of EU-15, and in modern – EU-27.

On the example and experience of the European Union, state members of EvrAzES have accepted corresponding documents on acceptance of collective measures on food safety in the states of Economic Community. The purpose of collective food safety where Kyrgyzstan enters also is provision of all population with main foodstuffs, produced within the Republic at an obligatory priority of the most vulnerable, needy levels of population, with a condition of provision of physical and economic availability of foodstuff, according to physiological requirements, for preservation and provision of active live activity of the human.

Provision of collective safety, became one of central issues in system of their national safety by state-members of EvrAzEs, because without reliable supply of foodstuffs for the population any state system is not in a condition to function well.

Today in the Republic growth of consumption of foodstuff and its production is restrained by low purchasing capacity of the basic part of the population.

Thereupon, understanding that provision of food safety of the country demands the decision of a series of measures on employment of the population, with the purpose of increasing their consumer ability. The Republic has taken measures on performance of actions of the Program food safety provision, on commissioning of idle and new capacities.

Since 1998 Kyrgyzstan is a member of the World Trade Organization, however because of the low competitiveness of agricultural food production, the right of the WTO memberships isn't fully used by us.

In this connection, in the Republic measures on increase of quality indicators of agricultural food products, according to requirements of the international standards and creation of the monitoring system and the analysis of risks on indicators of products safety are carried out. Technical regulations on food and agricultural production are developed and introduced, safety parameters are harmonized with Codex Alimentarius requirements.

Increase of quality indicators of agricultural products will promote increase of its export potential.

Achievement of set purposes demands time and certain support from the state, and also understanding and support from the International organizations and developed states.

Chapter 3
Food Chain of Agriculture of Kyrgyzstan – Gained Experience, Learned Lessons and Development Perspectives

Abdybek J. Asanaliev and Rysbek Z. Nurgaziev

Abstract In the given article there is a review of activity of the regulatory authorities over safety food consumption of population in Kyrgyz Republic. The scheme of product movement in food chain is shown "from farm to consumers". Problems and developments of phytosanitary and veterinary control are highlighted; methods of access permit for pesticides and veterinary drugs, as well as problems of environment persistent pollutants. Examples of problems' solution through the use of prophylactic and integrated approaches (in pasturage, provender, animal vaccination, trade by products etc.) are illustrated. Successful stories and problems combating to brucellosis, zooantroponotic diseases, mycotoxins and other poisoning elements of feeding and food consummation of people, as well as utilization of persistent pesticides are given in the document. The role of education services (Universities, extensions), information services in safety food consumption of people at present and in future is emphasized in the article.

Keywords Food chain • Calories • Protein • Pesticides • Phytosanitary • Zoonotic infections • Poverty • Nutrition

3.1 Introduction

In the beginning of the 1990s the international organizations (FAO/WHO – international conference on nourishment) have given major consideration to the nourishment of vulnerable groups of population, growth of food security of households, reduction of nutritional deficiency, and the improvement of quality and security of food.

A.J. Asanaliev (✉) • R.Z. Nurgaziev
Kyrgyz National Agrarian University, Bishkek, Kyrgyz Republic
e-mail: asanaly61@mail.ru

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The quantity and quality of consumed victuals show considerable variation according to the economic development of a state. The distinction also occurs among ethnic cultures, because the consumption standard is conditioned by traditional, religious, social, climatic factors.

3.2 Legislation and Control System

The first laws in field of human and animals health protection in Kyrgyzstan were passed in the 1950s; likewise the proper legal texts were issued which instituted the regulations of official control over their execution. Since then the legislation and control in this sphere have continued developing and interacting. At the early stages of development in this field the main purpose was the prevention of any kind of food falsification, hygienic regulations and conditions control, protection of social and domestic cattle from epizootic diseases which could considerably impair socialist economics and the prevention of human morbidity with any kind of contagious zooanthroponotic diseases.

Regulation and control system were always on the move. The regulations concerning chemical pollutants, feed compound and harmful substances contained in it, were permanently worked out from the 1960s. In order to control the regulations compliance there were established monitoring systems which used the sampling practice, the laboratory basis of which was always altering. These are zonal and/or regional soil and agrochemical laboratories and veterinarian laboratories. There are also their central laboratories which located in Bishkek city.

By entering the different international political and economical organizations, Kyrgyzstan assumed a row of obligations. Due to this the industry standards, guidelines and instructions on production, storage and implementation of agricultural products for consumers are updated. Practical works on harmonization of our country's laws concerning food with legislation of European Union countries and other countries and WTO requirements are also being carried out.

According to Rome declaration which was accepted on 17th of November in 1996, during the worldwide high-level summit on food problems, the Kyrgyz Republic agreed "…to conduct a policy directed at poverty and inequality liquidation, provision of population with physical and economic access to sufficient and full-fledged nourishment".

At the present time, the Legislative basis concerning food security of the Kyrgyz Republic (KR) is the Law "On food security of the Kyrgyz Republic" (№ 183 from 4th of August in 2008), implementation of which is the responsibility of the Ministry of Agriculture of the Kyrgyz Republic.

After the Soviet Union had collapsed, a new law "On veterinary matters" was accepted in Kyrgyz Republic, in which the rules concerning implementation of veterinarian legislation were described and after the acceptance of law, there were issued relevant instructions.

The central toxicological laboratory of the Department of Chemicalization and plant protection was recreated and at present functions. On demand of producers and consumers, the laboratory does analysis of soil compound and phytogenic feeds.

Four phytosanitary posts of Quarantine regulations operate in Kyrgyzstan, which prevent delivery of quarantined objects and seed or plant stock diseases via food. A considerable problem is that quarantine regulations posts in all frontier points are located after the Customs survey stations. In accordance with "Plant Quarantine Law" (1996, amended in 1998) they have to be located next to passport control of arriving people and luggage. Therefore, there is a possibility of dangerous quarantine objects entering the country which may enter into food chain through agriculture.

The majority of standards and guidance on plant quarantine have to be refreshed in order to correspond with common conception and special standards of Mediterranean and European Organization on plant quarantine and protection and International Plant Protection Convention (IPPC). Kyrgyzstan as a member of WTO agreements on application of sanitary and phytosanitary measures and as a member of IPPC assumes a responsibility on harmonization of laws for accepting the substantiated phytosanitary solutions on consumers security.

Veterinarian quarantine posts exist to protect unsound and cattle-breeding products from entering the state's territory. The control is conducted in accordance with state standards and instructions.

There is a National council dealing with permits for the use of pesticides and other agrochemicals in KR under the Department of Chemicalization and Plant Protection. The Council tests pesticides, approves and then releases a list of pesticides admitted to be used in the Kyrgyz Republic territory.

3.3 Agriculture Production and Nourishment Condition

In Kyrgyzstan, since it has achieved independence (1991), in order to provide food security a great importance was attached to correct conservation of natural and climatic conditions of country and to output of products in required amount [2]. But from the beginning of the new century due to intensive trade with other countries, the opening of private manufacturing companies, etc., monitoring of food quality became one of the priority directions of public policy.

As in any other political and economic system, the main purpose of Kyrgyzstan is the protection of the human as a consumer and provision of his proper scale of living. There is a growth in demand by the basic mass of population for high quality food which are safe for consumption and not risky for human health. For the last 15 years, farmers of our country both supply our country with different products and export them to Kazakhstan and Russia. Examples of these exports include: potatos, milk and meat.

The annual gross output of grain varies from 800 thousand tons to 1,030 thousand tons. In most cases, the quality of farmers produced grains doesn't correspond

Table 3.1 Balance and value of daily nutrition of Kyrgyz Republic population[a]

#	The region and city, the population	Calories per day per capita	Proteins per day per capita, g	Fats per day per capita, g
Total population – **5,224,260**				
1.	Batken – **431,067**	2,345	60.4	66.3
2.	Jalal-Abad – **993,761**	2,652	70.9	65.5
3.	Issyk-Kul – **434,882**	2,349	63.8	57.3
4.	Naryn – **271,480**	2,183	59.1	53.4
5.	Osh – **1,339,205**	2,297	59.3	60.4
6.	Talas – **219,410**	2,443	65.4	65.4
7.	Chui – **762,492**	2,485	66.0	71.2
8.	Bishkek – **823,795**	2,519	69.7	71.5
Daily consumption		2,434	64.8	64.7
Daily needs		2,431	78.5	73.1
Balance: (+) or (−)		**3**	**−19**	**−8**

[a]Data of Kyrgyz Republic National Statistic Committee (2009)

to presented standards. Therefore, annually 500 thousand tons are imported from Kazakhstan. The import of grain is 18–35% from the volume of domestic food market.

The level of health and longevity of dwellers of any country depend on supply with proteins, fats and other nourishment components.

According to FAO, the average daily human consumption of protein should be 90–100 g. In the Kyrgyz Republic (KR) in 1990, per capita daily protein intake was 65 g. In 2008 the index was 59.4 g, and in the first quarter of 2009, daily protein consumption was 64.8 g [8]. These data indicate that the dwellers of KR didn't reach world figures in protein consumption; moreover there are problems to achieve similar indicators to those of the 1990s.

Consideration of provision the Kyrgyz Republic population with food calories, proteins and fats on a scale of areas:

In a crisis period of economic development the decline and imbalance of human nutrition and feeding of protein intensifies more than usual. Higher energy prices causes a rise in food prices, which causes their inaccessibility to the general population. To a certain extent, this means that in such conditions in many countries food security already cannot be guaranteed.

The data of Table 3.1 shows that our country has concerns with regard to the second category of supply of the domestic food market. Of all the regions of the country the lowest supply with food calories and accordingly with proteins and fats occurs in the Naryn and Osh regions. High energy supply of nutrition with fats and proteins is found in the Jalal-Abad. Therefore, the public and relevant government agencies should take note to ensure protein supply in Naryn and Osh regions. Especially if one takes into consideration that in these two areas the amount of population is in majority of the whole population of Kyrgyzstan.

In other areas a good supply of food calories, fats, proteins of the population is observed in the Chui and Talas. They are followed by residents of the Issyk-Kul region. This, apparently due to a balanced maintenance of cropping and livestock and as a consequence of the existence of the balanced nutrition plant and animal proteins. In these areas soybeans, beans and peas have long been grown.

3.4 About the Food Chain in Crop and Livestock Production

In the Kyrgyz Republic under the auspices of the Ministry of Agriculture there are attempts to trace the movement of food through the chain [5]. Thus, in 2008 and in 2009 with the assistance of project Sida (Support Seed Industry of Kyrgyzstan) held training seminars were held under the title "seed chain": breeder ↔ seed grower ↔ farmer ↔ miller ↔ baker ↔ consumer of bread'.

The idea was that each link in the chain receives a good product from the previous level. Workshop participants – representatives of each link in the chain had no information about the products from the previous management and/or focused only on product price. Currently, there are no established contacts between the first three links of a chain. Millers haven't yet signed contracts with farmers on supply high-quality grain, and bakers are not aware of the content of protein and gluten in the flour and guided only by the price of flour. Most of the bakers and millers are not aware of the impact on the quality of grain pests such as the bedbug pest and piyavitsa. Bread consumers are not associated into groups on expression of their interests on the quality and quantity of grain in the market.

Various kinds of agrochemicals including pesticides are used in order to increase crop agriculture. Pesticides, for not respecting the regulations of their application, are involved in the food chain at the level of plants. Toxic chemicals enter the body when used by humans and animals plants or products thereof (e.g., corn). Hazardous substances are concentrated at each successive level of the food chain. Consider the following food chain: grass (grain) → Sheep or cow → Man.

In this food chain the harmful chemical compounds enter the grass from soil. A sheep or a cow gets these substances when eating grass or grain. By drinking milk or meat of animals the harmful accumulated chemicals in milk or meat enter the consumers' body and accumulate there.

Experiments confirm that the harmful chemicals found in soil, water (after spraying pesticides), concentrate at each successive level of food (plants → animals → people), with the result that the harmful substance at the top level in the food chain (e.g. man) is concentrated in the product at the most hazardous amounts.

In Kyrgyzstan, the special study on this chain is currently not available. But there are instructions for maximum allowable pesticide residues in grain, forage, fruits and vegetables. On admission to market fruits and vegetables are controlled by laboratory specialists. The main testing indicator is the content of nitrates and nitrites. Test on the content of heavy elements and radionuclides are not carried out.

There are cases of human poisoning by nitrites and nitrates in the water-melons and melons purchased in natural outlets.

Hospitals often receive people diagnosed with botulism poisoning from home processing of vegetables and also salmonellosis. So according to the Bishkek Clinical Infectious Diseases Hospital in 2009, this hospital treated 22 people from botulism poisoning and 180 from human salmonellosis. In 2010, poisoning was much smaller, i.e. 14 people were treated for poisoning from botulism, and 52 of salmonellosis.

Another challenge is to conduct risk assessment, which represents 12 chemical compounds recognized as posing the greatest danger. The list of persistent organic pollutants (POPs) include: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, heksachlorbenzol, mirex, toxaphene, polihlorbenzol (PCBs), dioxins, furans (9 of which are pesticides).

In the Kyrgyz Republic, the situation on POPs and obsolete pesticides is not completely safe. Community of KR are well informed on environmental issues only with respect to the levels of radiation. However, on the use of crop protection chemicals, disposal of obsolete and banned pesticides, POPs and their adverse effect on the environment there is a lack of information in the country.

According to the operative data of the State Department's chemicals and plant protection in the Kyrgyz Republic in early 2000, there were about 700 tons of pesticides, of which 1.5 tons is to banned pesticides, in the warehouses of the former association "Kyrgyzselhozhimiya – Kyrgyz agricultural chemicals" and in warehouses and farms [4].

A positive factor contributing to these problems is the adoption in December 1998 Law of the Kyrgyz Republic "On The Use Of Chemicals And Plant Protection", where Article 14 provides for the termination of the implementation of pesticides and other agrochemicals and implementation of their disposal in cases where the safe use of them becomes impossible when use and transportation, etc.

According to experts of the World Federation of crops protection, if the drug is owned by a certain company, the responsibility for "life cycle" of the drug remains in the company. But the process of verification of stocks of pesticides is critical in addressing this problem and must involve other parties such as manufacturers, suppliers, donor agencies, relevant organizations, governments of exporting countries and regional bodies, as well as companies involved in hazardous waste.

The important point is to secure people's diet by regulating the presence or absence of genetically modified organisms (GMO). Under the Law "On Seeds," June 4, 2005 the use of genetically modified varieties is prohibited. The Law on "Legal Protection of New Varieties of Plants" with amendments adopted March 31, 2005 also prevents the use of genetically modified varieties.

Although grain was the main source of food, energy and protein in the world in agricultural development, as important is the production of animal products: milk, meat, fish and eggs are consumed in all countries.

In 2010, the Kyrgyz Republic 193.0 thousand tons of meat, 1357.0 thousand tons of milk produced which correspond to the minimum and physiological norms human consumption according to national standards.

In livestock in the last century there were standards and specifications of feeding farm animals. Feeding rate and forage quality controlled by specialists in animal husbandry, veterinary doctors. Pastoralists, in principle, were also interested in observing the regulations.

These days most of the population belongs to private farms. Livestock products are moving around on a chain: the food on the field (pasture) ↔ animal on the farm ↔ slaughtering at farmer ↔ market (bazar), shop ↔ consumer.

There is another chain: feed in the field (pasture) ↔ animal on the farm ↔ broker-buyer deliveryman ↔ broker-seller ↔ slaughterhouse ↔ consumer. Under the existing veterinary legislation and other regulations all owners of the product and facilitators should be supervised by a veterinary specialist: from animal care, leaving the farm for the implementation of the consumer of animal products. As a result of a lack of qualified veterinarians in rural areas there are significant animal suffering devastating diseases such as: brucellosis, echinococcosis, salmonella and anthrax.

Statistics on the incidence of these diseases in animals in the KR is available only for official use, and very rarely published in the media. The drama of these diseases is not only that they lead to lower productivity and death of animals, but that failure to observe the necessary hygiene rules and regulations can result in being transmitted to humans. In KR brucellosis caused illness in 73 people per 100 thousand inhabitants (The National Statistical Committee of KR 2009). By no official figures 70% of patients with brucellosis herd yaks [1].

As a result of research by scientists of Research Institute of Veterinary Medicine, it became known that 30% of pet dogs suffer from echinococcosis, but according to official statistics, there is no echinococcosis in these areas [3].

During the period of 1980–2009 the country recorded 156 cases of anthrax infection. These were located as follows: 73 (46.8%) in Osh, Jalal-Abad – 29 (25.6%), in Chui – 18 (12.8%), Issyk-Kul – 8 (5.77%), in Naryn – 5 (3.21%), Talas – 4 (2.56%), and Batken – 5 (3.21%) [6].

In the complex of measures to ensure food security an important role is for the timely delivery of veterinary measures aimed at preventing the outbreak and spread of infectious diseases of animals, produce and to implement security in veterinary and sanitary products of animal origin. Veterinary specialists of the Kyrgyz Republic for 2010 held 47 170.53 various treatments for animals and birds diagnosed 7995.25; vaccinated 20 612.89 and 18 562.4 heads – number of animals are degelmintized (exterminate of parasites by using pills).

In the KR there are 1,229 centres of anthrax. Found on the ground – 583. Of these 434 are only fenced and 517 are concreted; not be found on the ground 691 lesions. In 2010, 4,952 heads of animals vaccinated against anthrax by veterinarians.

In 2010, the Veterinary Service identified 16 disadvantaged items on brucellosis of small livestock and 7 points for cattle. Since May in 2010, 896,682 heads of small livestock have been vaccinated with new – conjunctive method.

Meanwhile, the present situation of zoonotic infections in the country remains tense. Veterinary services included a lot of effort to reduce the incidence of these infections [7].

Thereupon, it's very timely for country to implement a HACCP (Hazard Analysis and Critical Control Point) system. It's necessary to adapt the monitoring and control system of the country to HACCP principals. HACCP is a risk analysis and critical strategic points – the standard which became a synonym of food security. It is a system which identifies, assesses and controls the risks that threaten seriously to food security. The system assures that Monitoring and Assessment (M&A) system on food security has been effectively implemented. It considers risks and some other factors which could influence food security, and then controls in order to prevent injury of consumers.

3.5 Availability of Clean Drinking Water

One of the agents present in all foods in food chain is water. And the availability of safe water to people is of great importance. The national average proportion of people without sustainable access to safe drinking water is 9,6%. In Batken region – 23.3%; Jalal-Abad region – 5.6%; Issyk-Kul region – 0.7%; Naryn region – 8.0%; Osh region – 22.7%; Talas region – 4.1%; Chui – 1.4% and in Bishkek – 0.00% [8].

Comprehensive studies on the correlation between the availability of safe water to people and the incidence of people in the food chain in agriculture are not conducted.

Determining the statistics for people suffering from food borne diseases (salmonellosis, etc.) and problems of animal feed origin, finding is difficult due to the difficulty of collecting this information and only a small portion of cases brought to the attention of official agencies. Human cases have become public only in cases of acute infection in the region (salmonellosis, anthrax, etc.) when it is possible to identify the problem by means of mass communication.

3.6 The Role of Educational Services (Universities, Consulting services), Information Services in a Safe Nutrition in the Present and Future

One problem is the lack of veterinary specialists (veterinary doctors, specialists, veterinary laboratories, conducting diagnostics), poorly equipped laboratories, the inability to engage more in need of specialists in the ongoing refresher courses. Virtually all training for veterinary workers are only for employees of national and regional laboratories, while the district laboratories do not have such opportunities. Provision of veterinarians in rural areas is only 40%.

Through the activities of the World Bank and the International Science and Technology Centre in Research Institute of Veterinary Medicine operates a modern

diagnostic equipment to determine the viral and bacterial infections asequencer. The device allows determination of the genomic structure of animal diseases.

Specialist training designed to ensure food safety is carried out several universities. This is the Kyrgyz Medical Academy, Kyrgyz National Agrarian University, Kyrgyz-Turkish Manas University (Kyrgyz-Turkish Manas University), and the Kyrgyz Technical University. But the competence of graduates includes only the individual links of the food chain in agriculture, but not the whole cycle of production, processing and consumption.

It is important to consider prospects for the development of infrastructure in the food chain and provision of services there. In this great assistance is provided by international organizations such as FAO, World Bank and many others. The government of Kyrgyz Republic approved a project on building a bio-safety laboratory.

Thus, there are certain legislative basis and regulation system on human nutrition security in the Kyrgyz Republic. But there is a lack of systematic approach and the responsibilities of regulatory bodies cover specific links of the food chain.

3.7 Prevention and Early Warning

Prevention is the best system. Therefore, the Government of Kyrgyz Republic must found a centre of crisis situation control on food chain. This means the creation of extreme prevention system on transboundary diseases of animals and plants. Institutionally, it is a standing commission between the State veterinary Department and the State quarantine regulations of Kyrgyz Republic. This centre should focus on Desert Locust – *Schistocerca gregaria* and fungi disease of Wheat Ug 99 which is able to shift by military aircraft of NATO through “Manas” airport. Because international militaries are fighting against Taliban in Afghanistan where spread desert locust and Ug 99. Government of Kyrgyz Republic and military authority do not pay attention to this problem.

3.8 Conclusion

The Government of Kyrgyz Republic must found a center for crisis situation control on food chain. This means the creation of extreme prevention system on transboundary diseases of animals and plants. Institutionally, it is a standing commission between the State veterinary Department and the State quarantine regulations of Kyrgyz Republic.

Ministry of agriculture and other ministries concerning to food chain shall begin to adapt a monitoring and assessment systems of food security to HACCP.

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Chapter 4
Food Safety Issues in Tajikistan

Khursheda Bobodzhanova

Abstract This article discusses the concept of food security in Tajikistan. Some of the socio-economic aspects related to food safety are reviewed.

Also describes the state of consumption of food products by the population in Tajikistan. The policy and legislation in the sphere of food security in Tajikistan considered.

Keywords Food safety • Tajikistan • Food security • Quality systems

4.1 Introduction

The problem of food security in Tajikistan due to low power, insufficient purchasing power of the population and a high proportion of imports in the total balance of food, express the real danger of food prerequisites.

In addition an implementation system of control and evaluation of the situation related to nutrition does not work, which complicates the correct determination of the causes, scope and nature of malnutrition in the country.

This prevents the efficient development, deployment, development of effective strategies to reduce malnutrition and improve nutritional status of the population.

There is also a very weak technical and human resource base for effective monitoring and food security in the country.

K. Bobodzhanova (✉)
Center of Biotechnology, Tajik National University, Dushanbe 734025, Tajikistan
e-mail: bobojankh_7@bk.ru

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All of this has already begun to negatively impact on reducing life expectancy, increasing the varieties of disease, and most importantly change the gene pool of the nation on a regressive form.

Therefore, food safety issues associated with the loss of human resource that is not capable to maintain full employment, and especially creative activities represent a direct threat to national security [7].

Widely used and accepted definition of food security is the definition adopted by the World Food Summit in 1996: "Food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" [1].

This definition points to the following aspects of food security:

- the availability of food;
- accessibility of food;
- food safety and healthy eating;
- food stability.

This definition was refined in The State of Food Insecurity 2001 document as follows: "Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" [2].

4.2 Background Information on Tajikistan

Republic of Tajikistan is located in Central Asia and has no outlet to the sea. Country's total territory is 143.100 km^2. It borders with China to the east, Afghanistan to the south and Uzbekistan and Kyrgyzstan to the west and north. Height above sea level on the territory of Tajikistan, ranges from 300 to 7,400 m, which causes a sharp contrast in climatic conditions. Mountains and hills take 93% of the territory of Tajikistan. The climate of Tajikistan is continental, with hot summers and mild winters, from semi-arid to polar in Pamir Mountains. The highest peak Qullai Ismoili Somoni is 7,495 m.

Civil War (1992–1997) seriously affected already weakened infrastructure of the economy, which caused a strong decline of industrial and agricultural productions. The country's economy is recovering from post-crisis, and all efforts are directed at solving the existing problems. GDP (gross domestic product) in 2007 amounted to 11.82 billion U.S. dollars. GDP is still low at only 70% of the level of 1991. Average GDP growth is 7.8%, at a time when inflation is 13.2%. The main agricultural products are cotton, grain, fruit, grapes, vegetables, animal husbandry (cattle and small ruminants). The main industrial products are aluminum, zinc, lead, chemicals and fertilizers, cement, vegetable oil, machine-building equipment, refrigerators and freezers. Tajikistan is rich in such natural resources such as hydropower, and also has a few resources of oil, uranium, mercury, coal, lead, zinc,

antimony, tungsten, silver and gold. The main export products are aluminum, electricity, cotton, fruits, vegetables and textile products. The total amount of exports in 2005 was 950 million U.S. dollars.

The total population of Tajikistan is about 7.6 million people, 60% of which has an age below 16 years. Approximately 26% of the population lives in cities and district centers and 74% – in rural areas. Human resources are 2.1 million people, of whom 67% are involved in agriculture, 7.5% – in industry and 25.3% – in the service sector. Unlike cities and regions, the trend of population growth is in rural areas. Population growth rate is very high and is about 21 per 1,000 people. Despite the measures taken by the Government for family planning in the next 5 years, reduction of the birth rate lower than 1.5% per year is not expected. The expected population by 2025 is 8.7 million people.

Population growth leads to increased demand for food that requires immediate action to improve food security. In recent years, consumption of food production per capita, especially animal husbandry products sharply declined all across the country. The diet of the population can become unbalanced and lack other important elements of nutrition. Currently, each resident of Tajikistan consumes about 10% of the recommended physiologic intakes of meat, 19% of normal milk and milk products, 30% – sugar, 36% – fruit and berries, 56% – of vegetables and melons, 68% – potatoes. It should be noted that about 90% of calories, protein, and fat, people receive from the use of crop production, most of which (80%) is bread. A WFP mission in 2002 found that out of the 58 districts in Tajikistan 27 have “highest” or “high” level of food insecurity. The population in the piedmont zone has a relatively greater access to food products than the population of mountainous and highland areas. Regarding to household members that are located in lowland areas, they are winning an advantage in terms of nutrition. Lack of sources of income exacerbates the state of food insecurity and as a result, most young people are leaving agriculture and migrating to Russia and other CIS (Commonwealth of Independent States) in search of seasonal work.

Agriculture in Tajikistan is in transition in market relations and the keeps reforming. The number of large farms is reducing during the restructuring and land distribution, and as a result are becoming small private dekhkan (individual) farms. The size of these private enterprises ranges from 0.5 to 20–50 ga in irrigated area and is 100–200 ga on non-irrigated lands. Currently, the agricultural sector comprises more than 30,000 farmer households, 14 farms, 18 state farms and 2,576 other forms of agricultural enterprises, which contributes to the development of the country’s economy.

Crop and livestock sectors are the major components of agriculture in Tajikistan. However, the crop has a greater contribution to the total value of agricultural products (70–72%) than in cattle (28–30%).

Farmers in Tajikistan contain different types of animals like cattle, sheep, goats, horses, donkeys, yaks and poultry. Because of the weakening of control over the industry and chaotic slaughter of animals for meat in the late 1990s there was a sharp reduction in livestock numbers. Decline in poultry, mainly occurred due to the weakening of veterinary disease control and lack of mixed feeds. Currently, there is

a gradual increase in the number of livestock. In agriculture of the Tajikistan general cattle population is 1,702,500 animals, including cows, 864,300, sheep and goats is 3,798,400, horses – 78,500 birds – 3,280,400, donkeys – 171,300, Yak – 15,200 and 1,186,000 families of honey bees. After the collapse of the USSR (Union of Soviet Socialist Republics) livestock production also dropped. In recent years, annually production was typically 119 tons of meat, 583.6 thousand tons of milk, 11.2 million eggs, and 1,975 tons of honey.

The main agricultural products, serving as raw materials for industry are cotton, cotton seed, cocoons, tobacco, fruits and vegetables, meat, milk and wool. However, the industry is not operating at full capacity, so the products are processed partially [9].

4.3 State Consumption of Food Products in the Republic of Tajikistan

One of the measurements of food and nutritional insecurity is the calculation of daily calorie intake per one household member. In 2008, the average daily calorie intake increased to 2175.5 Kcal per capita, which was slightly above the recommendations of the World Health Organization (WHO) (2,100 Kcal per a day). In 2009, the average daily calorie intake increased to 2246.40 Kcal per capita, while in January – December 2010 it decreased to 2209.05 Kcal per capita.

In 2010, consumption of bread and bread products exceeded the approved medical norm by 23.5% in all regions of Tajikistan and amounted on average to 160 kg per one household member.

In January – December of 2010, the average consumption of potato in Tajikistan amounted to 35 kg per capita, vegetables and melons – 70.6 kg, milk and dairy products – 60.8 kg, meat and meat products – 11 kg, vegetable oil – 14.4 kg, eggs – 36 pieces, sugar and confectionery – 12 kg, and fruits – 33 kg. In the total structure of household's expenditures for food, bread and bread products occupies the first place (35.8%).

It should be noted that the consumption of food products varies by decile groups of the population. Thus, in January – December of 2010, the average per capita consumption of potatoes in 10% most well-off population group exceeded that in 10% least well-of population group by 60%, meat and meat products –2.8 times, eggs – 3 times, fruits – 2.5 times.

The cost of consumer's basket, at actual consumption (according to household survey 2009) amounted to 110.55 somoni (16.82 Euros) per one household member in prices of the end of December 2010, while the cost of food basket according to rational nutritional standards would amount to 214.40 somoni (32.62 Euros) (Table 4.1).

In January-December 2010, the highest increase in prices was registered for onion (by 120%), buckwheat (by 41.3%), pea (by 30.2%), sand sugar (by 29.1%), light wheat flour (by 28.6%), cotton oil (by 22.9%), beef (by 21.8%), apple (by 13.9%), mutton (by 12.9%), sour-milk products (by 10.4%), semi-finished meat and

Table 4.1 Structure of consumer's basket in December of 2009 and 2010 (as of the end of the month, in %, per one household member)

	December 2009	December 2010
Fruits and vegetables	23.1	25.7
Vegetable oil	7.6	7.8
Sugar	7.3	7.6
Eggs	2.2	1.7
Bread products	33.2	32.8
Dairy products	9.9	8.1
Meat products	15.0	14.8
Others	1.7	1.5

Table 4.2 Exports and imports of basic food products in January–December of 2009 and 2010 (*thsd. tons*)

	2009	2010	2009	2010
	Exports		Imports	
Food products of which:	217	269	1,314	1,853
Wheat	–	0.1	413.1	442.8
Flour	2.7	0.8	410.1	370.3
Sugar	–	–	111.7	110.8
Spaghetti, noodles, elbow, and other products	–	–	10.4	12.3
Vegetable oil	–	–	68.7	75.0
Milk and dairy products	–	–	6.8	7.4
Eggs	–	–	8.0	6.1
Tea	–	–	6.7	6.2
Potato	0.3	0.3	27.5	25.7
Fresh vegetable	56.7	151.6	26.5	0.8
Fresh fruits and berries	16.0	11.6	11.3	17.3
Fruit and vegetable juice	7.0	3.8	1.3	0.7
Canned vegetables, tomatoes	2.3	1.4	2.6	2.0
Shave of food products in total volume (*thsd. tons*), %	6.0	5.3	16.0	18.5

animal oil (by 9.6%), fruit and vegetable juices (by 8.7%), sour cream (by 5.8%), salt (by 5.25%), sausage (by 4.2%), bread and chocolate sweets (by 3.0%), live fish (by 2.9%), tea (by 2.5%), pearled barley (by 2.4%), vodka (by 1.9%), pasta and coffee (by 1.6%), cookie (by 1.4%), and poultry meat (by 1.1%).

At the same time, the highest decrease in prices was registered for rice (by 19.9%), potato (by 18.0%), eggs (by 13.8%), carrot (by 8.4%), milk (by 6.8%), and cabbage (by 3.8%).

In January – December 2010, the imports of food products increased by 43.4% as compared to January–December 2009, of which the import of fruit increased by 55.8%, pasta – by 18.3%, vegetable oil, milk and dairy products – by 9%.

Import of wheat increased by 7.2% amounting to 442.8 Thousands tons (against 413.1 thsd. tons in January – December 2009). Import of flour decreased by 9.8% amounting to 370.3 thsd. tons (against 410.1 thousand tons in January – December 2009) (Table 4.2).

Table 4.3 Consumption of foodstuff per capita (kg/month)

	2009	2010
Bread products (expressed in grain)	13.3	13.4
Potatoes	3.0	2.9
Vegetable and melons	7.1	5.9
Fruits and berries	3.3	2.8
Sugar and confectionary items	1.0	1.0
Meat and meat products	0.9	0.9
Milk and dairy products	5.1	5.1
Eggs	3	3
Vegetable oil	1.2	1.2
Fish and fish products	0.01	0.01

Source: Household budget survey

In recent years, availability of food remains stable (Table 4.3).

According to preliminary estimates, the natural population growth in January – December 2010 was 155.3 thsd. persons (20.4 persons per 1,000 population), increasing by 9.0% as compared to January – December 2009 [3].

The country is prone to frequent natural disasters such as earthquakes, mudslides and landslides, and floods.

4.4 Legal Structure

The Constitution (November 6, 1994, with amendments in 1999 and 2003) is the basic law of Tajikistan [10]. All laws and legislation are based on the Constitution of the Republic of Tajikistan. The Government of Tajikistan took part in the adoption of the Rome Declaration on World Food Security and Plan of Action of the World Food Summit at the World Food Summit in 1996.

The right to food is a legal concept that goes beyond the political concept of food security.

The political structure of food security at national level in Tajikistan consists of the following documents:

- Poverty Reduction Strategy in the Republic of Tajikistan for 2007–2009 [6];
- The National Development Strategy of the Republic of Tajikistan for the period up to 2015 [11];
- Programme for Food Security of the Republic of Tajikistan for the period up to 2015 (February 2, 2009) [8];
- Law of the Republic of Tajikistan "On Food Security" (December 29, 2010, № 671) [5];

Poverty Reduction Strategy in the Republic Tajikistan for 2007–2009 and National Strategy Development of the Republic of Tajikistan for the period up to 2015 contain a section on food security.

National development strategy of the Republic of Tajikistan for the period to 2015 (approved by Decree of the Government of Tajikistan on April 3, 2007 № 166) will be developed and will implement a food security strategy, which provides for, particularly:

- greater purchasing power of population growth in food consumption and improving the structure of nutrition;
- increase in domestic consumption and production of selected agricultural products, raw materials and food, including animal products;
- food exports and reducing imports.
- strengthened measures to establish food reserves and the conditions of access to it.
- strengthened requirements for the implementation of standards for flour fortification and salt iodization, to support actions to reduce malnutrition, especially children .

The comprehensive policy documents on food security are the Programme for Food Security of the Republic of Tajikistan for the period up to 2015 (February 2, 2009) and Law of the Republic of Tajikistan "On Food Security" (December 29, 2010, #641).

The situation of food insecurity in the country, existing problems and search for solutions determined the purpose and program goals of food security, the choice of priorities in the implementation of this program.

The main objective of the Program of Food Security is to identify socially acceptable, economically efficient as well as financially and technically achievable measures to achieve food security.

The main priorities of this program are: providing availability and accessibility of food, economically and physically based on the sustainable development of the agricultural sector, providing food security.

Listed priorities will be achieved through promoting private sector development; rationalization of government regulation and support, promotion and the formation of a healthy life.

It should be taken into consideration that the food security (except agricultural policies for the efficient development of the agricultural sector),are directly or indirectly affected by:

– macroeconomic policies (monetary, fiscal);
– trade policy;
– infrastructural policy;
– social policy;
– health policy and education;
– demographic policy;
– regional policy (equalization of regional development) [7].

This law defines the main directions of public policy in the field of food security as a component of State security, in accordance with generally recognized principles and norms. The law is based on the Constitution of the Republic of Tajikistan.

Food security and independence will be provided by a set of actions taken public authorities. These are aimed at the creation of guarantees of food availability for the

population according to optimal consumption rates, which are based on their availability mainly due to the intrinsic production.

The main areas of food security and independence:

- establishing a list of basic foods;
- providing the physical and economic access to staple foods;
- providing of agricultural raw materials and finished food meeting the requirements of technical regulations, standards and regulations;
- intensification of foreign economic activity, including the balance of exports and imports;
- implementation of an effective agricultural policy;
- organization operational procurement, delivery and distribution of basic foodstuffs for the population in the event of a food crisis or the threat of its occurrence;
- monitoring of the market for food and agricultural raw materials;
- development of information and communication technologies in the food trade and agricultural raw materials.

Basic principles of food security:

- ensuring equal access to the food market organizations and enterprises, regardless of the legal and organizational forms;
- avoid reducing the available levels of food security at national level;
- providing state support to domestic producers of agricultural products, raw materials and foodstuffs on a competitive basis;
- program-target method of formation of food resources;
- management decisions based on monitoring in order to build and maintain a balance of internal food market;
- openness of information about the state of the food market;
- full harmonization of requirements for food products;
- match the quality of food produced, imported and sold with the requirements of the legislation on food safety;
- development, updating and maintenance of public resources, food products, regardless of the impact of internal and external factors;
- organization of agricultural production efficiency based on the proper use and management of natural resources in order to provide population food and agricultural raw materials industry in the amount necessary for sustainable economic growth and social development.

The purpose of state support of food security is to ensure the needs of the population with basic foodstuffs due to their production by domestic producers of agricultural products, raw materials and foodstuffs.

Coordination of food security and food self-sufficiency is carried out by the authorized state body appointed by the Government of the Republic of Tajikistan. State programs to ensure food safety are developed by the authorized state body.

The Government of Tajikistan formed Council on Food Security of the Republic of Tajikistan to coordinate actions and decisions of strategic and operational issues related to ensuring stable and uninterrupted supply of food to the country.

Food security is ensured if:

- annual production of basic foodstuffs in the country is at least 80% of the annual needs of the population in such kinds of food;
- quality, caloric content and food safety, put on the market of the country in accordance with the laws comply with the technical regulations and regulatory requirements;
- on the consumer market there is food in quantities sufficient to guarantee the security of the country's population which is not lower than the recommended size of consumption.

Agriculture plays a key role in food production. That is, efficient agriculture is a key factor in ensuring food security in Tajikistan. The Ministry of Agriculture and Environment has prepared a number of programs that promote the availability of food, which have been accepted as law (eg Law № 200 from July 28, 2006 "On Grain"), or as government regulations. There are currently four main operating programs: Seed potatoes, olericulture, development of beekeeping, and development of tobacco cultivation.

One of the most important prerequisites for achieving food security is to guarantee rights to land. Article 13 of the Constitution establishes that land and natural resources are the exclusive property of the state. At the same time, the Constitution does not limit the right of property and inheritance rights (see Articles 12, 17 and 32) [7].

Water is very important for food security. Populations with better access to water, as a rule, suffer less from malnutrition. In Tajikistan, where the population is heavily dependent on local agriculture for food and income, lack of water can be a major cause of malnutrition. Therefore, access to potable water for industrial purposes is fundamental in providing access to food. A well-designed and properly implemented water policy and legislation in this area provides the country's food security. Article 13 of the Constitution states that water is the exclusive property of the state and the state guarantees its effective use in the interests of the people. The relevant legislation in the water sector include: Water Code as the basic legal act, the Nature Protection Act, Land Code, Law on the farmer (farmer) facilities, the Law on State Sanitary Inspection, the Law on Payment for Land, Civil Code and the Penal Code.

Improving food safety is a significant element of improving food security [12]. Food safety is an integral aspect associated with the use, availability and access to food. It is necessary to address the problems of food safety to improve food security, to ensure presence of food of good quality, as well as the availability of food [1].

Improving food safety is a key to improving health and nutrition, which in the end, is the ultimate goal of improving food security. Improving the availability of food will not provide much benefit without proper nutritional improvement of nutrition and food safety. However, to refer to food safety in this context, Tajikistan should evaluate an investment with a comprehensive coverage of health, nutrition and food policy systems.

Legislation relating to food safety and consumer protection includes [4]:

- Law of the Republic of Tajikistan "On Food Safety" on December 29, 2010, № 671;
- Law of the Republic of Tajikistan "On the Quality and Food Safety" on April 23, 2002, № 240 from May 10, 2002, № 54 (as amended on March 3, 2006, № 176; on July 30, 2007, № 305);
- Law of the Republic of Tajikistan "On Consumer Rights Protection" from December 9, 2004, № 72;
- Law of the Republic of Tajikistan "About standardization" of December 14, 1996, № 25 (as amended on May 3, 2002, № 25);
- Law of the Republic of Tajikistan "On Certification of products and Services" from December 13, 1996, № 313;
- Law of the Republic of Tajikistan "On ensuring sanitary and epidemiological safety of population" of December 8, 2003, № 49;
- Law of the Republic of Tajikistan "On iodized salt" on December 2, 2002 №, 85;
- Law of the Republic of Tajikistan "On poultry" from June 21, 2010, № 633;
- Law of the Republic of Tajikistan "On the Protection of Plant Varieties" on December 29, 2010, № 672;
- Law of the Republic of Tajikistan "On Drinking Water and Drinking Water Supply" on December 29, 2010, № 670;
- Law of the Republic of Tajikistan "On veterinary medicine" from December 8, 2003, № 73;
- Resolution of the Government of the Republic of Tajikistan on March 16, 1999, № 97 "On the Protection of the consumer market in the Republic of Tajikistan on the penetration of low-quality products";
- Resolution of the Government of the Republic of Tajikistan on August 15, 1994, № 396 "On measures to prevent the harvesting and processing for food and folder purposes of grain mixed with seeds heliotrope, trihodesmy gray and other noxious weeds";
- The order for the examination, the destruction or further processing of food products, goods and products that are not suitable for human consumption, approved by the Director Tajikstandart on April 17, 2006, № 56;
- How to "Certify food and other goods imported into the territory of the Republic of Tajikistan and exported abroad", approved by the Government of the Republic of Tajikistan on March 16, 1999, № 97;
- The position of the Agency on Standardization, Metrology, Certification and Trade Inspection under the Government of the Republic of Tajikistan, approved by the Government of the Republic of Tajikistan on December 28, 2006, № 615.

Food safety in Tajikistan is mainly regulated by the Law "On quality and food safety" and "consumer protection". According to Article 13 of the Law "On quality and food safety", additional agencies responsible for state supervision and control over the quality and food safety are:

– State Veterinary Service,
– National Plant Quarantine Service,
– Tajikstandart and trade inspection authorities.

Tajikstandart ensures compliance with standards and prevents the marketing of banned or substandard food. In the Republic there are 153 accredited facilities, including 12 product certification bodies, and 33 testing laboratories accredited for technical competence and independence, 108 testing laboratories accredited for technical competence. Microbiology Laboratory Agency uses a test system RIDACOUNT manufactured by firm Biopharm. In addition, the center features a modern, specialized equipment (spectrophotometer "Kvant-2", "INFRALUM FT-10", "Laktan", "Fluorat 02-2 M", nitroanalizator). The center conducts testing of food products on the following characteristics: toxic elements (lead, arsenic, cadmium, mercury); radionukleotidy (cesium-137, strontium-90), nitrates, microbiological indicators (coliforms, salmonella, yeast and mold); mycotoxins. In addition, there are defined parameters of quality for grain products. New food products are subject to state registration in accordance with the Law "On the Quality and Food Safety".

The international community plays a key role in relation to the institutional arrangement of food security. Currently about 20 international organizations are operating in the field of food security. Among them are the Food and Agriculture Organization of the United Nations, the Asian Development Bank, European Bank for Reconstruction and Development Programme, United Nations, United Nations Development Fund for Women, the European Commission, The European Commission's Humanitarian Aid (ECHO), the World Bank and World Food Programme.

Bringing legislation into line with international standards of safety and food quality (ie standards of Codex Alimentarius) is still not completed. For example, the introduction of food safety management based on HACCP principles is a basic prerequisite for safe food production and access to food markets of developed countries. The introduction of this system in the food industry in Tajikistan is important. Certification of HACCP, with its effective implementation, will enhance food safety control in Tajikistan [4].

4.5 Conclusion

In Tajikistan, Food Security Act has been adopted, moreover, there are a large number of laws and regulations that govern food safety issues. Adopting the Food Security Act makes it possible to effectively coordinate all issues relating to food security in Tajikistan. This Act coordinates issues related to the development of food safety regulation to industry areas.

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In the section "State consumption of food products in the Republic of Tajikistan" information published in Information Bulletin on Food security and poverty was used.

In the section Legal structure material from the Institutional, Policy and Legislative Framework of Food Security of Tajikistan. Food and Agriculture Organization of the United Nations (FAO). Rome, 2008 was used.

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Chapter 5
Food Security in Uzbekistan

Shaira Payziyeva and Adkhamjon Paiziev

Abstract Twenty years have passed since Uzbekistan became independent. Following independence and the dissolution of existing trading arrangements, Uzbekistan faced a choice between self- sufficiency in food production and food security through a combination of own production and regional trade. Although Uzbekistan is self-sufficient in terms of food at present time, the problem of supplying food to a growing population and especially ensuring balanced and safe nutrition is a real one for future food security. This paper presents an overview of food security, a key welfare indicator, in Uzbekistan. The datasets that are available in the public domain are used to generate an overview.

Keywords Food security • Uzbekistan

5.1 Introduction

Food security serves as an indicator of any country's ability to ensure supply, affordability, and safety of food for its population.
FAO studies on nutrition and economic growth indicate that a 1% increase in protein consumption leads to a 0.49% rise in gross domestic product (GDP) over the long term. An annual growth in GDP of 1% doubles the income of the population in 72 years, while 2% growth doubles incomes in 36 years. The importance of nutrition in economic development cannot be understated [5].

S. Payziyeva (✉)
Tashkent State Agrarian University, Tashkent, Uzbekistan
e-mail: shairapayzieva@gmail.com

A. Paiziev
Institute of Electronics Uzbek Academy of Science, Tashkent, Uzbekistan

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Before independence, the Central Asian Republics were economically interdependent on each other and on the Soviet Union. The production of food and agricultural commodities were mainly organized through a central planning process, which supported the input supply and the output disposal systems. With interregional trade collapsing, each country chose to produce only the amount of food and agricultural commodities needed by its population. Efforts to improve the welfare of population of Uzbekistan were faced with unique economic opportunities.

In Uzbekistan the agriculture plays a key role in support of economic and social stability. Therefore food security relying on the country's own production is a high priority.

The country has some distinctive economic features, such as about 17.0 million or more than 60% of the population of the country living in rural areas, with 34% of them involved in the agricultural production [3, 6, 8]. Therefore, agriculture remains the principal income source for the rural people.

The reduction of the areas led out under cotton (approximately on 3 thousand ha) was a positive shift, not only in structure of areas under crops, but also in realization of the course of food security.

The share of agriculture is nearly a third of Uzbekistan's GDP, and agricultural exports (in particular cotton fiber) account for approximately 40% of total exports. Agriculture is also the key source of government revenue, primarily through cotton production and taxation. Moreover, the processing of primary agricultural output (food processing, dairy products production, cotton processing, etc.) represents a significant part of industrial activities and contributes to about 5% of the GDP.

Crop sector is dominated by cotton and, to less extent, by wheat. Approximately 60% of the value of agricultural production comes from the crop sector and the remainder from the livestock sector. Cotton is the most important crop economically. This "strategic crop", produced in irrigated areas throughout the country, accounts for about 40% of cultivated land and makes up about 40% of export earnings. It makes Uzbekistan the fifth largest cotton producer and second largest cotton exporter in the world. Since independence, and as a result of the self-sufficiency food policy adopted by the Uzbek Government, wheat has become the second "strategic crop". It accounts for about 30% of the cultivated area. The rest of the cultivated area is used for growing fruits and vegetables (Uzbekistan continues to be one of the major suppliers of fresh and processed fruits and vegetables in the region), in addition to potatoes, tobacco and fodder crops. Animal husbandry in Uzbekistan is specialized not only in production of foodstuffs (meat, diary products, eggs) but also in the production of raw materials that include cocoons of mulberry silkworms and karakul that are highly demanded in the world markets.

Since independence, Uzbekistan's agricultural policy has been determined by several objectives: stabilization of cotton export revenues; achieving self-sufficiency in wheat production; insuring government revenues through implicit taxation of agricultural products (cotton and wheat) and keeping food prices low in the local market.

5.2 Food Security Threat

As we know, the availability of and accessibility to sufficient food is the basis of human society. The global food crisis of 2007, which led to sharp increases in food prices in global markets, not only served as a reminder of this simple truth, but also as an impetus to take a fresh look at the problems of agricultural development and the use of agricultural products**.**

According to 2nd National message of Uzbekistan under the Frame Convention of the United Nations on climate change (FCUN), by 2050 lowering of allocated water resources and fertility of the lands owing to climatic changes, the difficult demographic situation in the Republic of Uzbekistan can lead to a deficit of agricultural production on 10–15% in comparison with the modern period that creates threat of food security. It can lead to a peaking of problems of violations of a supply, especially for agricultural population lower-income strata where the family income is immediately connected to manufacture of foodstuff. By 2050 loss of a crop of cotton only due to climate change (increase of evaporation and runoff reduction) in pool of Syr-Darya will reach 11–13%, in pool of Amu Darya – 13–23%. Probably also reduction of productivity of grain and vegetable cultures will occur.

National food security policy against the backdrop of the volatility of global food prices, the challenge to make agriculture sustainable and the need to ensure that the population has access to sufficient, safe and nutritious food is an essential factor in the sustainable development of Uzbekistan. The challenge of sustainable agriculture arises from global climate change, the degradation of agricultural lands and the increasing scarcity of water resources. Around this issue there is a great amount of international experience, the world-wide dissemination of which would solve the problem of food shortages by means of the introduction of new cultivation technologies that would increase capacity and the adaptation of crops to new agro-climatic and soil conditions.

Although Uzbekistan is self-sufficient in terms of food, there remains a vitally important problem of supplying food to a growing population and especially ensuring balanced and safe nutrition [1]. The challenge relates to the trends of the global food crisis and climate change, and other internal objective and subjective factors, the most important of which are:

- adaptation to climate change is a relatively new concept for Uzbekistan, and the country requires assistance in developing the knowledge and skills of the local population to prevent its negative impacts or benefit from the positive effects of climate change;
- the high transport costs of food imports in Uzbekistan, due to the necessity of passing through two other countries in order to access the sea, which demand increased attention to the development of agriculture;
- the lack of public understanding of the importance of balanced, sustainable and safe food as a basis for the development of intellectual and public health along with strengthening and improving the nation's gene pool;

- the lack of effective mechanisms to implement public policies promoting a more rational balance of nutrition thus leading to more healthy lifestyles;
- uncertainties around maintaining food independence in the medium and long term due to demographics and the limited amount and deteriorating quality of land suitable for agricultural use
- uncertainties around the long term supply of clean drinking water, as well as limited water resources for irrigated agriculture, due to the natural shrinkage of glaciers and, consequently, river flows, and the irrational use of available water resources;
- low levels of use of innovative agricultural technologies and, consequently, low crop yields and agricultural productivity;
- lack of incentives and financial capabilities of agricultural producers to improve the quality of land resources and increase agricultural production through the introduction of innovative technologies;
- relatively low income level of approximately one third of the population, resulting in a very high demand for flour, bread and bakery products, and insufficient purchasing power to purchase food enriched with valuable nutrients;
- absence or weakness of institutions responsible for ensuring nutritious and safe food for the population, including the development, implementation and monitoring of food quality standards(www.undp.uz/en).

To attain above mentioned goals the draft Concept of National Policies on Sustainable Agriculture, Food Security and Nutrition in Uzbekistan(www.undp.uz) has been developed by the Center for Economic Research in partnership with the state authorities, UNDP, Food and Agriculture Organization of the UN, World Health Organization, United Nations International Children's Emergency Fund and other stakeholders, as well as to provide preliminary inputs on possible technical assistance in this sphere. The most important, to promote nationwide understanding, that the level of health, intellectual development, and the preservation and strengthening of the nation's gene pool is largely dependent on balanced nutrition and access to clean drinking water.

5.3 Food Security Indicators

5.3.1 Food Deprivation and Consumption Indicators (Country Briefing: Uzbekistan)

Food Deprivation

Proportion of lower-income population:	19%(2002)	11%(2007)
Number of lower-income population:	4.7 million (2002)	3 million (2007)
Food deficit of lower-income population	200 kcal/person/day (2002)	190 kcal/person/day (2007)

Food Needs:

Minimum dietary energy requirement (MDER)	
1,850 kcal/person/day (2002)	1,890 kcal/person/day (2007)
Average dietary energy requirement (ADER)	
2340 kcal/person/day(2002)	2,400 kcal/person/day(2007)

Food Supply for Human Consumption

Dietary energy supply (DES)	2,320 kcal/person/day (2002)	2,530 kcal/person/day (2007)
Total protein consumption	66.7 g/person/day (2002)	75.0 g/person/day (2007)
Animal protein consumption	23 g/person/day (2002)	25.7 g/person/day (2007)

Major Food Commodities Consumed (share in DES, for 2002 and 2007 years)

1.	Flour of wheat:	51.4%	52.7%
2.	Oil (cottonseed):	10.2%	9.1%
3.	Cow milk (fresh):	9.5%	9%
4.	Beef and veal:	4.3%	5%
5.	Sugar, refined:	4.4%	3.1%
Cereals in DES:		58.9%	59.5%

5.3.2 Food Production Indicators

Role of Production to Consumption (for 2002 and 2007 years)

1.	Flour of wheat:	98.4%	86.4%
2.	Oil (cottonseed):	115.7%	132.1%
3.	Cow milk (fresh):	108.8%	9%
4.	Beef and veal:	98.6%	100%
5.	Sugar, refined:	2.2%	0.3%
Cereals in DES:		58.9%	59.5%

5.3.3 Food Trade Indicators

Foreign Food Trade

Exports (total merchandise-t.m)	Share of food in t.m. value	3.9% (2002)	5.4% (2007)
Imports (total merchandise-t.m)	Share of food in t.m. value	9.5% (2002)	9.1% (2007)

5.3.4 Macro and Socio Economic Indicators

Population total:	28,079,759
Share of urban in total:	37%
Age dependency ratio (per 100 persons aged 15–64):	57.7 (2007)

5.3.5 Agriculture Indicators

Major Exports (share in agriculture) (for 2002 and 2007 years)

Cotton lint:	81.2%	73.1%
Grapes	1.6%	5.7%
Fruit, fresh	0.6%	2.8%
Tomatoes	1.2%	2.6%
Vegetables	0.3%	1.2%

Major imports (share in agriculture) (for 2002 and 2007 years)

Sugar:	31.3%	28.9%
Flour-wheat:	4.8	24.8
Rice, paddy	0	7.1
Tea	4.2	4.1
Wheat	16.3	3.7

Role imports to consumption by major commodity (for 2002 and 2007 years)

1.	Flour of wheat:	2.5%	15.2%
2.	Oil (cottonseed):	0	
3.	Cow milk (fresh):	0	
4.	Beef and veal:	0.4% (2002)	
5.	Sugar, refined:	152.2%	176.3%

5.4 Uzbekistan GDP Growth Rate

GDP – composition of Uzbekistan: – agriculture- 26.7%, industry- 39.7%, services: 33.5% (2009 estimate) (Data released on November 2010). GDP Per Capita often used as suchFIG
an indicator the Standard of Living in an economy. GDP Per Capita (Constant Prices, National Currency) for Uzbekistan is UZS 25,175.53. In the previous year, 2009, GDP Per Capita (Constant Prices, National Currency) for Uzbekistan was UZS 23,590.40 GDP Per Capita (Constant Prices, National Currency) for Uzbekistan in 2010 was 6.72% more than it was in 2009.

GDP (purchasing power parity)**:**$86.07 billion (2010 est.)
country comparison to the world: 75 $79.55 billion (2009 est.)
$73.59 billion (2008 est.)
GDP – real growth rate**:** 8.2% (2010 est.) country comparison to the world: 10
8.1% (2009 est.) 9% (2008 est.) (Fig. 5.1)
GDP – per capita: $3,100 (2010 est.) country comparison to the world: 167
$2,900 (2009 est.) $2,700 (2008 est.)
Labor force: 16 million (2009 est.) country comparison to the world: 37
Labor force – by occupation**:** agriculture: 44% industry: 20% services: 36% (1995)
Unemployment rate: 1.1% (2009 est.) 1.1% (2010 est.) country comparison to the world: 6

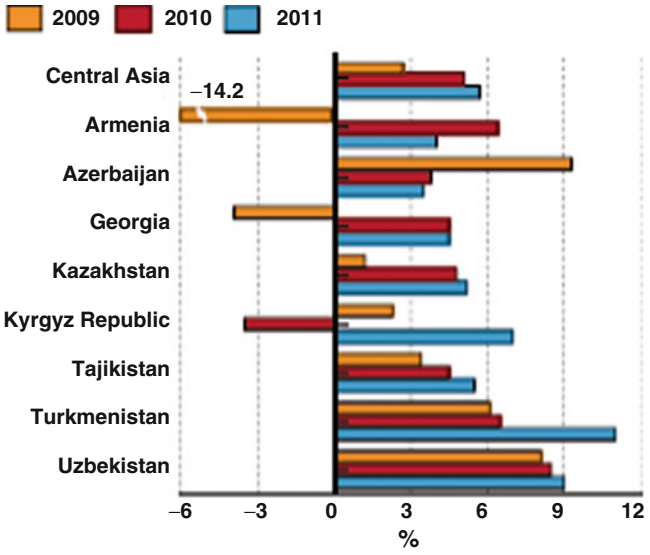

Fig. 5.1 GDP growth in Central Asia

Table 5.1 GDP real growth rate in figure

Year	GDP – real growth rate (%)	Rank	Percent change (%)	Date of information
2006	7.00	41	59.09	2005 est.
2007	7.30	45	4.29	2006 est.
2008	9.50	21	30.14	2007 est.
2009	9.00	17	–5.26	2008 est.
2010	8.10	6	–10.00	2009 est.

Inflation rate (consumer prices): 14.1% (2009 est.) 15% (2010 est.)
country comparison to the world: 221

The country's 2010 growth rate is projected to be among the highest in the region (www.adb.org/Documents/Books/ADO/2010)

In 2011, the GDP growth forecast for Central Asia is 5.7%, little changed from 5.9% expansion estimated in *ADO* [4]. Uzbekistan real growth rate is illustrated in Fig. 5.2 and Table 5.1 (http://www.indexmundi.com/uzbekistan/gdp_real_growth_rate.html).

The Center of Economic Research jointly with the United Nations Development Programme (UNDP) (on May 27, 2010 in Tashkent, www.undp.uz) to involve the best international and national expertise into a participatory dialogue to find an optimal ways to support the food security, sustainable agriculture and proper nutrition for all groups of population in the context of current stage of socio-economic development of Uzbekistan and global trends in these spheres.

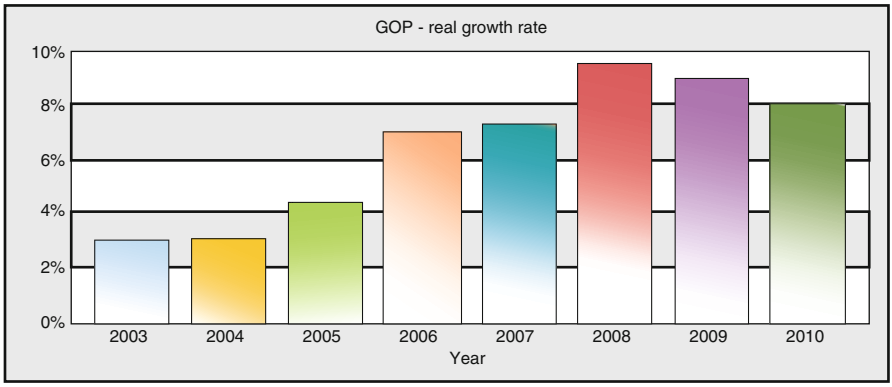

Fig. 5.2 GDP real growth rate

5.5 Policies to Achieve Food Security

Policies to achieve food security can be categorized into four groups: production support, food availability, consumption and trade.

The goal of Law about Food Quality & Security [7] determine legal basis of Quality and security food (http://lex.uz/cuz/doc/act2011-02.html).

5.5.1 Food Production

Food production volumes, together with food imports and exports, provide a rough indicator of general food availability in a country. According to the data of the State Committee on Statistics, in 2010 in Uzbekistan there has been produced 6,952 million tons grain crops (growth on 0.5%), 3,443 million tons of a cotton (+1.2%). Manufacture of vegetables has increased by 11.2% to 6,346 million tons, potato – on 11% to almost 1,693 million tons, watermelons, melons and gourds – on 10.4% to 1,182 million tons, fruit – on 10.8% to 1.71 million tons, grapes – on 9.7% to 987.3 thousand tons, 1,461 million tons of meat (+6.8%), 6,169 million tons of milk (+6.7%), 3,058 million eggs (+12.6%) (Fig. 5.3).

5.5.2 Food Availability

Simultaneous with the surge in food output, annual population growth rates were between 1.2% and 1.5% (Table 5.2). This suggests that food availability in Uzbekistan has gradually improved in recent years. Imports of food declined considerably. Although this reduced import dependency, it also to some extent lessened food availability. Overall, food availability in Uzbekistan is adequate in terms of calories. Generally speaking, Uzbekistan has a secure supply of food at the national level.

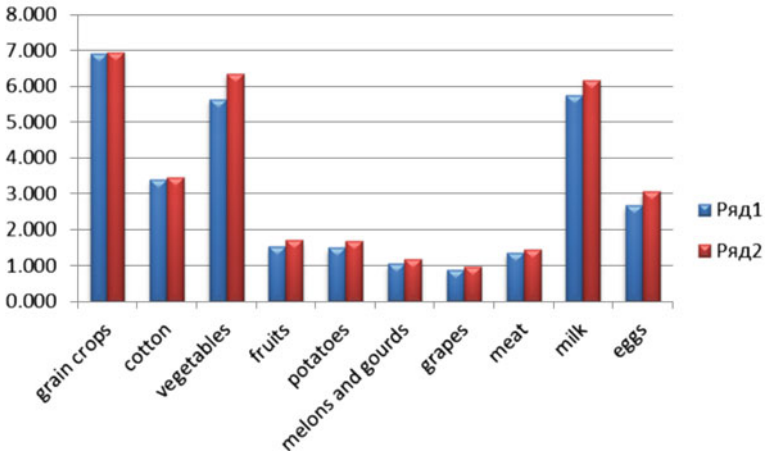

Fig. 5.3 Food production volume for Uzbekistan (2009–2010 years)

Table 5.2 Population growth in years of Uzbekistan

Population	1990–1992	1995–1997	2000–2002	2005–2007	2010	2015	2030
Total	21,008	23,327	25,098	26,610	28,080	29,456	33,933

Table 5.3 Low income population headcount (%)

Share of population	2000	2001	2003	2010
National	31.5		27.2	29.8
Rural	30.5	33.6	29.8	
Urban	22.5	27.8	22.6	

Poverty is a multidimensional notion in Uzbekistan. In Uzbekistan the term lower-income population is commonly used. 'Lower-income' means that the income level of a person allows him to satisfy only his basic needs. Almost 30% of people are low income population (Table 5.3).

Based on the 2006 Uzbekistan Regional Panel Survey, it is possible to estimate the food poverty line for Uzbekistan, using the standard food-energy intake approach, the minimum level of daily per capita calorie intake per person for the poorest quintile of the survey population. Each individual requires a minimum of 2,100 cal on a daily basis. In Uzbekistan, the actual daily calorie intake is estimated at 1,540 cal per person in the poorest quintile, and the food basket associated with it costs 14,460 sums (75.9 Euro) (in 2005 prices). In order to meet the minimum food energy requirement, assuming that an identical food basket is consumed by all, each person should spend 20,000 sums (108 Euros), which is the food poverty line.

The main data on poverty in Uzbekistan derives from the 2001 Household Budget Survey. Based on the 2,100 cal poverty line, 27.5% of Uzbekistan's population (6.8 million people) can be classified as poor in 2001. The Interim Poverty Reduction Strategy aims to reduce the poverty rate to 20% by 2010. The Government also estimates that by 2015 the percentage of poor population can be reduced to 14%.

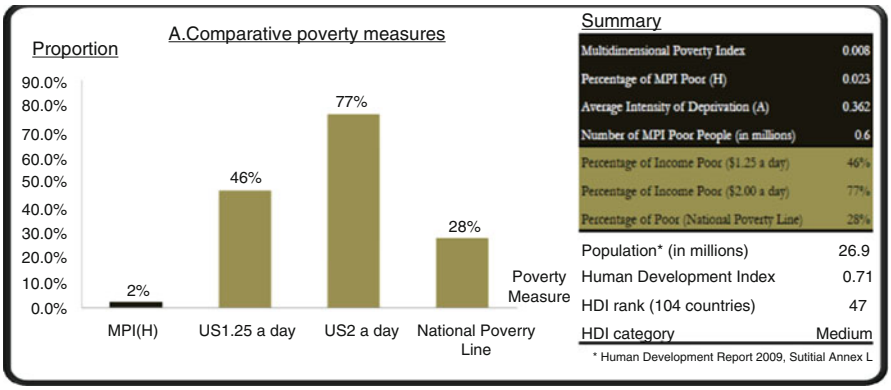

Fig. 5.4 Comparative poverty measures

Multidemensional Poverty Index (MPI)

MPI reflects both the incidence (H) poverty-the proportion of the population that is multidemensionally poor – and the average intensity (A) of their deprivation (*the UNDP's* [2, 5, 9] *Human Development Report*) (http://hdr.undp.org/en/)

Comparing the MPI with Other Poverty Measures

Multidemensional poverty index (MPI) (H-incidence of poverty)	2% (2010)
National Poverty Line	28% (2010)
Poverty measure US $1.25	46% (2010)
Poverty measure US $2	77% (2010)

Column chart A (Fig. 5.4) compares the poverty rate using the MPI with three other commonly used poverty measures. The height of the first column denotes the percentage of people who are MPI poor (also called the incidence or headcount). The second and third columns denote the percentages of people who are poor according to the $1.25 a day poverty line and $2.00 a day poverty line, respectively. The final column denotes the percentage of people who are poor according to the national poverty line. The table on the right hand side reports various descriptive statistics of the country.

Tracking poverty by demographic indicators helps us define better who the poor are and where they live. As is shown in the table, Uzbekistan's poor households are concentrated in rural and remote areas. About 70% of the whole population lives in rural areas and 30.5% of the poor are there, as compared to 22.5% in urban areas.

All state programs in Uzbekistan aim at fighting the problems of the 'lower income' population. Former large state farms reformed into agricultural firms generated the remainder. Currently, farmers produce the majority of grain, especially wheat. Dehkans provide the bulk of other food crops and livestock. Dehkan enterprises account for 37.8% of crop output, mainly vegetables, roots and potatoes, fruits, etc., and 93.1% of livestock output.

Overall, the statistics suggest that the productivity of small dehkan and farmer enterprises has increased more rapidly than that of large private and collective

farmers, thus having a considerable positive impact on food availability in Uzbekistan. In recent years the overall growth rate of agricultural production was significantly higher than population increase. This has driven up per capita agricultural production.

The significant expansion of the production of wheat, vegetables, pulses, and melons suggests improved food availability in Uzbekistan (production data are presented in Fig. 5.3). Particularly striking is the growth in the wheat harvest, which jumped from a mere 610,000 tonnes in 1991 to 2.3 million tonnes in 1995. By 2010 it had more than doubled to 6,952 million tonnes. The production of meat and eggs remains below the levels required for a healthy diet.

The data presented above indicates that livestock production is inadequate to meet the demand of growing population. Therefore, the average person's diet and nutrition intake remains heavily biased towards grains. To improve the availability of meat, milk products and eggs, the government should take measures to stimulate the consolidation of the livestock sector, improve animal productivity, expand the fodder base, and reduce tariff and non-tariff barriers for international trade in livestock products.

5.5.3 Food Consumption

Economic access to food is only a part of food security. Nutritionally balanced diets are critical for the well-being of the population. Lack of essential minerals and vitamins, proteins and fats causes nutrient deficiency, which in turn results in a variety of diseases and disabilities. We will utilise dietary indicators to analyse under nutrition and malnutrition. Although the analysis of nutritional status sometimes is complemented by anthropometric measures, we will focus upon food composition in terms of main food items and dietary nutrient values.

The WHO Country Office helps Uzbekistan to implement the priority areas of the WHO improving infant and child nutrition, including adequate breastfeeding and complementary feeding. It promotes the development and integration of public health nutrition programmes (including food fortification ones) to ensure optimal micronutrient intake within all age groups. The Country Office supports the establishment of national surveillance system on nutritional status, food availability and consumption, as well as the national surveillance system for foodborne diseases and monitoring microbial and chemical hazards at different points of the food chain

The FAO recommends about 75 mg of protein in dietary intake per each kilogram of a person's weight. Considering that an average person weighs 60–75 kg, protein intake should be in the range of 45–50 g per person per day. This places the cut-off line for adequate protein in the third quintile of the survey population. Similarly, the recommended fat intake per person is around 55–60 g per day. Thus, line separating the population with an adequate fat intake from those who do not have the required amounts falls in the third quintile. Table 5.4 provides information about Nutrition status prevalence of malnutrition in adults (%).

Table 5.4 About nutrition status prevalence of malnutrition in adults (%)

Age	Underweight		Overweight		Obesity	
15–49 F	Male	Female	Male	Female	Male	Female
15–59 M	3.8	5.9	31.9	27.8	5.4	7.1

Food security also encompasses affordable food and a diverse diet that includes essential nutrients. The poorest 20% of the population spend an average of 61% of their income on food and consume a diet dominated by cereals.

The Ministry of Health recommends an annual per capita consumption of meat and meat products of 46.1 kg, milk and milk products 156.3 kg, and eggs 295 pieces.

Micronutrients such as minerals and vitamins are needed by the human organism in small quantities and play a vital role in its development. Deficiency of micronutrients causes malnutrition, even when there is sufficient consumption of macronutrients, such as proteins, fats, and carbohydrates. Therefore, many countries have taken measures to supply the population with micronutrients. These include the support of production and consumption of products with a high content of micronutrients, e.g. diversified consumption, fortification or enrichment of food, and micronutrient supplementation. According to a World Bank report, the financing of programmes to improve access to micronutrients is one of most economically effective approaches to public healthcare and the prevention of diseases. According to the WHO, at present the population of 118 countries of the world suffers from iodine scarcity and is at risk of a deficiency in this micronutrient. Salt iodization is the most effective method of preventing and controlling diseases caused by an iodine deficiency.

61% of children under 3 are reported to suffer from iron deficiency anemia, at a time of rapid periods of growth. Uzbekistan has the highest anemia rates among children and women in reproductive age in the region. Anemia is found in 60% of women in 15–49 age group nationwide, and as a result children whose mothers are anemic are twice as likely to be anemic. Hence, these serious problems are being resolved but still remain significant. According to FAO, the production and consumption of iodized salt has grown. Consumption norm is recommended by the Ministry of Health of Uzbekistan.

There are developed, multiplied and spread brochures, booklets and the posters devoted to principles of a healthy nutrition, carried out trainings for doctors which lead large-scale propagation of a healthy nutrition. Besides, in four areas of Republic the Program on improving nutrition by supplying preparations of iron to children until 2 years as they represent, the most vulnerable population group before an anemia caused by climatic changes and social and economic conditions is carried out. With support from the WHO there has begun project implementation of Health protection of women of fertile age and children from climate changes in Republic Karakalpakstan and the Program on improving of a supply of iron to children and women fertile (childbearing) age in Karakalpakstan.

Based upon Ministry of Health of Uzbekistan per capita consumption requirements for main products and the supply of these products, the availability of milk and vegetables is sufficient. However, the supply of meat and potatoes cannot satisfy the needs of the population.

The headcount ratio, or the share of population under the poverty line, is estimated at 29.8% for the entire sample. Thus, it is the estimate of the share of population that cannot afford the basic food basket. It can be seen that headcount ratios vary dramatically across regions. Although the food basket is the most expensive in Tashkent, as expected, the headcount ratio is only 4.9%. This proportion this part of population did not consume an average of 2,100 cal per day.

5.5.4 Trade Policy

One of the strategic aims of Uzbekistan government is to increase export and improve its structure. As a result of implementation of this strategy in recent years a comprehensive system of government support for export facilitation was formed. This has led to an accelerated growth of export volume as well as the increase of the share of finished commodities with a relatively high value-added in the export structure. However, analysis shows that finished commodities comprise only ¼ of the total export. Moreover, it is important to note, that finished commodities comprise ½ of the total export to CIS countries and only 15% of the total export to other foreign countries. This situation makes the economy of Uzbekistan more vulnerable to the change of price for raw materials on the world market as well as the change of the economic situation in some countries and regions. Therefore**,** one of the main priorities of economic policy at the moment is not only to ensure high rates of total export growth, but also to stimulate growth of the share of final goods with high value added in the total export and ensure export diversification by commodities and geographical destinations.

Uzbekistan has experienced a trade surplus in the recent years. International food trade (imports and exports) is as important for food availability as production. Trade without distortions helps to utilize a country's comparative advantage in agricultural production. Food imports can improve food availability in a domestic market and create competition for local producers, while food exports allow local producers to compete in external markets. Domestic and international competition provides an incentive to enhance efficiency. Retail trade turnover of Uzbekistan comprised 21.449 trillion sums in 2010 or increased by 14.7% year-on-year. Foreign trade turnover of Uzbekistan grew by 3% year-on-year to US $21.842 billion. At the same time, exports of Uzbekistan rose by 10.8% to US $13.044 billion. Imports decreased by 6.8% to US $8.798 billion. At the same time, trade turnover of Uzbekistan with the Commonwealth of Independent States (CIS) made up US $9.424 billion (+17.7%) and other states US $12.418 billion (−5.9%). At the same time, US $13.044 billion (+10.8%) of total foreign trade turnover fell to share of Uzbekistan's exports and US $8.798 billion (−6.8%) to import transactions. The volume of imports of Uzbekistan from the CIS countries made up US $3.526 billion, or decreased by 13.8% year-on-year. Imports of Uzbekistan from other countries fell by 1.4% year-on-year to US $5.272 billion. In the reporting period, the share of the CIS states in total trade turnover of Uzbekistan made up 43.1% and other countries – 56.9% (Source: UzDaily.com).

5.6 Final Remarks

The country produces to 80% of the foodstuffs necessary for the population.

Uzbekistan is self-sufficient in terms of food at present time, but problem of supplying food to a growing population and especially ensuring balanced and safe nutrition is a real concern for future food security

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Chapter 6
The Problems of Management and Effective Utilization of Water and Ground Resources in Uzbekistan

Suriya Turayeva

Abstract Agriculture is the largest sector of the economy of Uzbekistan which provides more than 35% of gross domestic product and about 25% of export. The agriculture sector is a source of investment to other sectors of economy. In the early 1990s the least recession was marked in republican agriculture sector, in comparison with others, thus the sector in the following years was characterised by little, but steady growth.

From all countries of Central Asian region Uzbekistan feels the greatest requirement for irrigating water as it has the greatest area of the irrigated soils and the highest number of agricultural population.

According to experts at current use of water resources in 20–25 years Uzbekistan will face a sharp shortage of water for agricultural needs. In the intermediate term, the prospect of serious conflicts of interests will arise at water distribution between economy sectors, at interstate level and at local level – between water users of the top and bottom current of the rivers, between water consumers and ecosystems. Increase of efficiency of water use, the water savings and the demand management based on fair distribution of water and achievement of compromises, is the vital problem for Uzbekistan and other states of Central Asia.

Keywords Water and ground resources • Uzbekistan

S. Turayeva (✉)
World Economy Department, University of World Economy and Diplomacys, Tashkent, Uzbekistan
e-mail: suriya3@inbox.ru

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6.1 The Problems of Management and Effective Utilization of Water and Ground Resources in Uzbekistan

Agriculture is the largest sector of the economy of Uzbekistan which provides more than 35% of gross domestic product and about 25% of export. The agriculture sector is a source of investment to other sectors of the economy. In the early 1990s the least recession was marked in republican agriculture sector, in comparison with others, thus the sector the next years was characterised by little, but steady growth.

Now agriculture provides 31% of employment, and 16.5 million countrymen depend on agricultural incomes: according to empirical researches the share of incomes from agriculture in different regions varies from 35% to 60% of cumulative incomes of the population, and in countryside this indicator exceeds 70%. For poor families increase of efficiency of agriculture is especially important as the majority of determinants of neediness is connected with agricultural activity and is caused by low incomes in this sector. In turn low level of incomes is in many respects defined by low efficiency which, along with other reasons, is caused by degradation of the soil and problems in water supply.

Uzbekistan possesses considerable soil and water resources. The total area of farmland in the beginning of 2005 reached 17.8 million in hectares, 25% of which are composed by an arable land, 72% – hayfield and pastures, the remainder – long-term plantings. The main earth and water users are large agricultural enterprises – "shirkats" and the farms occupying about 97% of farmland; the share of the peasants' farms is equal to 3% [1].

About the structure of soil resources of the Republic of Uzbekistan it can be said that the soils of the desert zone, occupying 14 million ha (32%) have low fertility, humus content (<1%) and absorption capacity, high calcareousness and are subjected to salinization. The soils of the sierozem belt (light, typical and dark sierozem) with an area of 6.7 millions ha (15%) are common above the lower margin of piedmont plains from 200 to 700–900 m above mean sea level. The sierozems have a higher humus content (up to 2–3%) than desert soils and are less subject to salinization (with the exception of light sierozems). The typical sierozems are valuable for rainfed and irrigated agriculture. The dark sierozems are similar to the typical ones, but with a broader distribution area of shallow, stony and leached soil types. The hydromorphic soils (meadow desert, and meadow alluvial types) occupy 3.8 million ha (7% of total area). They are subject to natural and secondary salinization and water erosion and distributed in all regions of the country, although most are concentrated in the middle and lower river reaches, the Aral Sea littoral zone and isolated depressions. The chestnut, brown, and light brown soils of various depths occupy altitudes from 1,200 to 1,600 m above mean sea level. The soils of the mountain slopes are characterized by their high humus content (from 1.5% to 8%) and various degrees of erosion: up to 70% of brown soils are classified as moderately or severely eroded. Saline soils (residual, crust-puffed, puffed, etc.) with a total area of 1.3 millions ha (3% of the total land area) prevail in the local depressions located in lowland plains, lake basins and between mountains. Sands cover

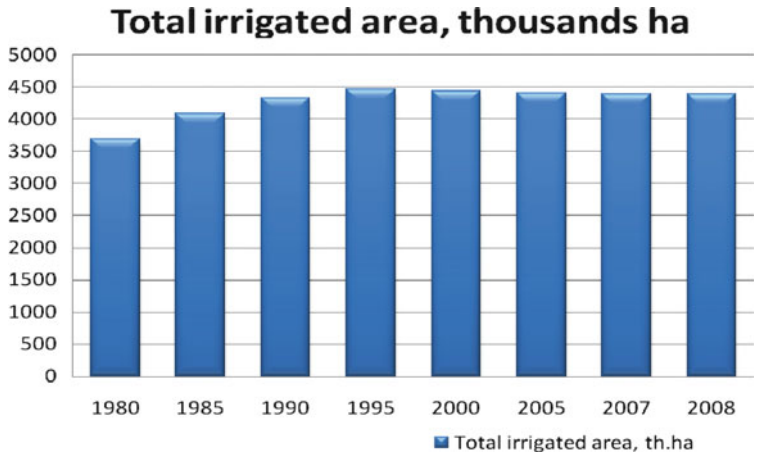

Fig. 6.1 Total irrigated area of the Republic of Uzbekistan (Source: http://www.cawater-info.net)

more than 12.1 million ha (27.6% of the total territory), including more than 0.5 millions ha of blown sands [2].

From all countries of Central Asian region Uzbekistan feels the greatest requirement for irrigating water as it has the greatest area of the irrigated soils (see the Fig. 6.1) and the highest number of agricultural population.

Water resources of Uzbekistan are a part of the general water resources which the pool of Aral Sea has and which Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan also use. Possibilities of Uzbekistan directly to influence a mode and water inflow volume are limited, as the country is located on the average current of the basic rivers of region – Amu Darya and Syrdarya.

The total area of the Syrdarya river basin is approximately 345 thousand km^2. The main Syrdarya river is formed by the confluence of the Naryn and Karadarya rivers. It is 2.8 km long, about 2,000 km out of the territory of Uzbekistan. The water resources of the Syrdarya average 41.6 km^3. Approximately 70% of the main flow volume is formed within the upper watershed down to the river's exit into the Fergana valley. The Syrdarya river flow is characterized by significant annual and long-term variability. The longterm average volume of inflow to the Chardara reservoir is 34.3 km^3. In a dry year this value decreases to 24.3 km^3. The natural river flow is significantly distorted by the diversion of water for irrigation and disposal of drainage water, as well as by reservoirs. These factors disturb the hydrodynamic and hydrochemical balance of river. The Chirchik river is the biggest right bank tributary of the Syrdarya river. The river watershed is 14,240 km^2 in area The maximum discharge (581 m^3/s) of this glacier/snowmelt fed river is in June, and the minimum in February (69.1 m^3/s). Water from the river is diverted for irrigation into big canals (Bozsu, Karasu, Parkent) [3].

Table 6.1 National surface water resources of Uzbekistan

River	Long-term average runoff (km^3)
Amudarya River Basin	4.82
Surkhandarya	3.25
Kashkadarya	1.06
Zarafshan	0.51
Syrdarya River Basin	6.65
Rivers of Fergana Valley	1.50
Rivers of Middle Reaches	0.36
Chirchik, Angren	4.79
Total	11.47

Source: Uzhydromet, NGW RUz, 2001

The Amudarya river is the largest in terms of runoff which accounts for two-thirds of the total water resources of the Aral Sea basin. The length of the Amudarya from the source of the Pyandj river to the Aral Sea is 2,540 km, including about 1,000 km within the territory of Uzbekistan. The basin covers a vast territory (approximately 1,327 thousand km^2). The Amudarya river is the glacier/snowmelt fed type of river and its water resources are 68.63 km^3 on average. The total calculated surface inflow from the watershed is more than 80.5 km^3. The long-term variability of the annual runoff is not so high (the variation coefficient is 0.15), but its uneven distribution through the year is well pronounced with 77–80% and 10–13% of total runoff in April-September and December-February respectively. Such runoff distribution is very favourable for irrigated agriculture. The total area of the Zerafshan river basin is 143 thousand km^2, including 131 thousand km^2 within Uzbekistan. The Kashkadarya river, flowing from the western spurs of the Zarafshan and Gissar mountain ridges, is 310 km long with a watershed area of 8,780 km^2 [4].

The total volume of natural underground water in Uzbekistan is 24.35 km^3. The regional replenishable underground water supply is 24.02 km^3. Out of this fresh water accounts for 8.95 km^3 (up to 1 g/l).

More than 80% of water resources of region are provided at the expense of eternal snow and glaciers in Kyrgyzstan and Tajikistan. According to intergovernmental Agreement 1992 on cooperation in sphere of a joint management, use and protection of water resources the volume of had water resources for Uzbekistan is established at 63.02 billion level m^3. This figure considers also own water resources of the internal rivers of Uzbekistan which volume is estimated in 11.5 billion m^3, or 18% from the established limit of water consumption (Table 6.1).

In practice the water supply in Uzbekistan is much less than the volume established by the interstate Agreement. This indicator considerably fluctuates depending on water supply year, however as a whole increases – in 2004 actual use made was 58.5 billion m^3. The basic source of a water supply is superficial water; water from underground sources and returnable water (Table 6.2) also are used.

Table 6.2 Water supply points from covering sources

	The volume of a water supply points confirmed by Agreement 1992	2004	2005	2006
In total it is taken away waters, billion m^3	63.02	50.3	56.5	58.5
Including, in % from the general water supply points:				
Superficial waters of the rivers	85.0	96.8	98	97.7
Underground waters	4.1	1.3	0.6	0.8
Returnable waters (industrial and municipal drain) and collecting-drainage waters	10.9[a]	1.9	1.4	1.5

Source: "the Condition of environment and use of natural resources in Uzbekistan: the facts and figures 2000–2004". UNDP, Statistic Committee and the State Committee on wildlife management, Tashkent, 2006

[a]Note: Without a returnable industrial and municipal drain

The basic sources of superficial waters of region of the Central Asia are pools of the rivers Amu Darya and Sir-Darya, which total average drain makes 115.6 billion m^3 (in pool of Amu Darya 78.5 billion m^3 is formed, Sir-Darya – 37.1 billion m^3). The total amount of water resources of Uzbekistan from superficial sources is estimated at 52.4 billion level m^3 in a year.

In Uzbekistan there are considerable stocks of the underground water which volume is estimated in 1.9 billion m^3. Additional volumes of water resources in Uzbekistan are the returnable waters dumped in water objects by industrial, municipal, agricultural consumers, and the collecting-drainage waters formed from the irrigated soils. The general mid-annual volume of returnable and collecting-drainage waters makes 4.9 billion m^3. Thus, mid-annual resources of water actually do not exceed 59.2 km^3 (from superficial sources – 52.4 billion m^3, underground waters – 1.9 billion m^3, returnable and collecting-drainage waters – 4.9 billion m^3). In days of lowered water supply Uzbekistan consumes less than 45 billion m^3, including only 40.3 billion m^3 on irrigation.

The basic consumer of water resources in republic is the agriculture on which 92–93% of all water resources (Table 6.3) are spent. Thus about 15–20% of irrigational water is spent during not vegetative period for irrigation of winter crops, before-winter watering and washing out salted soils.

Recently in the Republic there has been a reduction of the soils used for an agricultural purpose. For last 15 years the area of the irrigated earth was reduced by more than 5%, and per capita – by 22%. Only in 2000–2005 the total area of agricultural soils was reduced from 20.9 million in hectares to 17.8 million in hectares, that means 15% decrease. Reduction of farmland occurred basically at the expense of the pastures which area decreased for 19%. The size of arable land during the same period increased a little bit (by 2.7%) at the expense of expansion of crops on the dry earths. Actually, reduction of farmland occurred in all areas of Uzbekistan, but especially fast rates were presented in Navoi region (34%). By estimations of Asian Bank Development, if existing tendencies remain, the area of irrigated earths will be reduced by 20–25% during the following 30 years.

Table 6.3 Use of water resources

	2003	2004	2005	2006
Volume of used water, billion m^3	48.1	44.0	50.3	56.5
Including, in % from volume				
Irrigated agriculture	92.3	91.8	92	92.9
Power engineering	0.2	0.2	0.2	0.3
The industry	1.5	1.7	1.4	1.5
Fishing	0.8	0.8	0.9	0.9
Drinking water	4.6	5	4.8	3.9
Agricultural water supply	0.4	0.5	0.5	0.4
Others	0.2	0.2	0.3	0.2

Source: "the Condition of environment and use of natural resources in Uzbekistan: the facts and figures 2000–2004". UNDP, Statistic Committee and the State Committee on wildlife management, Tashkent, 2006

Note: In the table data only on irrevocable consumption of water in branches are cited

Simultaneously there is a deterioration of farmland. Degradation of ground resources in the country is shown everywhere. Over 3 million ha of soils suffer from wind and water erosion – for a season average losses of a fertile layer for this reason reach 80 tons/ha. The area of the pastures which are subject to destruction due to excessive pasture of cattle and technogenic infringements, makes 7.4 million ha, more than 5 million ha of pastures are subject to desertification. Problems of water and wind erosion are aggravated because of reduction of the woods the area of which was reduced from 8.5 million ha in 2000 to 8.1 million ha in 2004. About 54% of soils are polluted by pesticides, more than 80% have raised level of harmful substances.

One of the main reasons of decrease in quality of the earths – bogging and secondary salinization. During 1990–2001 of the area of the salted irrigated earths has increased by third – from 1.8 million in hectares to 2.5 million in hectares. In 2001 the area of the salted earths has made 66% from the area of an irrigated arable land. Thus weak salinizated earths have increased by 22%, mid salinizated – on 12%, strong salinizated – in 2.2 times.

Volumes of water resources are also reduced. Annual general deficiency in superficial sources of water is estimated from 4 billion m^3 to 5.5 billion m^3 depending on water supply year. Quality of water resources also worsens. The core pollutant of superficial and underground waters is the agriculture. Water selection for the purpose of agriculture causes essential quantitative reduction of the drain of the rivers, and dumps mineralized collecting-drainage waters back in the rivers which worsens the quality of water in them. Mineralization level increases from year to year in the bottom current of Amu Darya and Sir-Darya and now makes 1.2–1.9 g/l (normally 1 g\l and less).

Share of sewage dumps from the industrial and household enterprises is a little bit lower, but on level of toxicity they are more dangerous and harmful. About 500 industrial, municipal and other enterprises and the organisations discharge sewage into the water of the Republic with total amount of water removal more than 6 billion m^3 in a year. In the industry 40% of the sewage dumped to the rivers, are

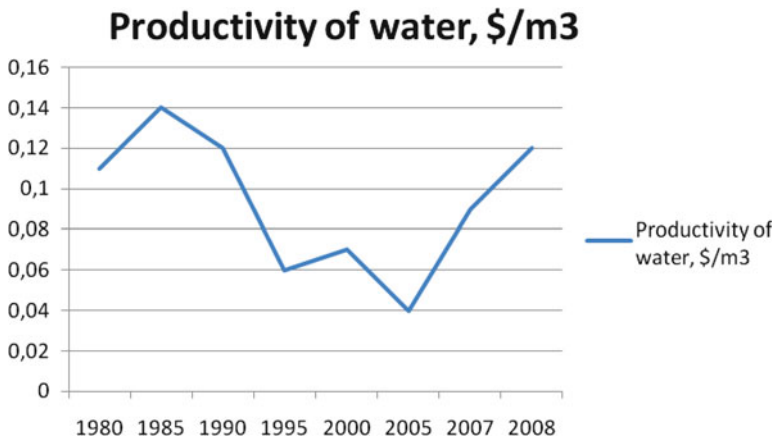

Fig. 6.2 Productivity of water in Uzbekistan (Source: http://www.cawater-info.net)

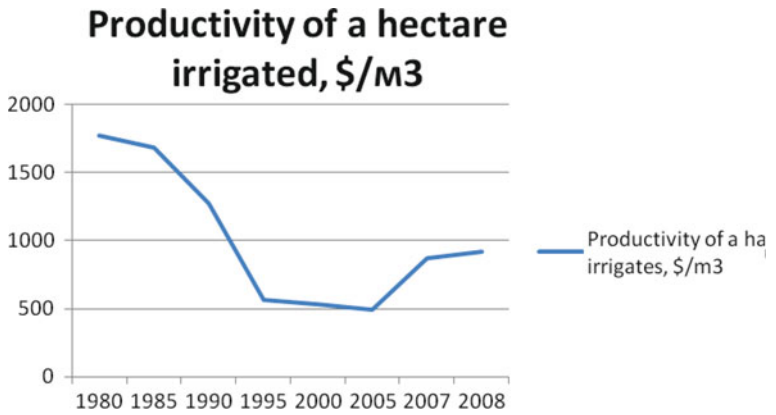

Fig. 6.3 Productivity of a hectare irrigated in Uzbekistan (Source: http://www.cawater-info.net)

polluted. The complex estimation of quality of superficial waters shows that the quality of water is satisfactory only in upper courses of the rivers of pools of Sir-Darya and Amu Darya, on the average and the bottom current of water the rivers are polluted.

The economic damage due to inefficient use of soil and water resources is very considerable. As a result of degradation of the earth and a lack of water from the middle 1980s untill 2004 productivity of hectare of an arable land has decreased by 23%, fodder capacity of pastures – by 21% (see Figs. 6.2 and 6.3). Productivity of cotton has decreased about 27 c\ha in 1990 to 19 c\ha in 2008.

Another important component of economic losses is irrational use of water resources. The area of the irrigated earth is reduced, and irrigational consumption grows. The average expense of water counting on 1 ha of the irrigated area has increased from 12 thousand m^3 in 2000 to 16 thousand m^3 in 2004. Irrational water consumption which is taking place within last 40–50 years was the reason of the most large-scale ecological crisis in region – drying of Aral Sea [2].

In addition, incorrectly carried out agro technical actions on the irrigated earths, application of inefficient ways of sprinkling and the low level of use of water saving technologies increases water supply points for irrigation by 10–15% [1].

Other reasons causing high consumption of water, include secondary salinization of the soil owing to lifting of subsoil waters and use of drainage waters for an irrigation As a consequence salted earths demand considerable expenses of water on washing which make more than 20% of all water used on fields.

The estimation of losses owing to inefficient water use is complicated in the absence of correct calculations of cost of irrigating water. However, by estimations of WB (2007) destruction/loss of resource base for an agricultural production costs to the country approximately $1 billion annually.

It is possible to allocate some groups of the factors reducing efficiency of an agricultural production.

The infringement of agro technologies expressed in intensive operation of grounds. The overwhelming majority of agricultural productions (including farms) cannot apply a crop rotation. For the same reason also practically the earths under steam are not allocated. The rules of application of fertilizers are broken everywhere because of irregular and unbalanced deliveries. The use of organic fertilizers is 3–4 times below requirements.

The technical condition of irrigational-drainage systems is important. Hydraulic engineering constructions and an irrigational-drainage network occupy 1.8% of the general fund of the earths of Uzbekistan. By present time deterioration of a fixed capital of a water economic infrastructure makes 30–50%.

There are problems of financing rural and a water management. Expenses on rural and a water management constantly decrease throughout the last one and a half decades. The share of expenses on agricultural sector in state budget structure has decreased from 27% in 1991 to 10% in 2005, capital investments in a water management were reduced for the same period almost in five times. Assignment for current maintenance and operation of an irrigational-drainage infrastructure has sharply decreased, reduced volumes of repair work, clearings of collectors and drains, works on reconstruction of channels and hydroconstructions are conducted in insufficient scales. After transfer of the earth to farms the situation with routine maintenance of an intraeconomic irrigational-drainage network (IDN) has started to improve, however farmers not in a condition to solve problems of major repairs, reconstruction and building IDN independently because of high expenses [4].

Management efficiency problems in agrarian sector are also an issue. Legislative-statutory acts, regulating questions to the earth – and water use, in many cases do not contain concrete mechanisms on carrying out of reforms in the sector and frequently are not supported by financial and material resources. Problems with the

legislation and necessity of performance of the state order quite often lead to the situation where local authorities are guided by the purposes of manufacture of a clap and grain showing indifference to maintenance of ground and water resources in a satisfactory condition. Besides, the mechanisms of control over observance of the nature protection legislation is poor.

There are also problems of paid water use. One of the central questions in relation to the earth – and water use is the problem of a payment for water and its delivery. Practically in all countries the payment for water is applied to compensation of the expenses connected with maintenance of water for the consumer, and also for stimulation of more rational water use and preservation of ground resources in the interests of all society. In practice the means of consumers are raised in various forms: for consumed quantity of water; for water delivery; on water use unit (from the person, an economy, for the irrigated hectare); for excess of a limit of use of water; for pollution of waters; for excess of a limit of pollution of waters; for the licence; the joint-stock right to water; the tax to the enterprises, including a payment for water.

In the conditions of Uzbekistan the tax for using water resources makes less than 0.4% from the general receipts in the budget and does not carry out stimulating function with regard to water savings: its rates are low, and coverage of users does not exceed 10%. With the organisation AVP the first steps on introduction of a payment for water delivery in agriculture have been made. Now AVP should carry out functions of planning, distribution and the account of the expense of water in intraeconomic networks and to raise a payment on delivery of water to fields of farmers. However AVP and agricultural producers face a number of the organizational, financial and technical problems which are not allowing it to maximize returns from introduction of a payment for delivery of water. Now collection of a payment for delivery of water which would cover costs of the organisations-suppliers and would provide with it at least is minimum necessary profit is complicated. Introduction of economically proved payment and completion of mechanisms of payment demands further all-round study in correlation with questions of maintenance of market pricing on the resources delivered agricultural producers, and ready agricultural products.

There is insufficient interstate regulation in relation to the water use sphere. For the decision of questions of joint water use the countries of Central Asian region (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) according to interstate agreements have created the joint Interstate coordination of water commission (ICWC), but its actions are inefficient.

The analysis of practice of application of the concluded water agreements shows their rather low efficiency at the decision of existing ecological, economic and social problems. The parties of agreements in force do not always accurately carry out of the accepted obligations because of weakness of mechanisms of their realisation, and on occasion owing to unacceptability for realisation. Monitoring of performance of decisions also, as a rule, is not spent. Between the region states mechanisms of the resolution of disputes and maintenance of observance of agreements are not developed. Till now between the countries of CA necessary terminology and

understanding of definition of transboundary water resources are not co-ordinated. The main principle of the International Water law – the obligation not to cause a considerable damage the states – is not always observed, especially in the headwaters countries.

Correctly to calculate full costs of absence of cooperation is impossible, but by estimations UNDP (2005) annual benefits from presence of such cooperation can average 5% of gross national product of region of CA, and for the countries of headwaters of benefit will be twice above.

6.2 Conclusion

Uzbekistan possesses the considerable ground and water resources, however the system which has developed for today to the earth – and water use is characterised by irrational use of resources, not enough high management efficiency, and ageing of irrigating and collecting-drainage systems. All cause shortage of water resources and degradation of the earths. The growing population and growth of requirement for water, transition of water objects of neighbouring countries with irrigation on a power mode will aggravate a situation. According to experts at current use of water resources in 20–25 years Uzbekistan will have a sharp shortage of water for agricultural needs. In the intermediate term there is the prospect of serious conflicts of interest that will arise due to water distribution between economy sectors, at interstate level and at local level – between water users of the top and bottom current of the rivers, between water consumers and ecosystems. Increase of efficiency of water use, the water savings and the demand management based on fair distribution of water and achievement of compromises, is the vital problem for Uzbekistan and other states of Central Asia.

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Chapter 7
Maintenance of Quality of Meat and Dairy Raw Materials and Products in Kazakhstan

Tamara Tultabaieva

Abstract The Republic of Kazakhstan is undertaking the steps for safety of meat and dairy products, through acceptance of new laws and technical regulations. Formation of institutional systems is also occurring including a Customs union, providing a new economic space on mutual trade for the goods of national manufacture of Belorussia, the Republic of Kazakhstan and the Russian Federation.

Keywords Meat and dairy products • Veterinarian-epidemiological safety of the Republic Kazakhstan • The Customs union

7.1 Introduction

Foodstuff safety remains one of the most actual and discussed problems in the world, including in Kazakhstan. Constantly the growing volume of international trade in foodstuff puts forward a problem of food safety to one of the first places – in respect of preventive maintenance of the diseases transferred through substandard products, and preservation of health of consumers.

The governments of the countries all over the world increase efforts on improvement of foodstuff safety. It is connected with the growth of a number of problems in this area and with increasing concern of consumers.

All the state's laws in the sphere of public healthcare and corresponding to the normative and technical documents specify the necessity of quality management and safety of food raw materials, foodstuff and forages. The control should be

T. Tultabaieva (✉)
LTD "The Kazakh research institute for the food-processing industry", JSC "KazAgroInnovation", Almaty 050060, Republic of Kazakhstan
e-mail: tamara_tch@list.ru

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carried out by bodies of consumer control, agricultural control, technical control, industrial laboratories of quality, etc.

By definition of the World Health Organization (WHO), about 70% of illnesses and 60% of death directly is connected with malnutrition. According to the Center of problems with the formation of healthy lifestyle, in the last 10 years, progressive growth of children's disease would be connected with the food factor.

Kazakhstan is working on the development of modern approaches to foodstuff safety, the principles of the work organization in state structures on controlling the foodstuff safety, scientific tools on working out and realization of the measures of management in the safety sphere of foodstuff, modern requirements to the organization of laboratory control, development of foodstuff potential, the methods of providing the safety of food production on the level of the food enterprises, and also informing the public on this points of questions.

7.2 The Normative-Legal Documents of Foodstuff Safety

The law "About food production safety", in Kazakhstan was adopted in 2007, this law is developed within the limits of the legislation on technical regulation, and contains the general safety requirements for all kinds of food production and as much as possible approached to the food legislation of the EU.

Besides, the creation of the technical legislation promotes unification giving a standard base at the expense of reduction of a file of obligatory requirements and their division with consumer properties of production.

The development of the laws "About food production safety" and "About technical regulation" were a part of the plan to work out technical regulations. According to it, 20 technical regulations on food production safety should be developed [7].

Requirements of 7 technical regulations have the general character and cover all kinds of foodstuff. Among them are technical regulations:

- Requirements on safety of food additives and their manufacture;
- Requirements on safety of food dyes.

The others (13) technical regulations extend on separate groups of production (meat, dairy, bakery and others).

By the present moment 4 technical regulations are operating:

- Requirements on packing, marks, labeling and their correct drawing (2008);
- Requirements on safety of juice and juice production (2008);
- Requirements on safety of dairy and dairy production (2008);
- Requirements on safety of children's products, dietary and treatment-and-prophylactic food (2008).

Acceptance of technical regulations in the republic, being based on practice of foreign countries, will provide the necessary level of safety and foodstuff protection, as an establishment with the state of uniform requirements on production

safety in documents of such high legal status as the law or the governmental order, enhances the responsibility of manufacturers and production sellers for conformity of safety indicators. In this case consumers will be less vulnerable and are subject to lower risk to get potentially dangerous production.

Last year's products of nonconventional structure are imported to the republic, for example, with addition of soya and various food additives, and also genetically modified foods, including vegetables and fruit (tomatoes, a potato, cabbage, a soya, corn, apples, and pears). In this connection there was a sharp question that our technical equipment does not always allow safety control of new food production when it arrives.

Limited analytical laboratories and absence of a legislative base has resulted in 40% of dairy products, up to 45% of meat products, approximately 28% of animal oils and canned fish not being of satisfactory standards in Kazakhstan.

For a solution a new law addressing the problem of application of food production with the maintenance of genetically modified sources will come into force in the autumn of 2011. This will be known as

"Requirements to safety of the food production received from geno-modified (transgenic) plants and animals" (21.09.2010)

7.3 The Control Organization of Safety Foodstuff

Unfortunately, now in Kazakhstan there are only two laboratories which can define the presence of the geno-modified sources in those or other kinds of foodstuff. To create more or less comprehensive laboratory on controlling the safety of food production, it is necessary to spend more than 20 million dollars. And it is necessary, because suppliers, knowing that our control is at insufficient level, will deliver to us the production which doesn't pass in other countries. For example, the Baltic fish is forbidden for circulation in the countries of the European Union, and to us it freely arrives [1].

In the republic there are no adequate methods for control of the existing wide nomenclature of articles of food and insufficient number of equipped laboratories with the necessary methodical and instrument base. All necessary complete sets of equipment and expendable materials for control of all indicators of quality and safety of milk and milk products, meat products, bakery products aren't produced. Express methods defining the major indicators of foodstuff safety aren't created.

In parallel it is necessary to solve questions of quality improvement and domestic competitiveness in food production. All today's import of separating foodstuff consist of: sugar – 30%, sour-milk products – 30%, sausage products – 40%, cheeses – 65%, canned meat – 50%, dairy and the condensed dairy products – 80%. The consumers want that quality of domestic and import foodstuff must be at high level. The basic part of food production is made under standards of the organizations (specifications). As a rule their indicators are established at the level of the requirements by standards on homogeneous groups of production, the most

part of them has become outdated, and doesn't correspond to the international quality standards.

In the last years traditional food technologies have given way to new technologies, which are characterized as follows:

- Reduction of a production cycle at the expense of decrease in passive processes (for example, drying, fermentation, maturing, a fermentation and others);
- Increases the exit of a ready product at the expense of increasing the share of brought water;
- Reductions in the share of the basic raw materials (meat, dairy, sugar, a flour, fat, juice) at the expense of cheap replacements, for example, soya, wheyish, collagen, chemical sweetener, the modified fats;
- The imitation of properties, characteristic to traditional products, at the expense of use in the food aromatics, dyes, baking powder and other food additives.

The listed fruits of progress have led to the situation that the foodstuff isn't always characterized by high quality and can potentially have risk of a trespass. It is established that 70% of harmful substances in a human body arrive with foodstuff, and the factors set forth above aggravate a situation with safety and qualities of food production.

Therefore technical regulation of foodstuff takes a special place, and their manufacture is one of the major spheres of the republic's economy who is urged to solve a problem of satisfaction of requirements of the republic population for a safe and qualitative foodstuff.

In agro industrial complex, since 2003, processes on the accelerated transition of the enterprises to the international systems of quality management and foodstuff safety corresponding to standards of series ISO 9000 and ISO HACCP 22000 became more active. Thereupon the republican budgetary program 051 "Subsidizing of control systems by manufacture of agricultural production" is realized [8].

The program provides financing of the actions connected with subsidizing of works relating to the introduction and certification of the international standards of the agriculture branches of enterprises. The sum of means paid from the republican budget, makes no more than 50% of customer's expenses from all cost of the project on working out, introduction and certification of the international standards. As a result the quantity of the agro industrial complexes enterprises which have introduced and certificated the manufactures and HACCP annually increases by conformity to requirements of international standards ISO. So, in 2003 the international standards have been entered at 5 enterprises of agro industrial complex in 2004 this indicator has made – 7 enterprises, 2005 – 40 enterprises, 2006 – 78 enterprises, 2007 – 102 enterprises, 2008 – 184 enterprises. In 2009 their quantity has reached 342 units.

In the Republic, the sanitary-and-epidemiologic control of foodstuff is constantly carried out from Ministry of Health. As the chairman of committee of the state sanitary-and-epidemiologic control of Ministry of Health RK has declared, volumes of defective food raw materials and foodstuff in Kazakhstan have in the last 2 years increased in 3.7 times. Thus 60.3% of defective raw materials are domestic while 39.7% are imported. According to republican committee sanitary-and-epidemiologic

control, from 15 thousand samples of the food production which has passed in 2007 sanitary-and-epidemiologic researches, 2.9% didn't answer the standard documentation. Physicians spend 174 researches of tests of food production on microbiological indicators from which 2.8% don't correspond to specifications [1].

A problem in the field of quality control of imported food production for the main health officer of the country is the weak material resources and shortage of experts of sanitary-quarantine control.

On modernization of laboratories of the state sanitary-and-epidemiologic service for effective control over the safety of foodstuff, including genetically modified, from the republican budget for the period till 2009 was allocated more than $64 million. Now is finished the modernization of all regional centers sanitary-and-epidemiologic service and 36 regional centers of sanitary-and-epidemiologic service, Astana and Almaty also was finished. And also will be modernized centers of sanitary-and-epidemiologic service in 61 regional centers such Atyrau, Karaganda and Akmola areas.

As the head of republican centers of sanitary-and-epidemiologic service has informed, on the basis of the republican sanitary-and-epidemiologic centre will be opening the laboratory for carrying out of researches of food production under the qualitative and quantitative maintenance of genetically modified organisms (GMO) in foodstuff, and also plans to open regional laboratories on control over GMO-production in the East Kazakhstan, North Kazakhstan, West Kazakhstan areas and Astana.

Government must divide accurately powers between the Ministries of Agriculture and public health services in the sphere of registration of genetically modified organisms intended for use in food production and forages, statements of separate lists of production which is subject to veterinary, quarantine and sanitary-and-epidemiologic control.

7.4 Veterinary – Epidemiological Service

In modern conditions of animal industries development of republic where the basic livestock of all kinds of agricultural animals is concentrated in private farmsteads, small-scale, farmer and co-operative farms, the urgency of the problems of diseases of animals, and safety of food production has considerably increased.

Infectious diseases, which contain extremely high contagiousness, have tendency to fast growth and dispersal. This seriously prevents preservation and increasing of livestock, efficiency growth, improvement in quality of received production and introduction of new methods in development of the branch [6].

The aim that Kazakhstan wants to reach entering the World Trade Organization [2] is organizing and carrying out some measures on food safety provision with a new level of quality in line with demand of 'application of sanitary and phytosanitary measures' Agreement (further – SPS), the Codex "Alimentarius" and the Sanitary Code of land animals of the World Health Organization of Animals Office International des Epizooties (OIE).

Safety of stock-breeding food output directly depends on veterinary – sanitary welfare of animals. According to international standards, the veterinary system has to provide food safety for the whole chain of life cycle: starting from creation (reproduction), slaughter, manufacture, cast, storage, transportation, realization, including import/export by a principle of "from farm to table".

To do so it is necessarily important to use an international experience, modern technologies and methodology, that will provide welfare, veterinary – sanitary and food safety of the country.

The most dangerous animal diseases are foot-and-mouth disease, brucellosis, Siberian ulcer and tuberculosis. Considering the huge harm they may cause, the leading place among epizootic activities is preventive diagnostic researches of the most dangerous animal diseases.

Epizootic situation of these diseases in Kazakhstan, as well as in the World, over the last 10 years remains difficult and strained. In Kazakhstan centre of foot-and-mouth disease were registered in 1996, 1998, 2001, 2007. Moreover there is always a threat to pick up a virus of foot-and-mouth disease from boarding countries such as China, Kyrgyzstan, Uzbekistan, etc. in which centre of this illness were registered from 1996 to 2008 [6].

In the country veterinary preventive and diagnostic actions against the most dangerous diseases of agricultural animals and birds are carried out according to the List of the most dangerous animal diseases, precautions, diagnostics and liquidation of which is carried out on republic budget, which was confirmed by government of Republic of Kazakhstan in 2003 [8]. Special veterinary actions which are carried out against diseases which are not in this List are made on the owner's budget and against enzootic illnesses on the local budget.

If any of the diseases occurs, some restrictive and quarantine methods are carried out in a line with veterinary rules, and in special occasions of infectious diseases which are in the List animal, products and raw materials have to be withdrawn and destroyed. Animals that may cause any danger to people or other animals are withdrawn and incinerated (e.g. rabies, Siberian ulcer, foot-and-mouth disease, pestilence, etc.)

It is important to notice, that during the last years, there is increases in investment of basic veterinary actions, which lead to increasing of immune system of animals, dramatically increase the number of animals that need diagnostic researches and control infection in time.

In particular, coverage by vaccination of animals against Siberian ulcer in 2002 made only 83% and now this number increased up to 100% [6].

For the purpose of creation of buffering zones, vaccination against foot-and-mouth disease is made along the border of the country, where there is a threat to pick up infection, and also along lines of republican value and in the registered not well-being points [8].

Considering situation in the country on brucellosis of agricultural animals, especially small cattle, it is paid a special attention on timely diagnostics of this disease. Epizootic monitoring is showing that before 2003 only 7–10% of small cattle were under diagnostic research, and at present this number has increased up to 100%.

Analogous work was made among big cattle animals, and moreover it is important to notice that all livestock of these animals are under serologic research, and starting from this year using high-sensitive method of diagnostics. (EIA)

Support that government provides on carrying out veterinary actions, allows stabilization and improvement of the epizootic situation on infectious diseases of animals.

For this purpose there is created a corresponding standard legal base. The Government policy on increase of competitiveness of animal industries and growth in share of home preparations in state purchase promotes formation and strengthens the home producers [8]. During the last years there is a constant tendency of increase in share of home preparations in the market of diagnostics in veterinary science, which reached 80% in 2009. Nevertheless, diagnostic test-systems for diseases such as tuberculosis, foot-and-mouth disease and brucellosis are still delivered from abroad.

According to The Republic of Kazakhstan legislation, manufacture, import, realization and application (use) of veterinary preparations, forages and fodder additives are allowed only after their registration, except for the cases of manufacture, import of the quantity that is necessary for carrying out of registration test.

The analysis of the data about result of purchase of veterinary preparations in the country [6], over the last years, shows an annual increase in preparations of home manufacture, so that in 2002, on means that were provided by state, 43 named veterinary preparations was purchased, in 2003 – 47, in 2004 – 46, in 2005 – 44 named preparations, 22 of which are home manufactured products (50%), this year this number reached 90% (among 34 named preparations 4 are from foreign manufactures).

7.5 The Production of Milk and Dairy Products in Kazakhstan

The food-processing industry is very important branch for any economy, because the foodstuff production directly influences the economic and food safety of the country.

In Kazakhstan according to Ministry of Agriculture of the Republic Kazakhstan there are 111 large and average milk processing enterprises, the total capacity of processing makes 1,680 thousand tons of raw materials in a year. The general capacity of all milk processing factories makes 2,024 tons in a year [8].

As a result the most part of milk is made in private farmsteads and the quality indicators are not of good quality, milk processing factories of the Republic can't provide domestic market with dairy production, but are compelled to buy imported raw materials for processing. The big assortment of dairy products in our shops directly depends on import production, from Russia, Belorussia, Kyrgyzstan, Ukraine, etc. (Table 7.1).

In connection with reduction of a domestic production the share of imported (Chart 7.1) dairy products in internal consumption remains so high, in 2008 by comparison with 2007 it has increased on the average on 2% and has made on dairy butter – 31%, on cheeses – 61.3% on the condensed milk and cream – 85.3%.

Table 7.1 Resources and use of dairy products

	2004	2005	2006	2007	2008
Milk-powder					
Export, ton	3,459	11,288	1,910	1,836	14
Import, ton	8,400	21,288	11,048	12,288	17,075
Production, ton	2,604	4,277	4,444	3,847	3,426
Realization in domestic market, ton	7,545	14,277	13,582	14,299	20,487
Import ratio, %	111	149	81	86	83
Dairy butter					
Export, ton	149	386.7	979.7	495	605.7
Import, ton	9442.0	7561.5	8171.3	7756.8	7326.9
Production, ton	13,040	19,736	18,596	19,707	16,775
Realization in domestic market, ton	22,333	26910.8	25787.6	26968.8	23496.2
Import ratio, %	42	28	32	29	31
Cheese and curd					
Export, ton	1,084	1276.5	1399.3	1,238	1241.1
Import, ton	3,717	6275.2	12335.4	19606.3	24128.9
Production, ton	13,033	14,952	17,042	17,154	16,425
Realization in domestic market, ton	15,666	19950.7	27978.1	35522.3	39312.8
Import ratio, %	24	31	44	55	61
The processed milk					
Export, ton	233	771	199.9	189.5	400.1
Import, ton	12,853	19,472	29517.6	28419.1	37,692
Production, ton	154,412	179,673	225,816	258,733	259,814
Realization in domestic market, ton	167,032	198,374	255,134	286,963	297,106
Import ratio, %	8	10	12	10	13

The information based on Kazakhstan [5]

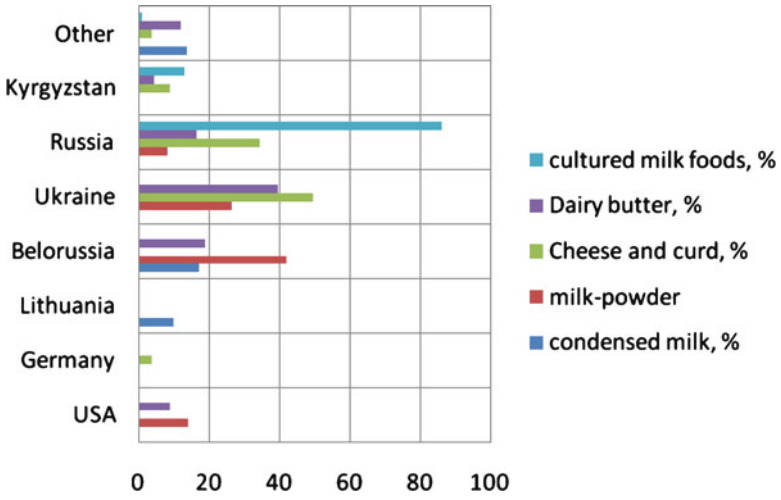

Chart 7.1 The share of dairy products import (The information based on Kazakhstan [5])

Now we don't have the necessary standards on methods of identification of falsification of milk and dairy production and components of non-dairy origin, in the absence of the information about the consumer and their use. Basically, it is vegetative and animal fats and proteins, various additives, fillers which are not appropriate as a part of raw materials for dairy production that are a problem. And also detection methods for definition of their natural aromatics, dyes etc. are needed.

These techniques are extremely necessary to control the safety of milk and dairy production and to prevent the consumer's deception. Without wide introduction of regulations with substantive provisions the "Requirements to safety of milk and dairy production" practically remain on a paper. Now control is reduced, basically, on conformity to the marks standard, instead of maintenances of the product.

For example, in the Russian Federation standards are already developed, laboratories are equipped; researches and preventive work under the prevention of the falsification facts of production and deceit of consumers are conducted. In Kazakhstan, unfortunately, this work isn't carried out and, by all appearance, what doesn't pass in Russia a wide stream goes to us because we haven't control system.

Thus the unfair competition isn't stopped. For example, instead of dairy fat is used the vegetative fat, which is 8–10 times cheaper, isn't present in the information for consumers about the product, and the prices are the same as a product using dairy fat. It is similar with the application of proteins not of a dairy origin etc.

Therefore, the standards on the test methods which specified above are necessary. The laboratories should be equipped for carrying out these tests. They should be state, instead of private if the state really wishes to protect the citizens both from import dangers and a deceit from the domestic foods.

The creation of such divisions will allow to be carried out in due time veterinary actions and to provide safe manufacture in the veterinary-sanitary relation of production of animal industries by the organization and performance of functions of the local executive powers transferred in the competence.

For the purpose of maintenance of epizootic well-being it is necessary to have the following:

- Creation of divisions of own industrial inspection at the processing enterprises of branches of agroindustrial complex;
- Introduction of principles HACCP in the organizations on manufacture, preparation, storage, processing and realization of animals, cattle-breeding production;
- Carrying out of veterinary-sanitary control by a principle "from a farm to a table" with carrying out of the analysis, an estimation and management of risks at all stages of life cycle of production (manufacture, preparation, storage, processing and realization).
- Introduction of modern ecologically safe technologies and achievements in the field of biotechnology at the enterprises of the biological industry of republic;
- Creation of a database of available domestic and foreign scientific methodologies and technologies in the field of veterinary science;
- Creation of a research center on control, standardization and certification of veterinary preparations, disinfectants, independent of the manufacturer and the consumer;
- Creation of the test laboratories (centers) which are carrying out researches and tests in the field of safety of dairy production.

7.6 The Production of Meat and Meat Raw Materials in Kazakhstan

The positive dynamics of development of the Kazakhstan's agriculture structure has been in existence for a long time [8]. The positive tendencies are characterized in its components – animal industries branches, and in particular to manufacture of meat in all principal views of agricultural animals and birds in all categories of economy. Growth of meat manufacture in 2008 in comparison with 2007 has made 4.2%, in comparison with 2006 – 8.1%. In addition the greatest rates of increase (an order of 6%) were for the given time in 2008 in manufacture of lamb meat and pig meat.

According to the Government Statistical Committee of Kazakhstan is observed the growth of beef manufacture and averages 9.2% in 2008 in comparison with 2006. In 2006 beef manufacture has made 366.5 thousand tons, in 2007 385.9 thousand tons in 2008 the volume has grown to 400. 1 thousand tons.

The same picture is observed about lamb meat. The volume of output in 2006 has made 114.9 thousand tons, in 2007 – 123.7 thousand tons and in 2008 – 130.8 thousand tons. From this it follows that increase rate of lamb meat manufacture is stable, while beef increases over the same time. The pig meat volume of output in 2006 and 2007 was approximately at one level and has made 193.4 and 193.9 accordingly. In 2008 it has grown on 6.6% in comparison with 2006 and has made 206.2 thousand tons. Stable growth of volume of output is observed and on a horse meat. In 2006 – 63.9 thousand tons, in 2007 – 65.3 thousand tons and in 2008 – 66.3 thousand tons. By other kinds of meat the situation is stable from 2003 to 2008, the volume of output averages 5.3 thousand tons in a year.

The modern way of manufacture of meat is small-scale, unorganized with both primitive and out-of-date technology and low level of mechanization of the basic technological processes of cultivation and fattening of agricultural animals [3]. In specialized managing subjects in 2008 only 10% from meat total amount are made. The basic volumes (81%) in Kazakhstan meat made are in a share of personal subsidiary plots of the population (Chart 7.2). High concentration of meat manufacture in personal subsidiary plots doesn't allow formation of export parties corresponding to requirements of the Office International des Epizooties (OIE).

In 2009 53 centers had notifiable diseases (rabies – 29, Aujeszky's disease – 1, an blackleg – 9, pasteurellosis – 9, a bradsot – 1, pearl disease – 2, the Siberian plague –1, enterotoxemia sheep – 1). Controls (liquidation) have been carried out. The registered centers of individual display disease had no epizootic character and are liquidated in due time. As of September 2009 from 53 centers 42 centers of sharp infections are closed. In the remaining 11 centers of infections liquidating actions according to instructions of measures of struggle against this or that illness of animals proceed. The furiousness among animals tends to decrease on republic display. The numbers were 47 in 2008 and decreased to 29 in 2009. [6].

In 2008 animal epidemic countermeasures for the budgetary program "Maintenance of epizootic well-being" has been allocated for performance near 54 thousand dollars, which all have been mastered.

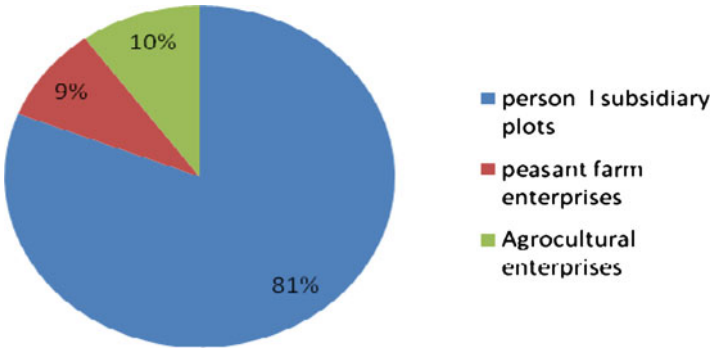

Chart 7.2 Meat manufactures in Kazakhstan (The information based on Kazakhstan [5])

Sixteen names of veterinary preparations are bought against especially dangerous disease of animals and birds for the sum of 9,500 thousand dollars of volume of 110.0 million doses. From the bought 16 names of veterinary preparations 12 are domestic productions or 75%.

Services in storage, transportation and application of veterinary preparations were carried out on places by domestic service providers.

Immunization of animals on the Siberian plague, allergic researches on a pearl disease are carried out with coverage of 100% of a susceptible livestock of animals in all regions of the Republic. Against rabies, leptospirosis, a listeriosis, pasteurellosis animals, variola, contagious ecthyma and a bradsot of a small ruminants, vaccination is spent only in earlier unsuccessful centers where within last 3 years disease flashes have been registered.

Tactics of immunization against aphthous fever cattle and a plague of small ruminants differs in that vaccination is spent in earlier unsuccessful centers, and also in southern and southeast regions of republic where there is a threat of penetration and drift of an infection from the adjacent states, for the purpose of creating a buffer zone.

On diagnostics of diseases of animals in 2008 has been allocated 16 thousand dollars. It has been spent on 15.7 million tests, including on 5.2 million horned cattle, and on 10.5 million small cattle tests for brucellosis.

In 2009 for these purposes it is allocated by 29 000 dollars. The allocated sum provides 34.0 million tests and coverage by diagnostic researches on a brucellosis makes at level of 113% of livestock cattle ruminants and 131% – small ruminants. Thus, in republic annually increases volumes of diagnostic actions.

Decrease in the centers of especially dangerous illnesses of animals and birds are annually observed. For example, in 2007 130 centers have been registered (103 rabies, 6 pasteurellosis etc.) for sharp infectious diseases of animals, and in 2008 the quantity of the centers of sharp infectious diseases of animals and birds was 95 centers (62 rabies, 6 pasteurellosis etc.). All above-stated epidemic countermeasures allow the carrying out of timely diagnostics, preventive maintenance and liquidation of the centers of especially dangerous illnesses of animal and birds.

For the purpose of safety of production and raw materials of an animal origin from the beginning of year, veterinary inspectors check up 61,339 objects, including veterinary laboratories – 4,809, the markets and shops – 30,047, the enterprises which are engaged in storage, realization, processing of products – 31,070, lethal points – 1,936 [8].

As a result of the work, efficiency of inspection work on places has considerably improved. In 2009 concerning physical and the legal bodies who have broken the veterinary legislations, penalties for the sum of 195 thousand dollars are imposed. The sum of the penalty for 2008 has made 112 thousand dollar or in 1.5 times less.

Now the market of meat and meat products of Kazakhstan needs serious scientific researchers regarding the satisfaction of the increased demand of the population, a solution of a problem of import, increase of profitability and competitiveness of animal industries.

Before scientific institutions there are problems of working out of methods of decrease in losses, quality preservations of production at processing, transportation, pre-slaughter preparation of animals; perfection of system of preparation of cattle-breeding production; creations of without waste and low-waste technologies of processing of cattle-breeding raw materials with full and rational use of all its components on development of foodstuff, and also forages for animal industries.

Here it is necessary to give great attention to a problem connected with preservation of quality of meat. Various factors cause physiological stress: starvation, weariness, fear, aggressive relations between separate kinds of animals, bad conditions of transportation – rise in temperature, increase in concentration CO_2 owing to bad ventilation. The quality of meat worsens as a result if such factors. Also various traumas, wrong bleeding can result in decrease of weight of animals before slaughter. By numerous researches it is established that decrease in quality of meat at transportation is influenced by temperature fluctuations, humidity of environment, duration of transportation, distance, speed of transportation, kinds of vehicles, methods of a bringing of animals to a loading place, density of their placing in vehicles, etc. For example, the size of losses of live weight of cattle at transportations fluctuates from 3.03% to 20.8%. In this connection, in the Republic it is necessary to develop standard conditions of transportation, acceptance at the enterprises, maintenance and preparation of the animals for slaughter and proof of the conditions of meat storage.

For prevention of loss and decrease in quality of production it is expedient, according to the experience of foreign countries, to use the approach of building new meat-packing plants to economize on cattle and bird cultivation or opening in them of shops on slaughter and primary processing, and where the consumption centers are a long distance away, to carry the meat under cool conditions.

In modern conditions scientifically well-founded requirements to quality of lethal cattle and meat are defined by the standards considering conditions of production of raw materials, its processing, and the consumer requirement. In new developed standards the actions operating quality of production will be in details formulated and regulated.

Thus, saturation of the domestic market by meat puts in the forefront quality of production. Conformity of quality to market requirements becomes an important condition of realization of meat production.

7.7 The Customs Union

Ability of the state to effectively carry out the control over the safety of foodstuff made in the country, and also production which imported into country, and providing health of consumers is one of the basic conditions of the Kazakhstan's entry to the World Trade Organization (WTO).

In October, 2007 in Dushanbe Belorussia, Kazakhstan and the Russian Federation have signed Agreement on the Customs Union Commission. It is a supranational body, the structure of which includes representatives of the three parties and its decisions are obligatory in territory of the three states.

Since January, 2009 the Commission has begun the high-grade activity. The commission of the Customs union of Belorussia, Russia and Kazakhstan is created to form the institutional system of the Customs union, new economic space, the free movement of the goods, elimination of customs procedures in mutual trade in the goods of national manufacture.

During the current year (2011) is planned the working out of the prime technical regulations of the Customs union, in particular safety of foodstuff:

1. about safety of production intended for children and teenagers;
2. about safety of packing;
3. about safety of grain;
4. about safety of food production.

7.8 Conclusion

Thanks to modern practical techniques of intensive agriculture the quantity of accessible foodstuff at cost increases, and by means of food additives it is possible to improve quality, quantity and safety of foodstuff.

However corresponding control devices are necessary for maintenance of appropriate and safe use of such additives on all points of a food chain. Checks and approval are necessary for maintenance of safe use of pesticides, veterinary preparations and food additives before sale. There should be continuous monitoring.

In this connection, it is necessary to develop new techniques allowing the establishment of the qualitative and quantitative structure of raw materials in any multi component foodstuff, by means of various methods.

The developed methods will be intended for use at the enterprises and the establishments providing a definition of quality and conformity to standard documents of raw materials, semi finished products and foodstuff, and will gain the big distribution.

The WHO (World Health Organization) promotes use of all technologies in the field of foodstuff which can benefit public health services, such as pasteurization, an irradiation of foodstuff and fermentation.

In this regard, preparation of the experts occupied in the field of foodstuff production, concerning safe handling of them is one of the most important actions for preventive maintenance of illnesses of a food origin.

The Republic Kazakhstan's Ministry of Agriculture, with a view of improvement of quality and competitiveness of production in agro industrial complex realizes measures on revision and actualization of standard base and standards operating in territory of the country, and also maintenance of harmonization of state standards in conformity with the international requirements.

In territory of Republic Kazakhstan in the field of agro industrial are 2,083 complex standards, including Federal standard – 1,771, Standard of Republic Kazakhstan – 377 operate, from them 244 standards that makes 11.7% are harmonized. By results of the preliminary analysis, the quantity of necessary standards on agricultural production makes 132, including: meat and meat products – 7; fish and fish products – 4; milk and dairy products – 5; juice production – 24; fruit-and-vegetable production – 55; flour and grits production – 37.

Besides, in agro industrial complex processes on the accelerated transition of the enterprises to the international systems of quality management and safety of foodstuff become more active. In this regard, the republican budgetary program provides support for the working out, introduction and certification of the international standards of subjects of agro industrial complex.

For today the quantity of the enterprises which have introduced standards ISO and HACCP, has reached 323 units, at a stage of working out and preparation of manufacture for introduction of quality management system there are 84 enterprises. By the end of 2014 the quantity of the enterprises which have introduced standards ISO and HACCP, will increase to 500 units [4].

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Part II
Aspects of Food Security Systems

Chapter 8
The Breakdown of Food Safety Management Systems

Madeleine Smith

Abstract Food Safety Management systems such as HACCP must be implemented correctly in order to guarantee safe food. Flaws in the implementation can result in threats to public health. Four outbreaks are described which demonstrate this outcome.

Keywords HACCP • Food Safety Management • Outbreaks

8.1 Introduction

Food safety management systems such as HACCP are considered to be an effective way to ensure the production of safe food [12] and are used in many countries to protect public health. In Europe food safety management systems have been a legal requirement in food businesses since 1995 when Council Directive 93/43/EEC on the hygiene of foodstuffs first came into effect. Subsequent legislation has strengthened this requirement but despite this, serious outbreaks of food borne illness continue to occur in the UK. A consideration of these outbreaks identifies some limitations of food safety management systems. These are not due to any inherent flaw in the HACCP process but from problems of implementation or design. Four outbreaks of interest are described here. Two are well documented, having been the subject of reports by Professor Hugh Pennington, while the other two are less well known.

M. Smith (✉)
Chemical Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
e-mail: m.smith.2@bham.ac.uk

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8.2 Outbreaks

8.2.1 The Lanarkshire Outbreak

The outbreak commonly referred to in the UK as 'the Lanarkshire outbreak' occurred in Scotland in 1996 and was caused by the ingestion of meat which had been contaminated by *E coli* 0157 PT2. The contaminated product was traced back to a supplier who was registered as a retail butcher. On investigation the premises proved to be producing meat products which were sold to the public but were also sold to a number of other businesses [4, 11]. The outbreak caused significant morbidity and 17 deaths. The requirements of Directive 93/43 (that food businesses should have food safety management systems) had been in place for 14 months when this outbreak occurred. However, the premises at the centre of the outbreak had no such system.

A report into the causes of the outbreak was commissioned and one recommendation of the report was that all food businesses should have HACCP systems and that butchers handling raw and ready to eat food, in particular, should be trained properly in HACCP and its implementation. It was also recommended that butchers handling raw and ready to eat food should be licensed [11]. There is no universal requirement for licensing of food businesses in the UK, although all must be registered with the Food Authority. The Pennington report recommended that licensing should be implemented for this group and the terms of the license should include the requirement for a HACCP system.

The UK government accepted these proposals as being in the interests of public health and new legislation was drafted to implement the requirements. The majority of premises covered by the new legislation were small family owned premises. As Small/Medium sized Enterprises tend to face particular barriers when implementing HACCP, notably the lack of expertise [8], the Meat and Livestock Commission was funded by Central Government to develop a generic HACCP plan that could be used by all butchers and which would meet the requirements of the new legislation. Public funds were also made available to assist the butchers in training and in implementing the new plans. By 2001 all butchers were licensed and a study carried out in Birmingham indicated that the process had improved hygiene in the study group [13]. A re visit to the same sample group in 2011 indicated that the improvements had been maintained.

The Butchers License was an annual license with a modest fee (£100). All Butchers were inspected annually by officers from the local food authority. After the inspection, the license could be renewed provided the premises still complied with the conditions.

8.2.2 South Wales Outbreak

Four years after the start of the licensing initiative another major outbreak occurred in the UK involving contamination of meat products by *E. coli* 0157. This was again

traced to a retail butcher producing cooked meat products for sale to other businesses. Sadly the purchasers of the contaminated product were schools who unwittingly offered the meat to their young pupils as part of the daily lunch provision. According to the report of the public enquiry that ensued, there were 157 cases and one death [12]. The outbreak began in September 2005, just after the children had returned to school from their summer holiday.

The contaminated meat was produced by a licensed butcher. He had been given a license in 2001 according to the legislation enacted [1]as a result of the Lanarkshire outbreak, and this had been renewed annually, with the latest visit/renewal being 8 weeks before the outbreak. However, when the HACCP plan from the premises was assessed by experts participating in the public enquiry, it was found to be unfit for purpose with a number of serious flaws in its design and implementation. The experts reported the following problems:

- a process was completely missing from the plan (the purchase and further processing of ready cooked meats)
- process steps were missing,
- hazards had not been identified,
- control measures and monitoring were inappropriate
- critical limits were missing.

In addition, the paperwork was considered to be inadequate and did not reflect the actuality of the situation.

A HACCP plan can only ensure safe food when it is fit for purpose. It must cover all processes and food stuffs handled in the premises and correctly identify the relevant hazards and critical control points (CCP's). Appropriate control measures with workable critical limits must be designed and implemented for all CCP's, monitored accurately and recorded. Corrective action must be taken when dictated by the plan. Under the UK Regulations[2] in place at the time of the outbreak, the person with responsibility for correctly implementing a HACCP plan was the food business operator and in this situation, he was clearly at fault. In addition he had failed to correctly implement necessary pre-requisite programmes such as cleaning and training. These omissions would further compromise the efficacy of any HACCP plan and consequently the safety of the food produced in the premises.

All food businesses were required to have food safety management systems at the time of the outbreak. According to UK legislation,[3] the schools that purchased the contaminated meat were classed as food businesses and should also have been using such a system. The purchase and receipt of a ready-to-eat food such as cooked meat should be identified as a CCP in any food safety management system and a typical control measure would be to buy only from a reputable supplier. Clearly the schools were not buying from a reputable supplier as The Public Enquiry Report refers to a

[1] Food Safety (General Food Hygiene) (Butchers shops)(amendment) (Wales) Regulations 2000.

[2] Food Safety (General Food Hygiene) Regulations 1995.

[3] Food Safety Act 1990.

series of complaints made by the participating schools regarding deliveries from this supplier [12]. Some complaints were serious and indicated inadequate controls in the production and delivery of the meat products for example the delivery of undercooked meats and deliveries where there was blood contamination on the outside of cooked meat packaging. A supplier delivering cooked meats in such a state could not be classed as reputable and therefore one must conclude that the schools were not implementing their food safety management system correctly either.

The Enforcement Authority was also criticized during the investigation. Officers had been inspecting and licensing the premises which produced the meat for 4 years at the time of the outbreak. The most recent visit took place 2 months before the outbreak began. Whether or not the inspectors could or should have taken a different enforcement approach can be debated but vigorous enforcement can only identify flaws in a HACCP plan and/or punish the owner for non compliance. It is not the responsibility of the enforcement officer to draw up food safety management plans for food premises. It is also beyond their remit to ensure implementation on a daily basis. That duty rests with the food business operator. Lax enforcement is not in itself a failure of the HACCP system but when a flawed plan is being used in a business, it does allow potentially unsafe food to continue being produced without censure or pressure to improve. Had the food business operator been diligent and carefully followed a satisfactory plan, he would have produced safe food whatever rigor of the local authority's enforcement policy. This applies also to the schools that needed, as part of their own food safety controls, to assess whether their suppliers were providing safe food and to reject the product when their monitoring indicated that critical limits had been breached.

8.2.3 Contaminated Sandwiches

An incident which occurred in the UK in July 2009 again highlighted the importance of ensuring a reputable supplier. This outbreak affected officers policing a demonstration which took place in a major city in the West Midlands [1]. Demonstrators arrived by public transport during the morning to participate in the demonstration which was scheduled to begin at 12 noon. In total, 324 police officers were covering the event, some assigned to the arrival stage, others to the event itself and a third group to cover the period after the event when demonstrators would be leaving the city. Officers were required to attend one of three briefing sessions scheduled for 10 am, 12 noon and 3 pm according to the stage they were policing. At the briefing session, each officer was given a packed lunch comprising two sandwiches, crisps and bottled water. The sandwiches had been ordered from a local café. They were collected from the café for distribution at times designed to coincide with the briefing sessions. The aim was to minimize the time the sandwiches spent at ambient temperature. The officers attending the first briefing at 10 am ate the sandwiches during the morning and shortly afterwards some began to show symptoms. In all, 43 of the officers policing the demonstration were affected, some so seriously that hospitalization was required. *Staphylococcus aureus* Phage type A with enterotoxin genes A and H was identified as the causative

organism through examination of faecal samples provided by three affected officers and also from uneaten sandwiches provided for the 3 o'clock briefing.

The investigation revealed that the café supplying the sandwiches was a very small business, local to one of the police stations. The main food handler involved in producing the sandwiches was also the owner and she suffered from eczema. Swabs from her skin and nose, samples of leftover food stored at the café and environmental samples from surfaces and equipment all tested positive for the outbreak strain.

As in the case of the South Wales outbreak this food business had not implemented the pre-requisite systems or a HACCP plan correctly. There was evidence of a pest infestation (mice) in the premises, the two employees had no food hygiene training and the cleaning was inadequate. The sickness policy was also clearly inappropriate as the owner was handling ready to eat food in spite of having an open infected area on her thumb. There was a food safety management plan but it was being used haphazardly. The café used a generic system known as Safer Food Better Business.[4] However critical controls such as the temperature control of ready-to-eat foods (sandwiches) were not being carried out. The documentation associated with the system had not been completed for several months [3]. As a consequence of failing to implement pre-requisite systems properly and omitting to properly control critical steps in the food production, the owner of the café produced food that was inherently unsafe.

Under article 3(2) of Regulation (EC) no 178/2002 'any *undertaking, whether for profit or not and whether public or private, carrying out any of the activities related to any stage of production, processing and distribution of food'* is defined as a food business As the police force were distributing food as part of their normal business (policing a demonstration) they constitute a food business under this regulation and therefore must implement food safety management systems according to article 5 of Regulation (EC) no 852/2004. Those in charge of procuring the food for the officers should have been following a HACCP plan and, like the schools involved in the South Wales outbreak should surely have identified the receipt of ready to eat foods such as sandwiches as a CCP. The organizers did try to minimize the time the food spent at ambient temperature while under their control but clearly did not use a reputable supplier to control the hazard of inherent contamination.

8.2.4 Chocolate Contaminated with Salmonella

During the period March – June 2006, the Health Protection Agency in the UK identified an increase in the number of isolates of a strain of *Salmonella enterica* serovar Montevideo. PFGE typing indicated all were type smvd X07. Patients resided in many areas of the UK and 52% of the cases were under 4 years old [9]. Investigation and research identified the source of the outbreak to be chocolate produced in the UK and distributed widely throughout the country. Forty two cases

[4] Safer Food Better Business was designed by the Food Standards Agency, UK, to assist small catering businesses develop a food safety management system and comply with the requirements of article 5 of Regulation(EC) no 852/2004 [6].

were definitely associated with this food source, two of whom were hospitalized. The youngest case was 9 months old.

The manufacturer responsible was an established company which had been producing chocolate on that site for many years [15]. The chocolate was manufactured using chocolate crumb produced in a factory some distance away but owned by the same company. The manufacturer had a food safety management system in place and had identified contamination of the product by *Salmonella* as a hazard. The delivery of chocolate crumb had been identified as a CCP and a critical limit of absence in 25 g was set. Batches were tested at the sister factory producing the crumb. Where a batch tested positive, the corrective action was to reject the batch. End product testing at the manufacturer provided the validation for the process. This plan was apparently followed until 2003. After 2003 the testing procedure was changed and the batches were tested for *Salmonella* using a version of the Most Probable Number method. In conjunction with this revision new corrective actions were identified and a new critical limit was set. Under the revised plan, if a batch tested above the new critical limit of <0.5 cfu/g, the batch was retested. If the retest was below <0.5 cfu/g it was assumed that the original test was an error and the batch was used. If the retest was above the critical limit the batch was still used but the end product testing was increased [2].

The revised HACCP plan did not offer as high a level of safety as the original had done. One problem was that the new testing method could be considered unsuitable for use in this context. MPN assumes that the sample can be prepared to allow a random distribution of the test organism, that there will be no clustering of organisms and that one viable cell in any tube will yield a positive result [14]. These assumptions may not apply to chocolate meaning that the test was considered by some to be inappropriate [2]. Further, the interpretation of the results used by the company provided a mean contamination level for a batch rather than the statistical probability which is the appropriate outcome for this test. In an MPN test, the level of contamination is derived from accepted tables which indicate the likely contamination level given the pattern of positive results at three dilution levels. This has a confidence of 95% and the results should be indicated as mpn, not cfu/g [14]. The company carried out the test by taking multiple samples from a batch, averaging the results and apparently expressing them as cfu/g [2]. This made it appear as if there was a very low level of contamination which could have been interpreted as below an infectious dose. In reality it showed that some samples, and therefore the batch, were contaminated with *Salmonella*. It should be noted that published evidence from other outbreaks suggests that in chocolate only a very low level of contamination is required to cause illness, especially in children [7, 10, 16].

8.3 Discussion

The four outbreaks described above each highlight a failure in food safety management. In the first outbreak, there was no system at all and consequently poor control over food safety. The business was in contravention of the existing legislation.

Although HACCP is not the only way to ensure production of safe food, the premises at the centre of the Lanarkshire outbreak did not appear to be using any other controls. Staff appeared to have a poor understanding of normally accepted prescriptive measures such as control of cross contamination using separation and cleaning [5]. These prescriptive measures are themselves based on the same principles of hazard identification and risk assessment that underpin HACCP and without an adequate implementation of one or the other, production of safe food cannot be assured.

In the second, the South Wales outbreak, the HACCP plan was fundamentally flawed, omitting hazards and control measures, as well as lacking required prerequisite programmes. Again the outcome was unsafe food. The reason for the inadequate plan appears to be a poor attitude on the part of the food proprietor. It seems that he did not view the HACCP plan as a crucial part of running his business, but rather as a superfluous exercise to be carried out with minimum effort in order to acquire the license. The same lack of understanding would appear to have been present in the third case involving the small café. It is well known that SME's have particular problems implementing food safety management systems and the UK government has spent substantial amounts of money addressing these barriers. The butcher responsible for the South Wales outbreak and the owner of the café supplying the police had both benefited from initiatives designed especially to assist them in developing food safety management systems. In both cases the proprietors neglected to engage with the process thoroughly. Probably because they did not understand the significance of the controls, they did not address them as diligently as was needed. What all three outbreaks have in common was that the proprietor failed to demonstrate a satisfactory understanding of the inherent dangers associated with food production. This was coupled with a poor attitude to compliance so that the premises did not fully implement the requirements of the existing food safety legislation. A business willing to implement food safety legislation by rote, even if the understanding is limited, can still achieve high standards of control. However, a business that neglects to follow established controls cannot guarantee safety.

The South Wales and *S. aureus* outbreaks also highlight another significant issue and that is the need for public bodies to ensure their own HACCP plans are thorough, rigorous and diligently implemented, especially in the matter of suppliers. Where a business is using the control measure of buying from a reputable supplier to control inherent hazards, the food business operator must have some way to assess whether the supplier actually is reputable and, if so, that this reputation relates to the safety of the food, not just whether deliveries are on time and competitively priced. Where a Food Business Operator uses inspection of delivered goods, including temperature monitoring, to establish the suppliers' standards, there must also be satisfactory corrective actions available for when/if the food is unacceptable. If (as would be normal) this corrective action involves rejecting the delivery, an alternate (safe) food supply or course of action must be available. The South Wales schools were feeding vulnerable children and the consequences of a failure of food safety management in that context could be and sadly, were fatal. A Police Force comprises fit healthy adults who do not usually constitute a vulnerable group.

Thankfully there were no deaths as a result of *S. aureus* outbreak. However, it significantly reduced the number of officers working at the event so the consequence of their failure to ensure a reputable supplier meant a dereliction of duty which resulted in public safety being put at risk.

The contaminated chocolate demonstrates a slightly different issue with regard to HACCP. In this case there was no lack of expertise or of understanding of the principles of HACCP. Indeed the company had been following a perfectly satisfactory plan for several years. Neither was the company dilatory in following their procedures. In this case, the problem was a decision to reset critical limits in a way that reduced the safety standard of the finished product. It highlights the importance of validation when developing a HACCP plan. Is the plan scientifically sound – in other words do the control measures and corrective actions actually control the hazard? Plainly in this example they did not.

Food Safety Management systems such as HACCP comprise a series of steps and processes, each of which must be carried out carefully and accurately. Attention must be given to every point, including implementation of the pre requisite systems upon which a HACCP plan will be based. What the above examples demonstrate is that a failure at any point in the process will compromise the safety of the food produced by the premises. Implementing a food safety management system takes commitment and effort. When these are lacking, or when inappropriate parameters are set, the plan will not guarantee safe food. This is not a flaw in the HACCP process but the manner in which Food Business Operator's choose to implement it.

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Chapter 9
Food Allergies, Intolerances and Food-Borne Intoxications

Faruk Bozoglu

Abstract Food sensitivities include many different types of sensitivities to food which may arise from a wide variety of reasons making it a complex, most of the times confusing and not easily defined area of study. Diagnosis can also be difficult because symptoms may be delayed for up to 2 days after a food has been consumed. In general, food sensitivities are the result of toxic responses to food and are divided into two categories: allergic responses; and food intolerances. Either food allergy, food intolerance or food intoxications affects nearly everyone at some point. When people have an unpleasant reaction to something they ate, they often think that they have an allergy to the food. Actually, only up to 3% of adults and 6–8% of children have clinically proven true allergic reactions to food. For those with food allergies, sensitivities or intolerances, avoiding specific foods and ingredients is an important health challenge. There is increasing evidence that food sensitivities are more common and have a wider and more varied impact on our health than previously realized. Although often equated with food allergies, food sensitivities also include food intolerances which, unlike allergies, are toxic reactions to foods that do not involve the immune system and are often more difficult to diagnose. Many of the symptoms of food sensitivities including vomiting, diarrhea, blood in the stool, eczema, urticaria (hives), skin rashes, wheezing and runny noses, are associated with an allergic reaction to specific foods. However, food sensitivities may also cause fatigue, gas, bloating, mood swings, nervousness, migraines and eating disorders. These symptoms which are more commonly related to food intolerance are less often associated with the consumption of food. Clinical research is accumulating evidence that the sensitivity to food can also increase the severity of the symptoms of rheumatoid arthritis, asthma and other diseases normally not considered food related.

F. Bozoglu (✉)
Department of Food Engineering, Middle East Technical University, Ankara 06531, Turkey
e-mail: bozoglu@metu.edu.tr

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9.1 Introduction

Food sensitivity is an adverse reaction to a food that other people can safely eat, and includes:

- food allergies,
- food intolerances and microbial toxications
- chemical sensitivities.

Food allergy is an abnormal response to a food triggered by your body's immune system. Allergic reactions to food can sometimes cause serious illness and death. Tree nuts and peanuts are the leading causes of deadly allergic reactions called anaphylaxis. There is another collection of symptoms that people report suffer from when they eat certain foods, such as bloating, muscle and joint aches and pains, and tiredness, which are often collectively known as food intolerance. This collection of symptoms is less well defined and poorly understood, and hence is generally much harder to diagnose than classical allergy. Another type of food intolerance is the adverse reaction to certain compounds that are added to food to enhance taste, provide color, or protect against the growth of microorganisms. Consumption of large amounts of these additives can produce symptoms that mimic the entire range of allergic symptoms. Food poisoning is the result of eating food that is contaminated with the toxins produced in the food by microorganisms. Thus, the ingestion of food with microbial toxins can produce symptoms that mimic food allergy.

9.2 Food Allergies

9.2.1 What Is Food Allergy

Allergens are usually proteins, and there are generally several kinds of allergens in each food. It is not fully understood why some foods can cause allergies and others do not, but a theory is that it is probably that some proteins in foods mimic very closely proteins present in viruses and bacteria. Hence, in some persons, usually this is genetically predisposed, their immune system is not able to distinguish the food protein from the virus or bacteria, hence it attacks. Some proteins or fragments of proteins are resistant to digestion and those that are not broken down in the digestive process are tagged by the Immunoglobulin E (IgE). These tags fool the immune system into thinking that the protein is harmful. The IgE acts like a tag, sticking to molecules in food or pollen called allergens. When someone who has an allergy eats a problem food the IgE attaches to the allergens, setting off an allergic reaction. One of the common effects that IgE triggers is the release of histamine, which causes the

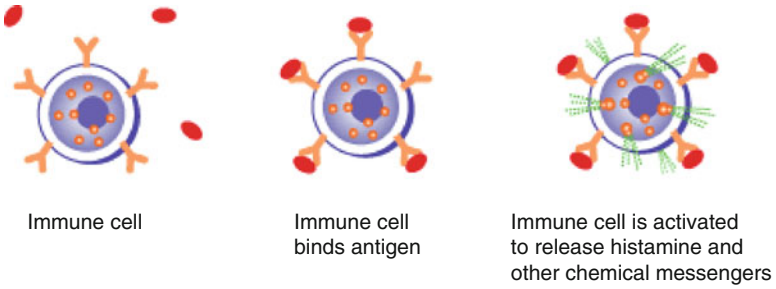

Fig. 9.1 Immune cell bonds antigen and releases chemical messengers, e.g., histamine (www.whfoods.com/genpage.php?tname=faq&dbid=30)

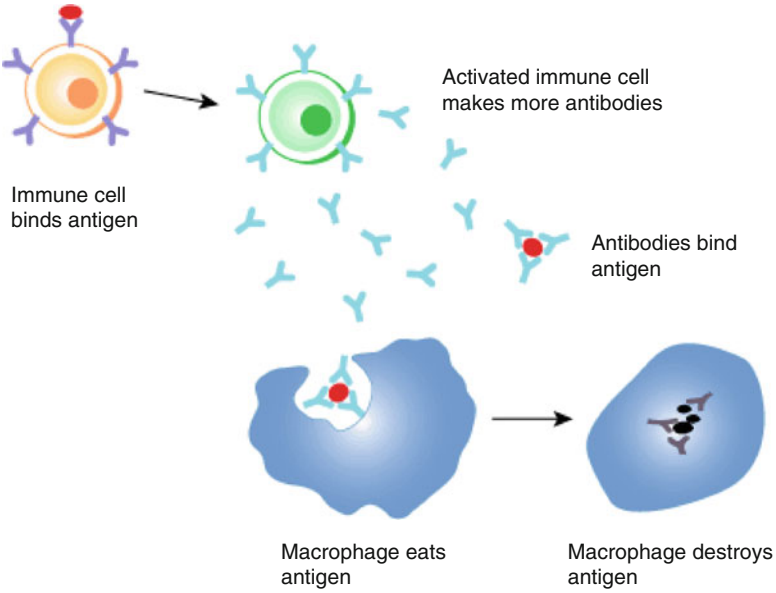

Fig. 9.2 Macrophage cells remove damaging molecules from the body

changes we see in our bodies as symptoms (Fig. 9.1), like nettle rash or wheezing. These reactions can range from mild to severe.

An antibody will only bind one specific antigen. When the antibody binds, or sticks, to the dangerous molecule it is acts like a red flag identifying the molecule as something potentially damaging that should be removed. Macrophage cells are often called the "scavenger" cells of the immune system and are specifically designed to remove damaging molecules from the body. After the antibody binds to a dangerous molecule the macrophages consume the molecule, taking it out of circulation and destroying it (Fig. 9.2).

9.2.1.1 Symptoms of Severe Allergic Reactions

Reactions to foods are usually rapid, appearing within an hour (or sometimes even seconds) of consumption, although in some cases they may be delayed and appear up to 4 h after eating. Skin rashes such as nettle rash (also called urticaria or hives) can appear which are generally short lived, disappearing within a few days. Longer lasting, chronic skin reactions (such as scaly patches) can also be experienced. Some of these longer lasting rashes are called atopic dermatitis. An itchy nose and eyes, sneezing and a runny nose may be experienced, as can asthmatic symptoms, such as wheezing, breathlessness and coughing. These types of symptom are not seen so often with food allergies. Itching and swelling around the lips and mouth may occur on contact with a food. Other symptoms include nausea, cramping pains, bloating, vomiting and diarrhoea.

9.2.1.2 Important Allergic Foods and Their Characteristic Symptoms

Although any food can provoke an immune response in allergic individuals, a few specific foods are responsible for the majority of food allergies.

- peanuts
- tree nuts (almonds, Brazil nuts, cashews, hazelnuts [filberts], macadamia nuts, pecans, pine nuts [pignolias], pistachio nuts, and walnuts)
- sesame seeds
- milk
- eggs
- fish (including shellfish and crustaceans)
- soy
- gluten
- fava beans
- garlic and onion
- mustard

9.2.1.3 Peanuts

Peanuts are the leading cause of severe food allergic reactions, followed by shellfish, fish, tree nuts and eggs. Peanut allergy is common, especially in children. Peanut allergy symptoms can range from a minor irritation to a life-threatening reaction (anaphylaxis). For some people with peanut allergy, even tiny amounts of peanuts can cause a serious reaction [1]. Symptoms of peanut allergy are related to the action of Immunoglobulin E (IgE) and other anaphylatoxins, which act to release histamine. Avoidance of peanuts is very difficult because peanuts are commonly used as an adulterant in the preparation of foods. As many as one-third of peanut-sensitive patients have severe reactions, such as fatal and near-fatal. The only real

way to treat a nut allergy is to avoid peanuts and tree nuts. Avoiding nuts means more than just not eating them [2]. It also means not eating any foods that might contain tree nuts or peanuts as ingredients. New process to make allergen-free peanuts testing showed a 100% deactivation of peanut allergens in whole roasted kernels, and human serums from severely allergic individuals showed no reaction when exposed to the processed peanuts [3].

9.2.1.4 Gluten

A gluten allergy, like any other food allergy, is when body's immune system reacts against gluten (protein), resulting in a number of food allergy symptoms [4]. Specific symptoms, along with the severity of each one, varies from one person to the next. Gluten allergy symptoms may be similar to the symptoms for celiac disease. In either case, management involved avoiding gluten. Still, a test for celiac to rule out this disease is recommend People having gluten allergy, should not need to worry about tiny amounts of gluten in their diet as long as they feel OK. On the other hand, if people have celiac disease, they must eliminate all gluten, even if they feel OK. In the case of allergic responses, symptoms may appear as dermatitis but could also present as difficulty breathing during exercise. In both cases gastrointestinal symptoms may occur. In the case of idiopathic gluten sensitivity all known symptoms are confined to the nervous system. Glutelins have not been characterized over broad taxa. With idiopathic gluten sensitivity, the antibodies that correlate with disease are anti-gliadin antibodies. Whether these antibodies are pathogenic or are simply indicators of circulating gliadin is unknown. The gluten source will need to be declared when a food contains gluten protein or modified gluten protein from barley, oats, rye, triticale or wheat. Gluten-free oats can provide a valuable source of fiber, vitamin B, iron, zinc and complex carbohydrates [5–7].General symptoms can be listed as;

- Upper repository tract problems
- Chronic fatigue syndrome
- Mouth ulcers
- Anaemia
- Osteoporosis
- Weight loss
- Short stature (the natural height of a in an upright position) in children
- Diarrhoea
- Abdominal bloating
- Diverticulitis
- Depression
- Attention and behavioral problems (in children and adults)
- Skin problems
- Asthma
- Irritability

A gluten allergy could appear early in life, and then disappear as the child grows older, or it could appear later in life, either vanishing some years later, or hanging around for the rest of your life.

9.2.1.5 Soy

Soy is one of the so-called "big eight" allergens, and along with milk allergies and egg allergies, it is one of the three allergies children are most likely to outgrow. Most soy allergies are fairly mild and may cause hives (red and sometimes itchy bumps on your skin), nausea, or rhinitis (stuffy nose). Soy rarely causes severe reactions, including breathing difficulty and anaphylaxis. Severe reactions are most likely in people who also have peanut allergies and asthma. Many people with soy allergy can tolerate small to moderate amounts of soy protein: the typical dose needed to induce an allergic response is about 100 times higher than for many other food allergens, with 90% of sufferers being able to tolerate doses up to 400 mg [8]. As a result, not all of those allergic to soy need to avoid very minor sources of soy protein such as soy oil or soy lecithin. Research has been done on soy allergies. Using a "gene silencing" technique, researchers were able to "knock out" a gene that makes a protein called P34, which is thought to trigger most allergic reactions to soy. Tests on blood from people allergic to soy showed no antibody response to the plant with the knocked-out gene, indicating that the allergen could not be detected. Some fermented soy foods such as tempeh, shoyu and miso cause less allergy than whole soybeans, because the fermentation process partly breaks down the proteins.

9.2.1.6 Egg

Egg allergy usually first appears when children are very young, and most outgrow it by the time they are 5 years old. A person who reacts only to a protein in the egg yolk may be able to easily tolerate egg whites, and vice versa. Some people will be allergic to proteins in both the egg white and the egg yolk. Egg yolk allergies may be somewhat more common in adults A small number of people who are allergic to eggs will develop an allergy to chicken or other poultry meats [9]. Every time something made with eggs enters the digestive system of a person with an egg allergy the immune system responds by creating specific antibodies (IgE) to that food that trigger the release of certain chemicals into the body, one of which is histamine. The release of these chemicals can affect the respiratory system, gastrointestinal tract, skin, and the cardiovascular system – causing allergy symptoms like wheezing, nausea, headache, stomachache, and itchy hives. Some research on lysozyme and ovotransferrin suggests that, perhaps, one of the causes of the allergy is from the chelating capacity of the proteins

with metals, especially those of heavy metals [10, 11]. However, little scientific information is available currently on the direct relationships of the heavy metals in hen eggs and egg allergy.

9.2.1.7 Milk

Milk allergy is one of the most common food allergies in children. Almost all infants are fussy at times. But some are excessively fussy because they have an allergy to the protein in cow's milk, which is the basis for most commercial baby formulas. A person of any age can have a milk allergy, but it's more common among infants (about 2–3% of babies), though most outgrow it [12]. Although cow's milk is the usual cause of milk allergy, milk from sheep, goats and buffalo also can cause a reaction. And, some children who are allergic to cow's milk are allergic to soy milk too. A milk allergy usually occurs a few minutes to a few hours after milk is consumed. Signs and symptoms of milk allergy range from mild to severe and can include wheezing, vomiting, hives and digestive problems. Rapid-onset reactions come on suddenly with symptoms that can include irritability, vomiting, wheezing, swelling, hives, other itchy bumps on the skin, and bloody diarrhea. In rare cases, a potentially severe allergic reaction (anaphylaxis) can occur and affect the baby's skin, stomach, breathing, and blood pressure [13]. Anaphylaxis is more common with other food allergies than with milk allergy. Milk allergy is a food allergy, an adverse immune reaction to a food protein that is normally harmless to the non-allergic individual. Milk protein intolerance (MPI) however, is different than the milk allergy. MPI is a delayed reaction to a food protein that is normally harmless to the non-allergic, non-intolerant individual. Milk protein intolerance produces a non-IgE antibody and is not detected by allergy blood tests. Milk protein intolerance produces a range of symptoms very similar to milk allergy symptoms, but can also include blood and/or mucus in the stool.

9.2.1.8 Shellfish

Shellfish allergy is the most common food allergy among adults. About 2% of adults have a shellfish allergy, and 0.1% of children have a shellfish allergy [14, 15]. Unlike many food allergies, shellfish allergy is more likely to develop in adulthood than in early childhood. Shellfish allergies tend to be severe, lifelong food allergies. Shellfish allergies are allergies to two classes of foods: – mollusks (which include clams, mussels, and oysters) and – crustaceans (which include shrimp, lobster, and crabs) [16]. Although these two groups are fairly distant biological relatives, there is a high rate of allergic cross reactivity between the two. So, many people who are allergic to any shellfish are advised to avoid all shellfish.

Shrimp is the considered the most allergenic. The protein that most commonly causes shellfish allergies is the tropomyosin. People who are allergic to one type of crustacean, such as shrimp, are generally allergic to all other crustaceans. If you are allergic to crustaceans, you may or may not be able to eat mollusks such as clams or oysters.

Shellfish allergy symptoms include:

- Hives, itching or eczema
- Swelling of the lips, face, tongue and throat, or other parts of the body
- Wheezing, nasal congestion or trouble breathing
- Abdominal pain, diarrhea, nausea or vomiting
- Dizziness, lightheadedness or fainting
- Tingling in the mouth

A true food allergy such as that to shrimp or crab starts within about 30 min after ingestion. A severe allergic reaction to shellfish called anaphylaxis is rare but can be life-threatening if it interferes with breathing. Not all reactions to seafood are allergies to the seafood protein itself. In fact a parasite called anisakiasis which frequently contaminates seafood is a major cause of gastrointestinal upset that many people interpret as a food allergy. This parasite is killed by deep freezing the shellfish so if you find you can tolerate shrimp that has been frozen but sometimes get sick eating fresh shrimp, it may be the parasite contamination rather than a seafood allergy.

9.2.1.9 Fava Beans

Favism is generally restricted to populations near the Mediterranean Sea or in China. The name favism is sometimes used to refer to the enzyme deficiency as a whole, although this is misleading as not all people with G6PD deficiency will manifest a physically observable reaction to consumption of broad beans [17]. People with G6PD deficiency are therefore at risk of hemolytic anemia in states of oxidative stress. Oxidative stress can result from infection and from chemical exposure to medication and certain foods. Broad beans, e.g., fava beans, contain high levels of vicine, divicine, convicine and isouramil, all of which are oxidants. Some studies claim that it may be a common disorder in American and African Blacks. Males are more affected than females. Infants and young children are more affected than adults. Fatalities are uncommon in adults but not in children. Symptoms result from red cell haemolysis and include nausea, abdominal pain, fever, chills, pallor (a pale color of skin due to reduced amount of oxyhaemoglobin in skin or mucous membrane), shortness of breath and fatigue. Renal failure occurs in the more severe cases. Symptoms appear within 24 h following ingestion of the bean and continue for 2 days. Recovery is usually spontaneous. There is a 10% mortality if not treated properly. People who think that they may have favism can be tested for it. There is a simple blood test which will check a patient's enzyme levels to determine whether or not the patient has favism and how severe the

condition is. If anyone in the family has the condition, they may want to consider testing, since G6PD deficiency is a genetic disordernes. Fava beans are becoming more widely used in many products. Fava beans are now used as flavoring or filling in some packaged products. One should read all package labels when purchasing commercially produced products even when person know the product as recipes are often changed.

9.2.1.10 New Additions

Mustard

European data indicate mustard as the third or fourth most common food allergen in France and mustard is recognized as an allergen by the International Union of Immunological Societies [18]. Mustard is a condiment is prepared from mustard seeds. It is widely used in numerous kinds of seasonings and sauces as well as in other industrial preparations and can often arise as a masked allergen leading to serious allergic reactions. Results from characterization studies of allergenic proteins indicate that proteins in mustard are resistant to degradation by heat and digestive enzymes. The thermostable allergenic proteins in mustard have the potential to be hidden within certain ingredients, preparations and mixtures in processed and pre-packaged foods, with exemptions from individual component declaration. According to the "Prospective Study of Mustard Allergy" published in the journal "Allergy", about 1.1% of children with food allergies are allergic to mustard. Symptoms can include your breathing being difficult, a rash or hives, or itchy skin. The skin can become swollen too as in other allergic reactions. In some severe cases, a reaction to mustard can result in painful, sensitive rashes on the skin of the back or abdomen, stomach cramps and vomiting. In these cases, the reaction is the body's attempt to remove the offending substance or to purge the body of toxins. In rare cases, an allergic reaction to mustard can prompt an anaphylactic response. Anaphylaxis can include dizziness, shortness of breath, difficulty breathing, swollen tongue, rapid heartbeat, dramatic change in blood pressure and fainting.

Onion/Garlic

The scientific literature consider garlic and/or onion as a food allergen. In addition, based on the currently available scientific information, the potential for severe allergic reactions to occur as a result of hidden sources of garlic and/or onion in pre-packaged foods is considered minimal [19]. A 12 kDa protein band to young garlic, garlic, and onion, extracts was detected in a garlic-allergic individual. Reactions to these allergens among allergic individuals range from mild to severe. Trace amounts of these food ingredients can potentially be found in a wide

range of food products including snack foods, health foods, baked goods, seasonings, and many other foods. Trouble breathing, speaking, or swallowing. Allergic symptoms are:

- A drop in blood pressure, rapid heart beat, and/or loss of consciousness
- Flushed face, hives or a rash, or red and itchy skin
- Swelling of the eyes, face, lips, throat, and tongue
- Anxiousness, distress, faintness, paleness, and/or weakness
- Cramps, diarrhea, and/or vomiting

9.3 FOOD Intolerance

9.3.1 What Is Food Intolerance?

Food intolerance is an adverse reaction to some sort of food or food ingredients that occurs every time the food is eaten, but particularly if larger quantities are consumed [20]. This isn't the same as a food allergy, because the immune system isn't activated. Neither is it the same as food poisoning, which is caused by toxic substances that would cause symptoms in anyone who ate the food. While the symptoms of food intolerance vary and can be mistaken for those of a food allergy, food intolerances are more likely to originate in the gastrointestinal system and are usually caused by an inability to digest or absorb certain foods, or components of those foods. Food intolerance occurs when the body is unable to deal with a certain type of foodstuff. This is usually because the body doesn't produce enough of the particular chemical or enzyme that's needed for digestion of that food. Food intolerances are rarely harmful but may cause unpleasant symptoms, including nausea, bloating, abdominal pain and diarrhoea, which can begin hours or days after eating or drinking the food in question. The severity of symptoms varies depending on the amount of enzyme the person makes and how much of the food has been consumed. Reactions to chemical components of the diet are more common than true food allergies. They are caused by various organic chemicals occurring naturally in a wide variety of foods, both of animal and vegetable origin more often than to food additives, preservatives, colourings and flavourings, such as sulfites or dyes. Both natural and artificial ingredients may cause adverse reactions in sensitive people depending on the amount of particular food consumed and the degree of sensitivity varying between individuals.

General Symptoms of food intolerance:

- Nausea
- Stomach pain
- Gas, cramps, or bloating
- Vomiting

- Heartburn
- Diarrhea
- Headaches
- Irritability or nervousness

9.3.2 Lactose Intolerance

About 70% of the world's population just can't drink milk or eat dairy products without getting an upset stomach. Lactose intolerance is genetic, and happens most often in people of African, Asian, and Mediterranean descent [21]. Lactose intolerance is the inability or insufficient ability to digest lactose, a sugar found in milk and milk products. Lactose intolerance is caused by a deficiency of the enzyme lactase, which is produced by the cells lining the small intestine [22]. Lactase breaks down lactose into two simpler forms of sugar called glucose and galactose, which are then absorbed into the bloodstream. Primary lactase deficiency develops over time and begins after about age 2 when the body begins to produce less lactase. Most children who have lactase deficiency do not experience symptoms of lactose intolerance until late adolescence or adulthood. In case of lactase deficiency disaccharides cannot be absorbed, so in the absence of lactase, lactose present in ingested dairy products remains uncleaved in the colon. The operons of enteric bacteria quickly switch over to lactose metabolism, and the resulting in-vivo fermentation produces large amounts of gas (a mixture of hydrogen, carbon dioxide, and methane). This, in turn, may cause a range of abdominal symptoms, including stomach cramps, nausea, bloating, acid reflux and flatulence. Lactose intolerance is not usually an all-or-nothing condition: the reduction in lactase production – and hence, the amount of lactose that can be tolerated – varies from person to person. Since lactose intolerance poses no further threat to a person's health, managing the condition consists of minimizing the occurrence and severity of symptoms. Lactose intolerance may also occurs when small intestine decreases lactase production after an illness, surgery or injury to small intestine. It can occur as a result of intestinal diseases, such as celiac disease, gastroenteritis and an inflammatory bowel disease like Crohn's disease. Treatment of the underlying disorder may restore lactase levels and improve signs and symptoms, though it can take time. Lactose intolerance can be controlled by carefully choosing a diet that limits dairy products [23].

9.3.3 Gluten-Sensitive Enteropathy (Celiac Disease)

Gluten-sensitive enteropathy or, as it is more commonly called, celiac disease, is an autoimmune inflammatory disease of the small intestine that is precipitated by the ingestion of gluten, a component of wheat protein, in genetically susceptible persons. Exclusion of dietary gluten results in healing of the mucosa, resolution of the malabsorptive state,

Table 9.1 Symptoms of Gluten-sensitive enteropathy *and possible causes*

Symptoms	Possible causes
Fatigue, malaise	Anemia, general immune system activation
Weight loss	Nutrient malabsorption
Diarrhea, abdominal pain	Accelerated gastrointestinal tract transit time, steatorrhea, malabsorption
Anemia	Most commonly, iron deficiency; less commonly, vitamin B_{12} and/or folate deficiency
Bone pain	Osteoporosis
Aphthous oral ulcers, glossitis, stomatitis	Vitamin deficiency, "oral" celiac disease
Infertility	Postulated cause: iron, folate, and/or zinc deficiency
Male impotence, decreased libido	Peripheral insensitivity to circulating testosterone
Alopecia areata	Immunologic attack on hair follicles
Dental enamel defects	Demineralization during tooth bud development in children
Hypoglycemia	Delayed absorption of glucose
Gas, flatus, borborygmus	Secondary digestion of sugars by intestinal flora
Seizures, gluten ataxia, central nervous system symptoms	Increased affinity of celiac antibodies for brain vasculature

and reversal of most, if not all, effects of celiac disease. Ingested protein does not normally provoke an immune response. This phenomenon is termed as an oral tolerance. The primary treatment for celiac disease is the removal of gluten and related proteins from the diet [24]. Complete exclusion of dietary gluten generally results in rapid and complete healing of small-bowel inflammation (Table 9.1). Commercial gluten-free products, including breads, cookies, chips, and cereals, that can be used as a rich and interesting diet. Meats, vegetables, fruit, and most dairy products are free of gluten, as long as they have not been contaminated during production [25, 26].

9.4 Chemical Sensitivities

Chemical sensitivities occur when a person has an adverse reaction to chemicals that occur naturally in, or are added to foods. Examples of chemical sensitivities are reactions to:

- caffeine in coffee,
- tyramine in aged cheese,
- histamine and
- some food additives

Tyramine is formed during the aging of protein-rich foods. Foods rich in tyramine (mature cheeses, pickled herring, and meat or yeast extracts) may produce migraines.

Although the reason tyramine causes toxic food responses such as migraines is not clearly understood, research suggests that people suffering from migraines may not adequately neutralize tyramine [27]. While normally neutralized through a detoxification process in the intestine and liver before it is absorbed into the body, tyramine sensitive individuals are believed to have increased amounts of unneutralized tyramine that gets absorbed and circulated to the brain where it may interfere with normal brain functions causing the pain that is experienced as a migraine. Histamine in foods can cause reactions resembling allergy. Histamine can reach high levels in cheese, some wines, and certain fish, particularly tuna and mackerel [28]. In fish, the histamine is believed to stem from bacterial metabolism especially in fish that has not been refrigerated properly. If a person eats a food that contains a high level of histamine, therefore, he may develop histamine toxicity, a response that strongly resembles an allergic reaction to food.

Symptoms:

– Skin flushing, typically on upper half of the body: The flushing may be aggravated by ultraviolet light.
– Headache (severe and throbbing)
– Nausea and vomiting
– Diarrhea
– Abdominal cramps or epigastric pain
– Palpitations
– Dizziness
– Dry mouth
– Respiratory distress and chest tightness (rare)

Another type of food intolerance is the adverse reaction to certain compounds that are added to food to enhance taste, provide color, or protect against the growth of microorganisms (food additives). Consumption of large amounts of these additives can produce symptoms that mimic the entire range of allergic symptoms. The compounds most frequently tied to adverse reactions that can be confused with food allergy are:

- yellow dye number 5 (tartrazine, grape skin extract),
- monosodium glutamate (MSG), and
- sulfites.

Yellow food dye #5 (tartrazine) has been implicated in allergic reactions also and triggering asthma episodes. There has been some research by the FDA to also link it to thyroid tumors. MSG enhances flavor, but when consumed in large amounts, can cause flushing, sensations of warmth, lightheadedness, headache, facial pressure, pain in the chest, and feelings of detachment. These symptoms occur soon after eating large amounts of food containing added MSG and are temporary. Sulfites occur naturally in some foods and are added to others to enhance crispness or prevent the growth of mold. The sulfites emit a gas called sulfur dioxide, which the asthmatic inhales while eating the food containing sulfites. This gas irritates the lungs and can induce in an asthmatic a severe constriction of the air passages to the lungs making breathing very difficult. Sulfites are known to increase asthma symptoms in approximately 5%

of asthmatics, particularly in adults with severe disease. Numerous well-controlled studies show that some asthmatics can have severe asthma symptoms with eating sulfite-containing foods/beverages or inhaling sulfite fumes or vapors. Added sulphites will have to be declared when directly added to a food, or when the total amount of added sulphites contained within the food is 10 parts per million or more.

9.5 Microbial Toxication

Food poisoning is the result of eating food that is contaminated with the toxins produced in the food by microorganisms. Thus, the ingestion of food with microbial toxins can produce symptoms that mimic food allergy.

Common microbes that can cause food poisoning include the:

- *S. aureus* (staph poisoning),
- *B. cereus* (emetic type),
- *C. botulinum* (botulism)

These bacteria produce their toxins in foods during growth.

Common symptoms for food poisoning:

- Diarrhea and vomiting can cause significant amounts of fluid loss, it may be difficult to replace that fluid, leading to dehydration.
- Most cases of food poisoning last about 1–2 days and symptoms resolve on their own.
- However toxins produced by *C. botulinum* has to be taken seriously since botulinum toxin is among the most deadly neurotoxins causing the fatal toxication Botulism. Minute doses of the toxin can be fatal and, “a single gram of crystalline toxin, evenly dispersed and inhaled, would kill more than one million people”.

9.6 Labelling as a Precaution to Minimize the Risk of Food Allergies

The *Food and Drug Regulations* require that most prepackaged foods carry a label and that the ingredients appear on labels in decreasing order of proportion. However, some ingredients used in food products are currently exempt from declaration in the list of ingredients, *e.g.*, components of margarine, seasoning and flour. Also these regulations do not currently require components (i.e. ingredients of ingredients) of certain foods and products, such as flavouring, seasoning, spices and vinegar, to be listed on food labels.

National food regulatory agencies must use advises of the Codex Alimentarius Commission on food additives and other chemicals and ingredients in food to

build on the Codex list and develop their own lists of priority foods that should be targeted for mandatory labelling on foods available for sale in the country or region under their oversight. Precautionary labelling, however, must be truthful and must not be used in lieu of adherence to legal requirements. When an allergen is likely to be present in a product, the use of precautionary labelling is not acceptable and the presence of the allergenic ingredient should be accurately declared on the label.

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Chapter 10
U.S. Government Efforts to Build Global Food Defense Capacity

Julia C. Guenther, Kelly J. McCormick, and Cory M. Bryant

Abstract Today's world is smaller and everything, including food, is shared amongst people in many countries. With the increase of international trade and the growing food import and export industry, it is even more important that we all take measures to ensure that the food we consume is safe from contamination – both unintentional and intentional. The chapter summarizes the U.S. Government's efforts to build global food defense capacity through cooperation and collaboration with international partners.

Keywords Food defense • Intentional contamination • Capacity building

10.1 Introduction

Food defense is the effort to prevent intentional contamination of the food supply. This differs from food safety, which is the effort to prevent unintentional contamination of food products by agents that are reasonably likely to occur in the food supply (e.g., E. coli, Salmonella, Listeria). The protecting of food against intentional contamination is also sometimes referred to as "food security." However, the term "food security" is generally used to mean "when all people at all times have access to

J.C. Guenther (✉) • C.M. Bryant
U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Food Defense, Communications and Emergency Response, Food Defense Oversight Team, College Park, MD, USA
e-mail: julia.guenther@fda.hhs.gov; cory.bryant@fda.hhs.gov

K.J. McCormick
U.S. Department of Agriculture, Foreign Agricultural Service, Office of Capacity Building and Development, Food Safety Team, Washington, DC, USA
e-mail: kelly.mccormick@fas.usda.gov

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sufficient, safe, nutritious food to maintain a healthy and active life," as defined by the World Health Organization (WHO). Another terminology that is used often is "food protection," which can mean the general protection of food supply and encompasses both food safety and food defense.

In the years since the attacks on the United States on September 11, 2001, there has been some intelligence that terrorists have discussed contaminating the food supply. However, food defense goes beyond protecting against foreign terrorism. The threat of intentional contamination could be from a number of other individuals and sources, including disgruntled employees, domestic terrorists/activist organizations, economic adulteration, and counterfeiting/diversion/tampering. Intentional contamination of the food supply could cause significant public health consequences, widespread public fear, devastating economic impacts, disruption of trade, and loss of public confidence in the safety of food and the effectiveness of government.

This contribution provides information about the previous and ongoing efforts of the U.S. Government to build global food defense capacity through outreach, collaboration, and coordination with other countries.

10.1.1 United States Government Agencies

Food defense efforts in the U.S. Government are the shared responsibility of many federal agencies. This section includes short descriptions of the mission of each of these agencies, the office within the agency that oversees food defense, and some of their ongoing contributions toward building global food defense capacity.

10.1.1.1 U.S. Department of Health and Human Services, Food and Drug Administration (FDA)

The U.S. FDA is responsible for protecting the public health by assuring the safety, effectiveness, and security of human and veterinary drugs, vaccines and other biological products, medical devices, our nation's food supply, cosmetics, dietary supplements, and products that give off radiation. The FDA regulates approximately 80% of the food consumed in the U.S., with the exception of most meats and poultry products, which are regulated by the U.S. Department of Agriculture.

Within the FDA, the Center for Food Safety and Applied Nutrition (CFSAN) provides services to consumers, domestic and foreign industry and other outside groups regarding field programs; agency administrative tasks; scientific analysis and support; and policy, planning and handling of critical issues related to food and cosmetics. The Food Defense Oversight Team in CFSAN oversees food defense activities of the Agency, developing and implementing procedures to prepare for, respond to, and recover from intentional contamination affecting the FDA regulated food industry with the emphasis on prevention. FDOT is

responsible for data collection and analysis, policy development and outreach efforts in food defense, including international outreach and awareness. FDA has been the lead agency within the U.S. government on the efforts to build global food defense capacity.

10.1.1.2 U.S. Department of Agriculture, Foreign Agricultural Service (FAS)

The Foreign Agricultural Service (FAS) links U.S. agriculture to the world to enhance export opportunities and global food security. Their efforts help build market-driven institutions and science-based regulatory frameworks that facilitate trade and create an environment conducive to agricultural growth. FAS also partners with the U.S. Agency for International Development to administer U.S. food aid programs, helping people in need around the world. FAS's non-emergency food aid programs help meet recipients' nutritional needs and also support agricultural development and education. These food assistance programs, combined with trade capacity building efforts, support long-term economic development and help countries make the transition from aid recipient to commercial buyer.

Within FAS, the Office of Capacity Building and Development/Trade and Scientific Capacity Building Division's Food Safety Team works on international food safety and defense issues and coordinates international outreach efforts with the FDA and USDA/FSIS.

10.1.1.3 U.S. Department of Agriculture, Food Safety and Inspection Service (FSIS)

The Food Safety and Inspection Service is the health agency in the U.S. Department of Agriculture responsible for ensuring that the nation's commercial supply of meat, poultry, and egg products is safe, wholesome, and correctly labelled and packaged. Within FSIS, the Office of Data Integration and Food Protection, Food Defense Assessment Staff works on food defense issues both domestically and internationally.

10.1.1.4 U.S. Department of State

Within the Executive Branch of the U.S. government, the U.S. Department of State is the lead U.S. foreign affairs agency and the Secretary of State is the President's principal foreign policy advisor. The State Department's mission statement is: "Advance freedom for the benefit of the American people and the international community by helping to build and sustain a more democratic, secure, and prosperous world composed of well-governed states that respond to the needs of their people, reduce widespread poverty, and act responsibly within the international system."

The State Department provides policy advice, and diplomatic and financial support to its partner federal agencies on the international food defense efforts. Specifically, the Office of Economic Policy, Bureau of East Asian and Pacific Affairs sponsors a number of the outreach efforts on food defense, including the Asia Pacific Economic Cooperation (APEC) Food Defense Pilot Program.

10.1.2 Asia Pacific Economic Cooperation (APEC)

The Asia Pacific Economic Cooperation (APEC) consists of 21 member economies that account for approximately 40.5% of the world's population, approximately 54.2% of world GDP and about 43.7% of world trade. APEC's primary goal is to support sustainable economic growth and prosperity in the Asia-Pacific region. APEC also works to create an environment for the safe and efficient movement of goods, services and people across borders in the region through policy alignment and economic and technical cooperation.[1]

The 21 member economies that make up APEC include:

Australia	Mexico
Brunei Darussalam	New Zealand
Canada	Papua New Guinea
Chile	Peru
People's Republic of China	Philippines
Hong Kong	Russia
Indonesia	Singapore
Japan	Chinese Taipei
Republic of Korea	Thailand
Malaysia	United States
	Vietnam

10.2 Food Defense Overview

Food defense is the effort to prevent intentional contamination of the food supply. While intentional contamination is typically thought of as only a foreign terrorist threat, there are other threats to intentional contamination, including disgruntled employees, domestic terrorists/activist organizations, economic adulteration, and counterfeiting/diversion/tampering. Intentional contamination could potentially occur at any point of the farm-to-table continuum. Within a food facility, anyone

[1] Information on APEC obtained from http://www.apec.org

who has access to the facility could potentially introduce an agent to contaminate the food. This includes disgruntled employees, cleaning crew, temporary employees, members of an extremist group posing as an employee, suppliers, truck drivers, visitors, organized extremist or activist groups, or even visitors to the facility. The contaminants that could be used in an intentional contamination incident are numerous and are not well studied in foods. Contaminants used to deliberately cause harm can be biological, chemical, radiological, or even physical.

Historically, there have been few reported cases of intentional contamination targeted at the general public. In 1984, members of the Rajneeshee cult poisoned salad bars with salmonella at a number of restaurants in Oregon in an attempt to prevent people from voting in local elections so that their candidates could win. Seven hundred and fifty one people became ill from the salmonella and of those 45 were hospitalized. In 2001, a man in New York City was arrested for spraying a liquid believed to be a mixture of his own feces and urine onto an open salad bar. He was also charged with spraying a substance on the counter of a sandwich shop in Grand Central Terminal in New York City. In 2002, a disgruntled supermarket employee laced about 200 lb of ground beef with insecticide, which contained high level of nicotine, sickening more than 40 people. In 2008, economic adulteration involving the use of melamine in pet food coming from China and infant formula sold in China caused an FDA investigation. There were no reported illnesses in the U.S. due to the melamine, but in China, at least six children died and more than 290,000 were made ill from the contaminated milk.[2]

Even the threat of intentional contamination could pose serious problems for public health and have significant impact on the international economy. In 1989 a threat of cyanide in seedless red grapes being imported into the U.S. from Chile caused widespread scare and led to a ban of Chilean food exports. Although just two grapes were found to have been injected with cyanide, this incident cost Chile approximately $300 million USD in lost revenue.

The examples above are only a few of the known cases of intentional contamination. Although these incidents affected a relatively small number of people within a centralized area, the impact of an intentional contamination incident has the potential to be widespread, to include crossing country borders. Not only would an incident affect public health, it may have varying impacts on the company, industry, or even the country's economy.

Currently in the U.S. most activities related to food defense are voluntary. However, the Food Safety Modernization Act (FSMA), which was signed into law in January 2011 includes requirements for protecting against intentional contamination for both domestic and foreign facilities importing food into the United States. FDA is currently working on developing regulations to promulgate the intentional

[2] "Food Defence Incidents 1950–2008" Centre of Excellence for National Security, S. Rajaratnam School of International Studies, Nanyang Technological University, Singapore.

contamination and other requirements within FSMA. All proposed and final regulations for the U.S. Government are available for public review and comment on http://www.regulations.gov.

10.2.1 Tools and Resources

Prior to the new FSMA requirements for food defense, FDA had made available written guidance documents as well as tools and resources to help the industry identify and mitigate against potential vulnerabilities to intentional contamination. These tools include the ALERT and Employees FIRST educational tools, CARVER + Shock software, and the Mitigations Strategies Database.

10.2.1.1 Food Defense Guidance

In March 2003, the FDA issued guidance for industry on Food Security and Preventive Measures. FDA has made available five guidance documents for (1) Importers and Filers, (2) Food Producers, Processors, and Transporters; (3) Dairy Farms, Bulk Milk Transfer Stations and Fluid Milk Processors, (4) Retail Food Stores and Food Service Establishments, and (5) Cosmetic Processors and Transporters. These guidance documents serve only as recommendations for best practices in food defense and were revised in October 2008 to include a Self Assessment checklist that guides the user through an assessment of recommended preventive measures to identify those applicable to the given facility. They identified preventive measures that the specific establishments can take to minimize the risk that food under their control will be subject to intentional tampering or other malicious, criminal or terrorist actions. The documents set out goals in this regard and provide example strategies for achieving those goals.

10.2.1.2 ALERT

The ALERT initiative is an education program intended to raise the awareness of state and local government agency and industry representatives regarding food defense issues and preparedness. It is meant to apply to all aspects of the farm-to-table supply chain and is designed to spark thought and discussion with a variety of stakeholders. ALERT identifies five key points that industry and businesses can use to decrease the risk of intentional food contamination at their facility: (1) How do you ASSURE that the supplies and ingredients you use are from safe and secure sources? (2) How do you LOOK after the security of the products and ingredients in your facility? (3) What do you know about your EMPLOYEES and people coming in and out of your facility? (4) Could you provide REPORTS about the security of your products while under your control? (5) What do you do and who do you notify if you have a THREAT or issue at your facility, including suspicious behavior?

10.2.1.3 Employees FIRST

The Employees FIRST educational tool is a food defense awareness training program for front-line food industry workers about the risk of intentional contamination and the actions they can take to identify and reduce these risks. FIRST teaches an employee to: (1) Follow company food defense plan and procedures. (2) Inspect your work area and surrounding areas. (3) Recognize anything out of the ordinary. (4) Secure all ingredients, supplies, and finished product. (5) Tell management if you notice anything unusual or suspicious.

10.2.1.4 CARVER + Shock

In 2005, FDA developed and launched the manufacturer module of CARVER + Shock, a risk assessment and prioritization software tool to assist users with conducting vulnerability assessments on their facilities by determining the "critical nodes" that are the vulnerable targets for terrorist attacks. Based on the vulnerabilities identified, CARVER + Shock then assists users to identify mitigation strategies that may reduce the risk of intentional contamination at their facility. By conducting a CARVER + Shock assessment of a food production facility or process, the user can focus resources on protecting the most susceptible points in their system.

In 2009 FDA launched the agriculture module of CARVER + Shock for farms and FDA is currently working on the third module for CARVER that covers retail establishments. This software program guides users through a series of questions to determine how vulnerable each of the nodes is within their process. CARVER is an acronym for the following six attributes used to evaluate the attractiveness of a target for attack: (1) Criticality – measure of public health and economic impacts of an attack, (2) Accessibility – ability to physically access and egress from targets undetected, (3) Recuperability – ability of system to recover from an attack, (4) Vulnerability – ease of accomplishing attack, (5) Effect – amount of direct loss from an attack as measured by loss in production, and (6) Recognizability – ease of identifying target. A seventh attribute, Shock, has been added to the original six to assess the combined health, economic and psychological impacts of an attack within the food supply.

10.2.1.5 Mitigation Strategies Database (MSD)

In March 2011, FDA launched the Mitigation Strategies Database (MSD), an online database of mitigation strategies searchable by key words, processing points (also known as "nodes") that are commonly used within the agriculture and commercial/retail food industries (i.e. harvesting, production, distribution). Mitigation strategies may be implemented all along the food production process, from basic agriculture, to food processing, distribution, and retail. MSD contains a range of preventative measures for industry to consider.

All these tools and resources can be downloaded at the FDA website at http://www.fda.gov/fooddefense.

10.3 APEC Food Defense Principles

In 2006, APEC Leaders and Ministers welcomed new initiatives to mitigate the terrorist threat to the APEC food supply. They encouraged Member Economies to further share strategies and develop best practices to defend the food supply from deliberate contamination. The APEC Counter-Terrorism Task Force (CTTF) has advanced this goal through workshops that engage experts from the public and private sector. In 2007, APEC economies identified the following voluntary principles for continued cooperation on food defense.

1. The food supply should be protected from intentional contamination at all points in the supply chain from farm to table to protect public health, commerce, and the potential shock to each economy.
2. Food defense is distinct from but related to food safety and often depends on building on a strong food safety foundation.
3. Food defense is a shared responsibility within each economy. Effective food defense requires cooperation among relevant agencies and industry to protect human, animal, or plant life from any potential threat of intentional contamination.
4. Effective food defense requires timely and accurate communication among stakeholders within an economy and as appropriate, among regional and international organizations.
5. Food defense awareness should be engendered within all stakeholders to successfully prevent, prepare for, detect, respond to, and recover from incidents of intentional contamination of the food supply.
6. Food defense is built upon four major activities – prevention, preparedness, response, and recovery.
7. To manage food defense emergencies effectively requires economies to have food defense awareness, appropriate capacity, and supporting infrastructure.
8. Food defense measures applied to mitigate intentional contamination should be consistent with the risk profile and vulnerability assessed by each economy.
9. Effective food defense program development and implementation involves a process that takes into account risk assessment, risk management, and risk communication with all stakeholders.

10.4 APEC Food Defense Pilot Program

10.4.1 Overview

Beginning in 2008, under the auspices of the Asia-Pacific Economic Cooperation (APEC), the U.S. Food and Drug Administration's (FDA), Food Defense Oversight Team (FDOT) collaborated with the U.S. Department of State, U.S. Department of Agriculture's (USDA) Foreign Agricultural Service (FAS) and Food Safety

Inspection Service to launch the Food Defense Pilot Program for the APEC member economies. Representatives from each of these U.S. Government agencies as well as U.S. industry consultant make up the U.S. Food Defense Expert Team. The Pilot Program was developed with the intent to implement the food defense principles endorsed by the APEC Counter Terrorism Task Force (CTTF) the prior year. The goal of the pilot program is to build and foster global capacity to prevent and protect against deliberate tampering and intentional contamination of the food supply through information sharing, outreach, and technical assistance on food defense, thereby safeguarding food trade and public health across the APEC member economies.

The overall objective of the pilot program is to institutionalize food defense measures and encourage their recognition globally to prevent incidents which would otherwise have severe and negative social, economic, and public health implications. General food defense efforts help build vital relationships to enhance food supply chain security, protect consumers and businesses against intentional contamination, and facilitate food defense collaboration. The pilot program supports these efforts by engaging appropriate government officials and private sector stakeholders in informational briefings/seminars and practical training in vulnerability assessments, mitigations development/implementation, and food defense planning.

Food defense measures covered during the international outreach include: (1) educational tools to facilitate food defense awareness in the workplace; (2) identification of vulnerable points in food processes/systems; (3) development and implementation of mitigation strategies to reduce the vulnerabilities identified; and (4) creation and implementation of food defense plans to support prevention efforts and provide food sector entities with a response plan should an act of intentional contamination occur.

10.4.2 Three Phases

The APEC Food Defense Pilot Program consists of three phases:

- Phase One – an assessment visit to gauge the food defense climate in the given economy and to establish relationships to ensure sustainability;
- Phase Two – workshops, complete with a preceding training element for workshop facilitators, to raise awareness of food defense and provide technical expertise on identifying vulnerable areas and the development of food defense plans, with focus on low-cost, no-cost strategies; and
- Phase Three – private sector expert consultants providing individual food defense plan development guidance to volunteer companies.

While the three phases of the pilot program are similar in structure, each program is tailored to the particular conditions in the individual pilot economy.

10.4.2.1 Phase I

During Phase I, representatives of the U.S. expert team travel to the pilot economy and meet with representatives from the pilot economy's government, industry, and academia. The objectives of these meetings are to gauge the food defense climate in the given economy, to develop relationships to build sustainability, and to garner interest and participation in the second and third phases. Some pilot economies use this opportunity to present their perspective on food defense and provide examples in the food industry. Based on the discussions and meetings during Phase I, the U.S. Food Defense Expert Team and the pilot economy identify host instructions for the Phase II food defense facilitator training and awareness workshops. They also work together to draft a list of potential individuals or groups who will be invited to participate in the Phase II workshops.

10.4.2.2 Phase II

Phase II consists of a facilitator training workshop where the U.S. Food Defense Expert Team provide a 1 day workshop to key government, industry, and university participants who will then serve as facilitators in the larger food defense awareness workshop. The facilitators are often individuals who have been identified as having expertise in the food industry and who can effectively lead smaller groups in food defense exercises during the awareness workshop.

During the 2-day food defense awareness workshop of Phase II, the U.S. Food Defense Expert Team presents an overview and global importance of food defense, the potential impacts of intentional contamination on the food supply, and an industry perspective. Often the pilot economy will also present their perspective on food defense, to include any government regulations or industry standards on food defense, if applicable.

The crux of the Phase II awareness workshop is a series of Food Defense Plan. During these exercises, participants are guided through a list of questions regarding the preventive measure in their facilities. These preventive measures cover areas such as outside security, inside security, utilities, laboratories, storage security, incoming shipments, processing, and personnel. For each preventive measure, participants must choose whether their facility already has the measure in place, if the measure is not applicable to their facility, or if the measure is something that should be addressed and there is a gap. If a gap is identified, participants will then determine whether the measure is practical, and if so, what action steps are needed to close the gap.

Next, participants conduct an abbreviated vulnerability assessment by drawing out a process flow of their facility and scoring each process step on accessibility and vulnerability. Accessibility scores are based on the question "Can I get to the target?" and the Vulnerability score asks "Once I get to the target, can I contaminate the product?" Similar to the CARVER + Shock vulnerability assessment, participants score each process step on a scale of 1–10, with 10 being highly vulnerable or

highly accessible. Once each process is scored for vulnerability and accessibility, participants then add up both scores for each process step to determine the ones that are high priority or critical. Then participants look through the list of mitigation strategies to identify which strategies they can be implemented to protect against those high priority and critical process steps.

At the end of the Food Defense Plan exercise in Phase II, participants have the basis for a food defense plan, which includes identification of preventive measure gaps, vulnerable and accessible process nodes, and mitigation strategies to protect the facility against intentional contamination. One of the key goals of the exercise is to demonstrate that developing and implementing a food defense plan can be done simply by thinking through potential weak points, and following steps to organize a preventive approach.

10.4.2.3 Phase III

Following the food defense awareness workshops, U.S. industry experts provide individualized food defense plan technical assistance and guidance to volunteer companies. At the end of the technical assistance session, the volunteer company will have a completed food defense plan tailored to their operation that they can implement and revise as necessary.

10.4.3 Benefits and Results

The APEC Food Defense Pilot Program was first implemented in Peru (2008) and Thailand (2009), reaching approximately 80 participants in Peru and over 300 in Thailand. In both countries, the majority of companies who participated in the Phase Two and Three workshops either have implemented or intend to implement food defense plans. University partners in Peru and Thailand have integrated food defense technical information into undergraduate, graduate, post-graduate, and continuing education program curricula as a result of the pilot projects. Additionally, the status of the program was reported at the APEC CTTF meeting in July 2009 in Singapore by representatives of the U.S. Department of State, FDA, and the Peruvian and Thai pilot projects. Based on the support shown at the APEC Senior Officials Meeting 2 and the overwhelming success and acceptance of the pilots in Peru and Thailand, the APEC Food Defense Pilot Program is continuing and refining the single-economy pilot approach in two additional economies: Vietnam (2010–2011) and the Philippines (2011).

In August 2010, a Collaborative Exchange Workshop elaborated further on the accomplishments of the APEC Food Defense Pilot Program. The University of Minnesota's National Center for Food Protection and Defense (a U.S. Department of Homeland Security Center of Excellence and leader in U.S. food defense education) was selected to serve as the host of the program. Five representatives from

academia and seven industry representatives from Peru and Thailand were selected to receive advanced technical information in order to better facilitate educational programs, vulnerability assessments, and food defense planning efforts in their home countries and regions. During the workshop, participants visited the Minnesota Department of Agriculture (MDA), a liquid egg processor, and a commercial bakery, which were viewed as highlights of the program. In addition to the site visits, participants spent time in didactic sessions that included presentations on risk communication, consumer confidence, cleaning and sanitation, food defense vulnerability assessment tools, and legal issues. The program culminated with participant presentations on food defense efforts and plans for future food defense measure engagement, for which there was great enthusiasm expressed. It is evident from participant evaluations received that this program served to solidify the institutionalization of food defense technical experts in Peru and Thailand.

As the pilot program continues to reach additional member economies, interested facilitators from the pilot economies will also work together to develop an APEC-specific set of food defense documentation, guidance, and educational materials. These four pilots (Peru, Thailand, Vietnam, and the Philippines) will culminate in an APEC regional event, wherein food defense awareness course materials will be delivered and expertise provided by facilitators from the economy-specific pilot projects. This regional workshop will take the facilitator training element integrated in the individual pilot projects to the next level, creating a regionally sustainable information-sharing system among all the APEC member economies.

FDA and FAS is continuing the Collaborative Exchange Workshop in 2011. Key participants from the Philippines and Vietnam will be invited to attend thereby furthering efforts to establish economies of food defense expertise within the APEC economies. In addition, a regulatory collaborative exchange workshop is being coordinated for 2011 to engage government officials from the Food Defense Pilot Program host economies. These types of events go a long way toward building relationships between U.S. and foreign experts, and will lend strength toward the establishment of centers and programs in their respective countries that will ensure sustainability of food defense technical expertise and support.

10.5 Other International Activities

In addition to the APEC Food Defense Pilot Program, the U.S. Government has provided technical assistance in food defense to a number of countries. Specifically, the FDA was invited to present a workshop on food defense infrastructure for the Middle East Partnership (MEPI) countries in Cairo, Egypt in 2008. FDA also conducted food defense workshops in the Caribbean Basin and Panama in 2009 and additional workshops in Peru, Panama, and Egypt in 2010.

Building from the success of the APEC Food Defense Pilot Program and the technical assistance workshops and in an effort to support the capacity building goals of the Food Safety Modernization Act (FSMA), the FDA is engaging in

additional international activities and opportunities for food defense collaboration. One of the main objectives of the upcoming food defense international activities is to support the FDA and USDA posts around the world.

Ultimately, we seek to institutionalize food defense measures and encourage their recognition globally to prevent incidents which would otherwise have severe and negative social, economic, and public health implications.

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Chapter 11
Risk Perception, Communication and Food Safety

Lynn J. Frewer

Abstract Developing an effective communication strategy about different food hazards depends not only on technical risk assessments (for example related to health or the environment) but must also take into account consumer perceptions and preferences. In addition, consumers make decisions about food choices or the acceptability of food processing technologies based on their assessment of both risks and benefits, which may include those related to socio-economic or ethical factors. Perceptions and priorities may vary both regionally and within the human life cycle. For example, health is a consumer priority, although the predominant issues of concern vary considerably according to local conditions. In Western and (in some sectors of) emerging economies, obesity continues to represent an important determinant of health. In addition, the ageing population in many countries means that diet may be linked to the development of healthy ageing trajectories, in particular associated with ensuring optimal quality of life through the entirety of the human life cycle. In other regions food security is a priority. Developing effective risk communication about food safety issues requires understanding of consumer perceptions, needs and behaviours and how these vary between different consumers. Risk (benefit) communication is likely to be most effective when targeted at specific groups of consumers with similar needs and interests. Understanding how individuals differ in, for example, their food safety information needs and preferences, how different individuals process food-related risk (and benefit) information, and how these may vary according to psychological and other individual differences will help risk communicators in developing and communicating their messages.

L.J. Frewer (✉)
Food and Society Centre for Rural Economy, School of Agriculture, Food and Rural Development, Newcastle University, Agriculture Building, Newcastle upon Tyne NE1 7RU, UK

MCB Group, Social Sciences, Wageningen University, Hollandseweg 1, 6706KN Wageningen, The Netherlands
e-mail: Lynn.Frewer@newcastle.ac.uk

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11.1 Introduction

Risk (benefit) perception and communication about food safety is complex, and dependent on both the severity of the risk should it occur, and consumer responses to the specific hazard under consideration. In addition, the area of food safety includes a broad range of different issues including (for example) microbial contamination of food, (for potential food hazards, extending through the entire food chain. For example, in the domestic environment), optimisation of nutrition and consumer food choices, and developing effective communication about the risks and benefits of food processing technologies such as genetic modification of food crops and (more recently) nanotechnology applied to food production. In addition, food choice is an important for all consumers. On one hand, food choices are representative of that class of behaviours which are frequently repeated by consumers and can be described as habitual [18]. However, consumers may also be suspicious of new foods which are outside of their experience or produced using novel technologies, a phenomenon known as food neophobia [13]. Communication about food safety may involve communication about both risks and benefits associated with consumption of a specific food product, for example related to its simultaneous potential for negative and positive health effects, and the impacts of these risks and benefits may also vary across the population as well as being be associated with different degrees of uncertainty [17]. Food choice is also heavily influenced by context, cultural and lifestyle factors, potentially influencing an individual's experience of their quality of life form both a health and societal perspective.

11.2 Emerging Issues in the Agrifood Sector

Consumer health is an obvious consumer priority related to health, although the predominant issues of concern vary considerably according to local conditions. For example, in Western and (in some sectors of) emerging economies, obesity continues to represent an important determinant of health, In addition, the ageing population in many countries means that diet may be linked to the development of healthy ageing trajectories, in particular associated with ensuring optimal quality of life through the entirety of the human life cycle. The development of functional foods and ingredients, and nutrigenomic applications (where optimal diets are tailored to individuals' genetic requirements) may deliver important benefits in terms of human health, but may also be rejected by some consumers on the basis of rejection of specific processing technologies being utilized in their application, or on the grounds of cost [12]. In the developing world, food security and the adequacy of basic nutrition remain important issues. Linked to this are issues related to food safety. For example, consumer and worker behavior related to food preparation

remains an important issue, as how foods are prepared may directly influence their safety. In addition, food safety objectives are often set at point of consumption. Adopting a total food chain approach (incorporating activities from the primary producer through to consumer behavior) becomes more complex in the globalizing food economy. The increasingly complex food chain (or food web) also increases difficulties associated with emerging risk identification, mitigation and prevention, given increased movement of plants, animals and foods. Globalisation results in lengthening food chains, increasing the opportunity for contamination of foods, for example, the introduction of allergens, fraudulent application of production processes (GMOs, organic production), and the need to develop more effective approaches to food recalls and crisis management should an incident occur. At the same time, improved sustainability of food production will require more efficient production at the global level, together with reduced consumer wastage. A tension may arise between Food safety consumer health, sustainability and other agri-production issues (for example, the use of agricultural land to produce biofuels, or novel production technologies applied to the production of meat substitutes).

11.3 Food-Related Risk (Benefit) Perception

As has been the case in with research in other risk "domains", research into risk perception in the area of food safety initially focused on understanding why lay peoples risk perceptions differed from "expert" risk assessments. In terms of perception, the extent to which a potential food risk is perceived to be *unnatural,* or *potentially catastrophic*, or to which an individual perceives exposure to be *involuntary*, increases peoples' risk perceptions. These psychological dimensions are reliable predictors of people's responses to potential risks associated with different foods, and have been shown to systematically vary across different types of food hazards (for example, see [3]). In addition, individual differences in consumer perceptions of, and responses to, food hazards, and communication about the associated risks, has also been a focus of empirical investigation. For example, risk perceptions, food safety related behaviours, consumer responses to food safety "incidents", and consumer use of information depend on the consumers own personality characteristics as well as other hazard–related variables [5].

Other psychological factors influence consumer risk perceptions. For example, some consumers appear to be especially *neophobic* in terms of their reactions to novel foods (e.g., [13]). Neophobia may represent a human response which evolved in order to protect people from consuming potentially toxic new foods. Neophobia is generally greater for older people, and reduces as educational level increases

The 'locus of control' is a measure of attribution of control of external events which potentially affect people's health status. A high *internal* locus of control reflects an individual's belief that they can have personal control over important life-events. A high *external* locus of control reflects an individual's belief that external events control various life events, and reflects a 'fatalistic' interpretation of

life [9]. Individuals with a high internal food-related health locus of control are more likely to change their food-related behaviours in order to protect themselves against potential food risks, with the result that they are also more likely to attend to food risk communication messages.

Another relevant psychological phenomenon is that of *optimistic bias* or unreal optimism [19]. Optimistic bias refers to an individual's judgment that negative events are less likely to happen to the person making the judgement in comparison to the risks experienced by an average member of society other people This is because people personally believe that they are at low personal risk from the hazard and that 'bad things happen to other people'. Optimistic bias has been observed for a range of food related hazards, but tends to be more pronounced for that which can be described as 'lifestyle' related as opposed to 'technological' in origin [6]. For example, in the case of saturated fat consumption, people justify their lower than average personal risk ratings by attributing higher perceived personal control over risk exposure to the hazard, together with increased perceived personal knowledge about the effects of saturated fat consumption on health. As a consequence, it may be difficult to motivate consumers to reduce their fat intake since they perceive that information is directed towards more vulnerable and less knowledgeable members of society.

Research into consumer attitudes to emerging food technologies, such as genetically modified foods, food irradiation, or highly technological food processing practices (see, for example, [1, 8]) has demonstrated that consumer attitudes towards these technologies, and the products of these technologies, do not only include evaluations of the potential personal benefits and health effects, but also take account of moral concerns and beliefs such as *ethical and moral* considerations, and *values* such as *concern about the integrity of nature*. The extent to which a specific food technology has potential for unintended bioactive effects may also reduce consumer acceptance. The public perception that institutions and industries introduced genetically modified foods in order to protect their own vested economic interests rather than to support societal benefits did little to alleviate societal concerns [7]. Emerging technologies applied to food production (for example, nanotechnology), may give rise to other public concerns under conditions of increased complexities and uncertainties regarding both risks and benefits associated with these novel food production processes, and food products produced by such processes. Both risk and benefit perceptions need to be considered in the design of optimal communication about foods.

Very generally, perceived risk and perceived benefit have consistently been found to be negatively correlated This would imply that perceived high levels of risk are only acceptable when they are offset by high perceived levels of benefit Slovic et al. [11] report that perceived risk is reduced when the public trust expert knowledge, regulators and risk managers in being able to control risks. More recent studies indicated that other dimensions of trust, such as perceived honesty and care for public welfare of different actors, might overrule perceived competence in influencing risk perceptions and attitudes [16].

11.4 Risk (-Benefit) Communication

Another concept that has been extensively studied in relation to consumer perceptions of food safety is the concept of trust in food risk communication. Research in this area also has implications for as the practice of food risk management. The influence of specific food safety incidents on consumer risk perceptions and behaviour (e.g., in a "crisis" context) may also influence the effectiveness of risk communication practices. For example, people may respond negatively to a message from an information source which has mishandled a food safety incident in the past, or failed to convey accurate information which takes account of both technical risk estimates and consumer concerns.

Cultural and historical variation in both consumer perceptions of food risks, and trust in local and international regulatory institutions, across different geographical regions and within different social contexts implies consumer responses to information about food safety may be prone to cross-cultural differences. Individual differences in consumer evaluations of risks (for example, the extent to which an individual perceives that they personally have control over their own health status through, in this case, making safe and/or healthy food choices) may also be influential determinants of consumer responses to communication.

An example is provided by the development of communication interventions to prevent the occurrence of food poisoning incidents originating in the domestic environment. Food poisoning represents an important public health issue. The introduction of "food safety objectives" reflected the need to promote public health through reduction in the number of cases of food-borne illnesses. From the perspective of public health, it is far more useful to set food safety objectives at the point of consumption, as this is the point where microbial load determines the probability of illness occurring. In order to meet food safety objectives, changes in consumer behaviour (for example, regarding inappropriate storage, and food preparation practices) may reduce the incidence of food-borne illness. As a consequence, the goal of improving public health can only be obtained through implementation of appropriate and effective communication interventions [10].

Domestic food preparation is an example of a human activity which involves "frequently repeated" behaviours embedded in an individual's routine activities, and is associated with "lifestyle choices" (for example, the selection of healthy foods). Given that optimistic bias or unrealistic optimism is more frequently observed for "lifestyle" risks, (such as food poisoning contracted in the home), people exhibiting optimistic bias may not take precautions to reduce their risk from a hazard. The risks of food poisoning are typically prone to optimistic biases. Although targeting information to those individuals most at risk may optimise use of available resources, this cannot be done unless there is an understanding of which consumers are most at risk. An important first step in targeting risk communication associated with food safety is to differentiate or segment consumers who are most at risk, as a consequence of both attitudinal factors and their vulnerability to the risks, identify potential barriers to communication relevant to these individuals, and to utilise

this information in optimising risk communication. Understanding those social psychological factors which determine consumer behaviour is important if consumer protection is to be optimized. For example, despite the fact that consumers appear to be knowledgeable about how to prepare food safely, other factors (for example, optimistic bias or habitual food preparation practices) may result in incidences of domestic food poisoning occurring. It is also recognised that some segments of the population are more at risk than others from adopting unsafe food preparation practices. For example, there is evidence to suggest that young single males are most likely to create a contaminated meal. This suggests that stratified risk communication strategy is important if risk communication is to be targeted to those who are most vulnerable. It has been found that embedding relevant emotional cues associated with food safety (in this case, imagery or text which provokes disgust) in information about food safety increased both consumer awareness of food safety risks and their motivation to behave in such a way as to protect their own health from the risks of food poisoning. In another example, it has been found that including information about safe food preparation in a recipe increased food safety relevant behaviours. It appears that the message included in the recipe activated an existing attitude to produce a positive effect in terms of consumer health protection [4]. One conclusion is that consumers possess more knowledge about safe food preparation than they use, and activating this knowledge at the same time the behaviour is being conducted is important. Communication about food safety might usefully exploit recipes or instructions on food packaging to "activate" existing knowledge about food safety held by consumers, or incorporate "emotional" imagery or text to ensure consumers read the information provided about food safety.

An example of a situation where potential conflict in perceived risks and benefits may be experienced by consumers is provided by fish consumption. Fish and other marine products are an important supplier of omega-3-fatty-acids, high in vitamin D, and low in unsaturated fat, and may provide other potentially positive nutrients. However, fish may be with contaminants such as methyl mercury, PCB's and dioxins which may have negative health effects, in particular in potentially vulnerable groups, such as immuno-compromised individuals and pregnant women. Thus a communication dilemma arises. On the one hand, communication might usefully focus on the benefits of fish consumption in order to improve public health across the population. At the same time, however, risk communication needs to be targeted at vulnerable population groups. The question is how to simultaneously provide disparate messages targeting different groups in the population. For example, generally the message provided by nutritionists may focus on nutritional benefits to the population overall. Risk messages regarding potential toxicological problems should target vulnerable groups in the population [14, 15]. The problem is that individuals who prefer not to eat fish (for example, because fish is not included in their normal range of dietary choices) may differentially process risk messages (even if the individual selectively selecting to process risk information is not in a potentially vulnerable population group) in order to reinforce their existing food choices.

The order in which risk or benefit information is provided may influence the relative impact of information on risk or benefit attitudes held by consumers.

For example, the information provided first (either risk or benefit information) may differentially influence consumer attitudes towards a particular food. The impact of communication about both risks and benefits may also be affected by the prior attitudes held by the consumer toward a particular food or food production process. For example, people may not pay attention to information which contradicts an already strongly held attitude about a particular food [4]. If people perceive that eating a specific food is potentially risky, they may not attend to information about the potential benefits associated with the same food, and vice versa. Similarly, if people are very negative about the application of a particular food processing technology to food production, they may only attend to risk messages about the technology, and avoid messages about benefit.

11.5 Communicating Uncertainty

Uncertainty may be associated with different food risk issues, for example in relation to lack of knowledge about the health impact of a specific hazard, and the potential impact or extent of a particular hazard, should it occur. In the context of transparency and consumer trust, information about uncertainties needs to be included in food safety communications. The public also require information about what is being done by institutions with responsibility for consumer protection (whether governmental or industrial) in order to reduce uncertainties where these exist. In line with this, various challenges associated with the communication of uncertainty have been identified. For example, individuals appear to have difficulties in interpreting low probabilities and associated events, and tend not to seek out probabilistic information under conditions of uncertainty. In addition, "heuristics" or cognitive decision rules may exert influence on interpretation of uncertain events associated with food safety issues. For example, *the availability heuristic* results in people estimating greater probabilities of the occurrence of future events if they can recollect past examples of similar incidents in the past.

11.6 The Role of Trust

Consumer trust in different actors and institutions responsible for guaranteeing and controlling food safety, as well as trust in the information provided by different information sources that communicate about food safety or food-related risks, is an important part in developing effective communication about food safety. Other dimensions of trust, such as perceived honesty and concern about public welfare and consumer protection on the part of risk communicators, might overrule perceived competence as a determinant of risk perceptions and attitudes towards food safety issues [2]. In addition, existing attitudes held by consumers toward food hazards or food production technologies might influence whom the public trusts.

For example, if consumers have a strongly held attitude about a potentially hazardous activity, they are more likely to trust a source that provides a message which aligns with their existing attitude, and to distrust a source that provides a message that disagrees with what they already believe.

Various approaches to improving trust can be identified. For example, consumer evaluations of the effectiveness food risk management are primarily driven by whether consumers perceive effective and proactive consumer protection systems are being put into action. As a consequence, risk communication should also include information about proactive consumer protection strategies if trust in food risk managers and institutions is to be developed and maintained [16]. Increased transparency about scientific uncertainties associated with combined risk-benefit communication has the potential to increase perception of honesty associated with the information source, whilst at the same time reinforcing perceptions of transparency in the process of food risk analysis. Maintaining public trust in regulatory activities associated with food risk requires transparency and openness in communication practices. As a consequence, the effective communication of uncertainty and variability associated with risk (and benefit) assessment is increasingly important.

11.7 Conclusions

Developing effective risk communication about food safety issues requires understanding of consumer perceptions, needs and behaviours. Risk communication is likely to be most effective when targeted at specific groups of consumers with similar needs and interests. Understanding how individuals differ in, for example, their food safety information needs and preferences, how different individuals process food-related risk (and benefit) information, and how these may vary according to psychological and other individual differences will help risk communicators in developing and communicating their messages.

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Chapter 12
Educational Programs to Translate Food Safety Knowledge

Susan Sumner and Cameron Hackney

Abstract Education is an important component of all food safety and food security programs. To achieve food security, food has to reach the entire population and involves not only growing or importing food, but also storage, transportation and marketing. Food safety and quality programs designed around the HACCP concept, that incorporates good manufacturing practices helps ensure that food is stored and distributed in a manner to avoid safety hazards and minimize losses due to spoilage, pests and cross-contamination. Embedded within HACCP regulations of the United States and the European Union are requirements for training farmers, workers, supervisors, and regulatory officials. This educational training must be ongoing and tailored to each specific audience, which may range from college educated to illiterate workers. Food safety educational programs are best translated when a holistic approach to learning objectives is used. It is important to encourage a learner-centered approach to food safety education, which encourages innovation and collaboration. If the instructor is committed to quality and continuous improvement, it is easy to incorporate new food safety knowledge into any educational program. The cooperative extension program in the United States is the most successful model for taking knowledge from discovery to the end user.

Keywords Education • Food security • Food safety

S. Sumner (✉)
College of Agriculture and Life Sciences, Virginia Tech, Blacksburg, VA 24061, USA
e-mail: sumners@vt.edu

C. Hackney
College of Agriculture, Natural Resources and Design, West Virginia University, Morgantown, WV 26506, USA
e-mail: cameron.hackney@mail.wvu.edu

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12.1 Introduction

To enhance food security and food safety, education must be taken from universities to people in all walks of life. As knowledge is discovered, it must be translated to farmer, producer and consumer. In the United States all aspects of food production have benefited from Cooperative Extension which is a partnership between federal, state and local governments, agricultural universities and in some cases private industry [7]. This partnership is nearly 150 years old and is the principal reason for the success of American agriculture. The Morrill's Act, signed into law by President Abraham Lincoln on July 2, 1862, specified, That there shall be granted to the state proceeds from the sale of public land for the "support, and maintenance of at least one college where the leading object shall be, without excluding other scientific learning as are related to agriculture and the mechanic arts." The term land-grant university arose because the public land sold provided the funds to start the colleges. The Hatch Act of 1887, which established the agricultural experiment stations as an integral part of the colleges of agriculture, was in response to the need to develop scientific information. An important part of the Hatch Act was the mandate to take information developed to the end user to improve productivity. This aspect of the Hatch Act was formalized by the Smith-Lever Act of 1914, which established the Extension Service [4]. Therefore, the land grant mission is to develop leaders and to improve quality (and safety), profitability and quality of life for the citizens of the state, country and the world. It has three parts, research, teaching and service. Research has become the core mission and it provides the foundation for excellence in teaching and extension. It is important to conduct research with practical and economic value to the state, and apply that knowledge to improve the lives of the people in region, the nation and the world. This mission is more relevant today than ever before. Global pressures require us to do everything better, more efficiently, while holding down costs [3]. We must anticipate consumer expectations and needs and have the products ready for them. Food and fuel security and the threat of economic bio-terrorism will be at the forefront of research efforts. Our students are the future leaders and they must have a global perspective to keep our food, agricultural and natural resources industries competitive. This concept will help insure food safety and food security in developing countries.

More than ever before, extension is needed to keep farmers, land owners, processors, foresters, families, and consumers up to date. The important role of extension education in improving nutrition and quality of life is greater than ever. The interaction among research, extension and teaching is important to move successfully into the future. This relationship is a catalyst for excellence in all three missions. Extension has a very role strong to play in technology transfer, bio-security issues and food security. Embedded within HACCP regulations of the United States and the European Union are requirements for training farmers, workers, supervisors, and regulatory officials. In all contexts, extension means education. Cooperative Extension is perhaps the most effective model for teaching food safety educational programs and is a mainstay in the delivery of food safety information in the United States.

Cooperative Extension is based on understanding that knowledge is power and placing the power into the hands of the citizens to help them how to learn how to use it and improve the quality of their lives [7]. Cooperative Extension is built on the foundation of science-based research that is translated to the general public through Extension specialists and Extension educators (agents). The Extension educators are based in the local communities. Effective Cooperative Extension programs are built on a direct relationship between a specialist and educator to deliver an educational program. Cooperative Extension is a network of specialists and educators whose classrooms are the communities where they bring research-based solutions to today's problem. Extension is an internet-based collaborative environment where Land Grant university content providers exchange objective, research-based knowledge to solve real challenges in real time. This new electronic collaboration has expanded the effectiveness of Cooperative Extension.

There are also two other significant sources of food safety information: partnerships between academia, public sector organizations and the food industry and governmental agencies. Some of the more widely known governmental agencies are the Food and Drug Administration, the United States Department of Agriculture and the World Health organization [3]. All these agencies provide timely food safety information not only to consumers, but also to the regulatory officials within their agencies.

12.2 Holistic Approach to Learning

It is important to remember that education is a process comprised of both teaching and learning [2]. The two areas are synergistic; however, they are separate functions. To have an effective educational program it is important to first define the audience for your program as well as define the goals of the program. If one correctly identifies and establishes learning objectives, a meaningful educational program may be developed. Selecting a delivery style for the educational material will depend on your audience and subject material to be taught. The ultimate goal of food safety instruction and instructional design is effective and efficient student learning in its many forms. Food safety educational programs are best translated when a holistic approach to learning objectives is used. It is important to encourage a learner-centered approach to food safety education, which encourages innovation and collaboration. If the instructor is committed to quality and continuous improvement, it is easy to incorporate new food safety knowledge into any educational program. With the rapid changes in food safety and the need to communicate up to date information, food safety instructors need to be prepared to alter training materials as needed.

Effective food safety educational training programs are established around core learning values:

- A shared vision
- An environment of integrity, trust, and open communication

- A spirit of courage and risk-taking that nurtures creativity and innovation
- An appreciation and respect of diverse backgrounds and opinions

Food safety educational programs must be systematically designed. Educators must give thought to planning, developing, evaluating, and managing the educational process. The concept of instructional design is based on what to teach and how to teach the material. Instructional design is based on several basic components: instructional needs, instructional objectives, instructional strategies, and instructional assessment [1].

Instructional needs assessment can identify a need or gap in food safety education. It might be determined that food safety workers are lacking knowledge about the importance of an important or proper food safety task, i.e. proper hand washing. Once it is determined that a hand washing educational program needs to be developed, the food safety educator must determine the audience for the educational program.

A basic question must first be answered. Who are the learners? Do the learners have any shared characteristics? Once these two questions are answered, the food safety educator may then ask more specific questions about the individual student to help design an effective educational program [5]. The educational level and ability of the students should dictate the development of course material. Students often gravitate toward a specific teaching style. However, this component of an educational program is the most difficult to determine and to plan for in the designing of food safety educational materials.

It is imperative in the development of food safety educational materials to first develop instructional outcomes. These outcomes are often based on a specific learning objective or a specific behavioral change. Students will be required to demonstrate a specific learned practice in order that the instructor can gauge the effectiveness of the food safety training [1]. Specifically, what should students know, be able to do, or appreciate when the course, class, or activity are complete? To adequately answer this question, the food safety educator must be able to measure a student's performance against a learning objective.

There are several major elements in a teaching-learner situation: the teacher, the learner, the subject, the physical facilities/environment, and the instructional materials/methods used [2]. In regards to the teacher, one of the most important criteria is their knowledge of food safety. A student's attitude toward an instructor will influence the student's willingness to participate and be engaged in the educational opportunity. The learner must be motivated to attend a food safety training session. As mentioned previously, the educational background and prior experiences of the learner will influence their reaction to the educational material. An experienced food safety educator will adjust their educational material to the level of their learners. The subject of the training session is also important. If the food safety educator has conducted a needs assessment, the educator knows that some learners need the proposed educational topic. Ignoring the results of a needs assessment might result in a poorly designed educational program that wastes the time of the instructor and the learners. The effectiveness of a food safety-training program may be diminished

by the lack of appropriate facilities for the training session. An environment that is too cold or too hot in temperature will distract learners. The component of the educational program that is most controlled by the instructor is the design of the educational materials and the method used to deliver the materials.

All materials used in the educational program are part of the instructional media. These materials might include the more traditional overhead and pencil and paper to newer materials such as computers, Internet, and interactive video [6]. Food safety educators now have even more opportunities to introduce the use of technology into their food safety programs. It is common for food safety educators to use multi-media slides and incorporate video into their presentation. One important point to remember is that although technology allows for the introduction of a more dynamic display of the material, the food safety educator must remember to still provide the depth of knowledge that is needed. When making the decision on whether to use a particular technology, the instructor must not lose sight of the message to be communicated. Some particular considerations are the learner's literacy/training, the objective of lifelong learning, and the instructional design principles.

The availability of food safety educational programs is abundant. Most often the challenge for students is to determine what information is credible and accurate. Many professional organizations offer individuals the opportunity to join a group of food safety professionals to share information.

Without a doubt, distance education/learning has transformed food safety education [6]. Distance learning transcends the barriers of time and place to offer new knowledge for a global community. The most recent growth area in distance learning is food safety on Twitter. There are several recognized food safety sites on Twitter that offer reliable food safety information. Another method of food safety education is the utilization of food safety webinars. On any given day, a webinar in hazard analysis critical control point, foodborne illness, food inspections or food laws and regulations might be offered.

A well-designed food safety educational program will appreciate that sensation and perception are part of the equation for effective learning. A learner's sensation plus recognition equals their perception. It is often said that perception is worth a 1,000 words. A learner's prior experience influences their sensation as well as prior knowledge. The prior knowledge has an impact on their recognition.

There are several important components of instructional guidelines for successful learning

- Teach in chunks to respect the working memories limitations
- Build meaning in chunks, one piece at a time
- Use imagery, when appropriate
- Have learner's self-generate materials and knowledge
- Teach to the learning outcomes
- Provide experiences from which to build knowledge
- Connect the new knowledge to prior knowledge
- Present one message at a time, multitasking is a myth

12.3 Summary

In conclusion, there is a need to implement strategies for protection, preservation and food safety that work with the production (including fishing), transportation, distribution, and retail sectors to ensure that the whole system is working effectively. Hazards, quality concerns, and loss due to spoilage arise at each stage in the farm-to-table continuum. Education and training are the keys to successful implementation of food safety programs. Those in control of each segment of the continuum must take responsibility for quality, safety and food security (Adapted from PR/HACCP & SQF-2000). In summary, it is important to remember what happens beyond the presentation or education program. People retain about 20% of what they see, 30% of what they hear, 50% of what they hear and see, and up to 80% of what they see, hear, and do. What we process, we learn.

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Chapter 13
Distribution and Water as Related to Food Safety and Food Security

Cameron Hackney and Susan Sumner

Abstract To achieve food security, food has to reach the entire population and involves not only growing or importing food, but also storage, transportation and marketing. The food must processed, warehoused and distributed in a manner that avoids spoilage, avoids losses due to pests and avoids cross contamination with microbial, chemical or physical hazards. Food safety and quality programs designed around the HACCP concept, that incorporates good manufacturing practices helps insure that food is stored and distributed in a manner to avoid safety hazards and minimize losses due to spoilage, pests and cross-contamination. This paper looks most at transportation by trucks, but the principles apply to rail and ship transportation. Warehousing concerns are addressed in the context of good manufacturing practices. Finally we examine the importance of clean water for food processing and food security.

Keywords Food security • Transportation • Warehousing • Distribution • Water

13.1 Introduction

The world food supply is being challenged by increasing populations, the bio-economy, land use and climate change. Food security refers to having enough food to feed a nation's population. Feeding the people requires that the food reach the entire population and involves not only growing or importing food, but also storage, transportation

C. Hackney (✉)
College of Agriculture, Natural Resources and Design, West Virginia University, Morgantown, WV 26506, USA
e-mail: cameron.hackney@mail.wvu.edu

S. Sumner
College of Agriculture and Life Sciences, Virginia Tech, Blacksburg, VA 24061, USA

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and marketing [1, 3, 6]. The food must be processed, warehoused and distributed in a manner that avoids spoilage, avoids losses due to pests and avoids cross contamination with microbial, chemical or physical hazards. Food security is achieved when all people at all times have physical and economic access to sufficient, safe and nutritious food for a healthy and active life. Some of the causes for food insecurity include [2, 3, 4, 7, 8]:

- Low rates of agriculture production from climate change, natural disasters and war
- Insufficient access to food – from lack of roads, infrastructure, and illness (especially HIV)
- Lack of transportation
- Insufficient amounts of low priced food at local markets
- Price increases caused by international markets
- Removal of food subsidies
- Insufficient income to afford nutritious foods

To achieve food security we will need to have a multifaceted approach that addresses all the issues from biotechnology, food production, improvements in cost and quality of food storage, food processing, packaging, transportation and better education, communication (extension for developing countries) and better government policies. This paper will concentrate on the aspects of transportation, warehousing and water. We take an approach that builds on the good manufacturing practices and HACCP concepts to insure that food is stored and distributed in a manner to avoid safety hazards and minimize losses due to spoilage, pests and cross-contamination.

The United States and the world are moving into the "bioeconomy" and we will rely more on renewable resources to meet society's needs for energy, chemicals and materials (such as bio-based plastics, solvents, lubricants, etc.). However, as more land and crops are used for fuel, food security can become more of a problem. Recent headlines have addressed the issue of food security. A recent story by Dario Thuburn of the AFP notes that the Food and Agriculture Organization (Rome) indicated in world food prices hit record high in February 2011. Prior to that, former United States President Bill Clinton, in an article written by Mary Jalonicjk, warned farmers using too much corn to produce ethanol could lead to food riots. The article also noted that nearly 40% of the US corn crop was going for ethanol production. National Geographic's January 2011 issue's lead story was about the world population reaching seven billion (with one billion going hungry); the population is expected to grow to nine billion over the next 30–40 years. Other headlines have noted that the global food chain is stretched to the limit and soaring prices spark fears of social unrest in developing countries and that the era of cheap food may be drawing to a close.

13.2 Food Security and Distribution

Food security must balance the bio-economy (renewable resources for fuel, materials, and products from plants and animals), need for clean water, land for housing, and food supply. Increased agricultural production through increasing arable land

through irrigation, increasing crop yields, and cropping frequency is only part of the solution. There is a need to limit post-harvest losses due to spoilage, insect damage, and inability to get the food to processors and the consuming populations in a way that promotes food safety and quality. This presentation will concentrate on issues of distribution, warehousing and water for processing and their role in food security and food safety.

An ideal food safety and food security system will ensure that adequate public protection measures are located throughout the food system, from the farm, pond, and boat to the consumer (adapted from *Meat and Poultry Inspection, The Scientific Basis of the Nation's Program, National Research Council, 1985,* EUFIC [9]). We have to implement strategies for preservation and food safety that work with the production (including fishing) transportation, distribution, and retail sectors to ensure that the whole system is working effectively.

With respect to warehousing, we discuss topics related to storage, pest control, cross contamination, product rotation and other factors that affect quality and safety. Following good manufacturing practices could greatly reduce losses due to pests and spoilage during distribution and warehousing while insuring better food safety. In the United States good manufacturing practices are covered in part 110 of the food code [12]. It states that storage and transportation of finished food shall be under conditions that protect food against physical, chemical, and microbial contamination as well as against deterioration of the food and the container (GMP110.93). The International Institute of Refrigeration published a paper in 2009 stating that "refrigeration has a vital role to play in reducing post-harvest losses." Food stuffs from both plant and animal origin are highly perishable and the use of refrigerated transportation can compensate for bad roads and slow travel.

In addition to reducing loss and improving quality, refrigerated transport can also improve food safety [6]. However, there are also problems associate with maintaining refrigerated transportation such as increased fuel consumption. Temperatures must be monitored to keep drivers from turning off units to save fuel. The authors of this paper did a transportation study in the mid-1980s when fuel prices were at record highs for the time. Independent drivers who transported raw oysters from Louisiana to Virginia frequently (70% of the time) turned off the refrigeration units at the beginning of the 30 h trip and turned them on again 1 or 2 h before reaching their final destination. The air appeared cool, but the sacks of oysters were still warm after the extended time without refrigeration which allowed the pathogenic *Vibrio* populations to increase by several logs. Many of the oysters arrived in poor condition. This was at a time when continuous temperature monitoring devices were new. The effort of the drivers to save fuel contributed to both food safety and quality concerns (unpublished data). It would be logical to assume that this practice could occur in other parts of the world. Also, infrastructures in developing countries may not be adequate to maintain "cold chains." During transportation and storage, the challenge is to maintain proper refrigeration temperatures and to keep the "cold chain" from breaking during steps such as palletization, staging, loading and unloading of containers, movement into storage, and time spent on docks and in storage [11].

In 1995 the United States Department of Agriculture Food Safety Inspection Service, the United States Food and Drug Administration, and the United States Department of Transportation contracted with the Technical Analysis Group (TAG) to identify hazards associated with transportation of perishable foods and to recommend reasonable controls [5]. The TAG group conducted a hazard analysis of two major areas of concern in trucking, the transport of live animals or fresh materials and the transport of perishable processed or finished products. Their conclusion was that more sanitary and temperature-controlled food transportation would benefit both industry and consumers. One concern recommended to be addressed by companies was to maintain proper refrigeration temperatures and to keep the "cold chain" from breaking during steps such as palletization, staging, loading and unloading of containers, movement into storage, and time spent on docks and in storage. The TAG team noted that mix loads (where raw, processed, or ready to eat foods are loaded on the same truck, along with non-food items that might present a health hazard) may lead to cross contamination of pathogens from raw products to ready to eat or potential adulteration of food cargoes by incompatible food or non-food cargoes. Such a load may also consist of foods with different holding temperature requirements, including fresh and frozen.

Another concern noted by TAG was failure to maintain the proper storage temperature throughout the transit because of frequent loading and unloading. Other issues were the loading patterns and partial loading or unloading of trucks which could cause contamination, the adequacy of refrigeration units, air circulation, humidity, insulation of trucks, and the time taken to transport the food. For refrigerated trucks TAG noted a need to focus on establishing control points that will monitor temperatures and times en route and at the loading and storage facilities. Good manufacturing practices must be adhered to and control plans recording time, temperature and sanitation are needed. Other problems with refrigerated transportation are as mentioned increased fuel consumption and requirement that temperatures must be monitored to keep drivers from turning off units to save fuel. In many developing countries, unfortunately, the infrastructure may not be adequate to maintain "cold chains." During transportation and storage, the challenge is to maintain proper refrigeration temperatures and to keep the "cold chain" from breaking during steps such as palletization, staging, loading and unloading of containers, movement into storage, and time spent on docks and in storage. In very warm climates, refrigeration systems may not be able to maintain temperatures. Refrigeration systems simply do not work well when the air temperature is greater than 40°C.

Food safety protection can be improved by the control of microbiological and other hazards through the use of preventive methods such as HACCP, good sanitation and manufacturing practices, and food safety performance standards, as appropriate, throughout the food production and distribution chain [11, 13]. A carrier cannot transport hazardous material required to be labeled poison in the same motor vehicle with material that is marked or known to be a foodstuff, feed, or any edible material intended for consumption by humans or animals unless packaged in specifically prescribed packages [11]. This is a problem in most countries. Specific steps to take to help prevent food safety and quality concerns during shipping

include: (1) inspect the truck trailer before loading; (2) ensure that the temperature of the product to be loaded is not above 4°C; (3) properly configure the load; (4) maintain a 4°C temperature while awaiting additional product to be loaded; (5) maintain temperature of food during transit; (6) maintain the inside temperature of the food during unloading and movement to storage.

13.3 Warehousing and Good Manufacturing Practices

When it comes to warehousing, following good manufacturing practices (GMPs are universal steps or procedures that control operational conditions within a food plant, allowing for environmental conditions that are favorable to the production of safe food products) will help protect food against physical, chemical, and microbial contamination as well as against deterioration of the food. Unless stored properly, considerable food losses can occur due to spoilage, insect and rodent damage or adulteration. Records are critical as is product rotation and following the "first in first out" rule. It is important to prevent cross contamination from foods being stored together. Poisonous non-food products cannot be stored near foods. In our opinion, enforcement of GMP's would do more to increase food safety and decrease losses due to spoilage and insects than any other action. GMPs include premises, receiving and storage, equipment performance and maintenance, personal training, sanitation, health and safety recalls [10, 12, 14].

Premises are the building and surroundings. It is important that the outside property be free of debris and refuse, the roadways in good shape and the facility not in close proximity to any source of pollution. The building should be designed and constructed for easy cleaning and constructed to prevent entrance and harborage of pests. This means that floors, walls and ceiling materials are cleanable, and windows are secure and fit tightly to prevent entrance of pests. Also, doors must fit tightly to prevent entrance of pests. Finally, lighting should be covered and the building must be properly ventilated. Product flow considers traffic patterns and physical separation of cooked and raw products and there should be rules to prevent cross contamination by staff. The building's sanitary facilities (toilet facilities and hand washing stations) must be working, cleaned regularly and equipped with hot water and paper towels. It is important to prevent cross contamination during receiving and storage. There should be proper separation of raw materials, packaging materials, non-food items, package foods, frozen foods and shelf-stable (canned, dry, ETC) items and they should be stored in a sanitary manner. Incoming foods and materials should be inspected on receipt for spoilage, pests and intact packaging. The trucks should be inspected for cleanliness and cross-contamination. A problem I have seen in some countries is that some food additives are not food grade. With respect to storage, depending on the location, there should be temperature and humidity controls. Care must be taken to prevent damage and contamination, to segregate returned goods and non-food chemicals such as cleaning supplies that should not come into contact with foods. Equipment should be designed for cleaning

with sanitation and prevention of contamination of food in mind. Equipment maintenance programs are very important and it is important to train maintenance personnel on cross contamination issues [10, 12, 14].

Personnel are major sources of contamination and it is critical that hygienic practices be used in handling of food. The workers should be free of communicable diseases; cuts must be covered and not come into contact with foods. Workers must wash their hands and wear proper clothing and hair restraints. Within the warehouse, there should be controlled access for the purposes of food defense and to prevent cross-contamination.

A sanitation program maintains or restores a state of cleanliness, and promotes hygiene for the prevention of foodborne illness. It outlines parameters that need to be controlled. There should be procedures for premises, equipment, utensils, refrigeration units, and anything else that may impact the food. Equipment should be cleaned and sanitized at least once daily or more often if necessary. Appropriate chemicals must be used and stored properly.

As mentioned pest control programs are needed to keep from losing food. Exclude pests when possible and have plans for control of insects, rodents, birds, lizards and other pests unique to area.

Health and safety recalls are another part of GMP's. A recall plan is needed along with good records of products and distribution [10, 12, 14] .

13.4 Water Concerns

Water quality and safety are major concerns for food security. Climate change and population growth have put pressure on water supplies worldwide. Safe food and food security depends on clean, plentiful water supplies. Many cities are promoting urban gardens, but brown sites and access to clean water will affect if the food is safe. Likewise, water used for processing must be potable and safe. Sources of water may include municipal treated water, private wells and, in coastal areas, seawater may be sued for some food processing applications. This section will concentrate on water used in food processing. It is important to have a safe supply for water that contacts food and food contact surfaces, production of ice and that there be no cross-connections between potable and non-potable water. Municipal water supplies are usually tested and treated to be safe. However, during the rainy season or in times of high water, treatment plants sometimes cannot handle the volume and untreated water may go to the consumer, the food processors or for crops. Private wells are used in many areas. Water monitoring should be conducted in these areas before it is used for processing operations and then at least on a semi-annual basis. It is always important to consider the safety and quality of the water a flood or heavy rains, when wells are located too close to cesspools, septic tanks, or when wells are near agricultural sites, or associated drainage fields that may lead to contamination. The wells must be inspected for cracked or improperly sealed well casing or liners.

In some coastal areas where fresh water is in short supply, seawater is used for some food processing applications such as cleaning, removing ice from shrimp, and fluming operations. It is not used as an ingredient, but it does come into contact with the food in these cases. It is important that the source of the seawater be free of contamination and the seawater monitoring plans be in place. Monitoring for seawater safety in processing should be conducted more frequently than for land-based municipal or private sources. The guidelines should be in accordance with state requirements and locally approved testing labs. The World Health Organization defines 'clean sea water' as seawater which meets the same microbiological standards as potable water and is free from objectionable substances. For example, the water intake cannot be near ship repair or flush out facilities (US seafood HACCP guidelines). One of the problems is that ship maintenance and pump-out facilities for waste on the ships are often conducted in the same areas as the seawater intake. The authors recommend that each site be evaluated as to the type of testing. For example, if ship maintenance and chemicals are applied to prevent barnacles then those chemicals should be tested for. Records are critical and should be specific for each site.

In conclusion, there is a need to implement strategies for protection, preservation and food safety that work with the production (including fishing), transportation, distribution, and retail sectors to ensure that the whole system is working effectively. Hazards, quality concerns, and loss due to spoilage arise at each stage in the farm-to-table continuum. Those in control of each segment of the continuum bear responsibility. Regulators and companies must address hazards and quality concerns within each segment of the food production chain and implement preventative strategies. Those in control of each segment of the continuum must take responsibility for quality, safety and food security. (Adapted from PR/HACCP & SQF-2000)

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Chapter 14
Food Research Ethics

David Coles

Abstract Awareness and application of ethical principles has been increasingly highlighted as an essential consideration that must be addressed in all areas of scientific research and their translation into commercial applications. Ethical considerations are also very important in relation to global trade and development aid. This has direct application to the whole spectrum of interests related to Food, be it research into new products and processes, consumer behaviour, health claims, supply chain, farming methods, food safety, security, sustainability, regulation, trade and emergency food aid. In all these areas ethics has a part to play and frequently gives rise to questions and challenges to issues and practices that may not previously have been considered.

The area of food and nutrition is extremely diverse. While much of this paper will focus on ethical issues related to food research. However, there will also be some consideration of the ethical questions that need to be considered when addressing the broader policy and regulatory issues related to food security, safety, sustainability and trade. The purpose of this paper is therefore to help provide Food experts, be they researchers, producers, regulators or policy-makers, with an opportunity to consider and reflect upon the ethical issues which may need to be taken into account in the application of their particular area of expertise. Some of the issues considered in this paper have emerged from my work as a member of a European Commission expert group developing a guidance document on food research for the European Framework Programme for Research [Ethics and food-related research – a guidance note: European Commission FP7 Ethical Rules (in preparation)].

D. Coles (✉)
Centre for Rural Economy, Newcastle University, Newcastle upon Tyne, UK
e-mail: david.coles2@newcastle.ac.uk

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14.1 General Ethical Principles

There are basic ethical principles which can be considered to apply to most areas of human activity and increasingly it is only those activities that are ethically sustainable that achieve acceptability by the general public and also by co-workers, collaborators and regulators at both national and international level. In relation to food in particular there is the additional dimension that personal decisions related to eating have strong cultural, social and spiritual dimensions that also have to be considered. For this reason most aspects of ethical governance are handled at the national level. However in many areas including food, where international interactions are so vital, there need to be agreed international ethical principles. As a result this paper cannot hope to deal with food ethics questions at all levels but will at least try to address ethical issues that are relevant internationally.

Fundamental ethical principles which apply to most situations include:

Respect for Persons
Benefits and Harms
Equity and Justice

These principles are now subscribed to by almost all countries around the world and underlie a number of important international conventions to which most nations are signatories. The Charter of Fundamental Rights of the European Union and the Council of Europe Convention on Human Rights and Fundamental Freedoms are examples of these. However, it is important to note that while international agreements and conventions can be a good starting point for ethical governance, particularly for developing countries and emerging economies participating in international activity, they should not become a long term substitute for ethically sustainable regulations and guidelines at the national level.

14.2 Ethics and Research

When considering ethics and research, there are a number of other important ethical principles that also need to be considered. These include:

Respect for Animals
Respect for the Environment
Respect for the Public Good
Probity and Accountability

Research is an area where an ethical approach is essential. Most internationally respected journals now refuse to publish research results where a clear ethical

approach cannot be demonstrated. One important element of the ethical aspects of research relates to considering whether or not the research presents an actual or potential risk. This may include risks to human participants or animal subjects, other humans, animals or the environment or indeed risks to society.

14.2.1 Risks to Humans

Risks to humans might include:

Medical interventions on research participants which may result in physical, psychological or emotional harms or stress.
Non-medical use of or exposure to substances and situations that may be detrimental to the health of participants, society, animals or the environment. This could include actual or potential exposure to toxic or pathogenic substances and organisms.
Non-interventional methodologies which might lead to psychological, emotional or stress-related harms. These could include medical, psychological or social science methodologies ranging from interviews, observational studies, exposure of participants to uncomfortable or stressful situations.
Harms to humans may also arise from the way in which information gathered about them is handled and stored. Breaches of privacy and/or confidentiality for example could lead to emotional or psychological harms and in some case put their life or well-being at risk.
The anticipated outcomes of the research itself may also have a potential impact on society, animals or the environment and the ethical implications of this should also be considered by researchers together with a consideration of how any potentially adverse effects might be alleviated or avoided.

14.2.2 Risks to Animals

Animals are clearly 'at risk' in research projects as they are frequently subject to some degree of suffering and harm and the research protocol usually demands their sacrifice either at certain end-points or at the end of their usefulness to the research.

However, in accordance with the internationally accepted "3Rs" principle, numbers of animals and their level of suffering must be kept to the minimum necessary to achieve the justifiable objectives of the research.

14.2.3 Risks to the Environment

Release of organisms into the environment, particularly Genetically Modified Organisms (GMOs), pathogens or other organisms that might disturb the natural ecological balance present a potential risk which needs to be assessed and managed.

There is also a risk from release of toxins that may have either a short or long-term adverse impacts on the environment or its plants, animals or microorganisms. This also needs to be assessed, including consideration of waste management during research, particularly where this involves medical or chemical waste.

14.2.4 Risk/Benefit Assessment

An important element in determining the ethical acceptability of a particular research project is to assess the potential risk/benefit balance, where the potential magnitude and severity of the risk has to be weighed against the magnitude and significance of its potential benefits to humanity. However, even if potential benefits to humanity are great the research still must be carried out in such a way as to ensure that the fundamental principles of human dignity, beneficence, non-malfeasance and justice are upheld.

14.3 Generic Ethical Guidance for Research

14.3.1 Research Involving Human Subjects

Pure interventional medical research has for many years had very clear ethical guidelines and a strict accompanying regulatory regime. However other areas of research involving humans, with both medical and non-medical objectives have not always had appropriate guidance on the ethical aspects of their research methodologies. In particular research involving human participants which is considered to fall outside the medical field has not been so strictly regulated through research ethics review and many researchers have challenged the need for the rigorous ethical review of non-medical research. This is particularly true for research activities involving, for example, observational studies, interviews, surveys, anthropological and epidemiological studies.

However, many professional associations have now drawn up codes of practice related to research in their particular areas of activity and it is increasingly accepted that good ethical practices result in good science. One reason for this is the increasing interdisciplinarity of much current research particularly in an international context.

14.3.2 Food-Related Research Methodologies

Much food research is now multidisciplinary and a single research project may incorporate research methodologies drawn from *inter alia*, medicine, psychology, social science, anthropology, epidemiology, risk analysis etc. Consequently

understanding and addressing the ethical issues that might emerge during a research project can sometimes be complex particularly when the research includes disciplines that traditionally have had little or no need to consider ethical questions in their research.

14.3.3 Maintaining Ethical Standards in Multidisciplinary Research

In multidisciplinary research, different participating disciplines may have different norms relating to ethical requirements. For example, if there is an interventional medical component to a project, ethical requirements for medical research will need to apply to this component (see also above). However, the question arises as to what extent these ethical standards should then apply to the whole project. Clearly for some aspects of the research such as data sharing amongst researchers, the data transfer and data protection criteria should be consistent across the project. One particular requirement for data sharing across a multidisciplinary project is to ensure that informed consent is in place for secondary use of any pre-existing data (and indeed tissues). Ethical standards for animal use should also be applied consistently so that the highest standard is applied across the whole project where different participant countries have different national regulations. For informed consent however, particularly where some participants may be exposed to significant risks and others to minimal risks, the recruitment and consent procedures should be adapted to the type of participant (e.g. healthy adults, children, vulnerable groups) and the type of research to be conducted.

14.3.4 Variation in National Regulations

Multidisciplinary research often involves partnerships between researchers from different countries and each country may have different approaches to certain ethical issues and different requirements for obtaining ethical approval. This can make it difficult to ensure consistency, particularly where individual work packages may be carried out in different countries but the research results are shared across the whole consortium. Within the EU Framework Programme this problem is to a large extent avoided by the requirement for the consortium as a whole to comply with the EU Framework Programme ethical rules in addition to individual national requirements. However, this can result in more than one ethical review of a particular procedure being necessary. For instance, if the research takes place in a developing country with little or no ethical review infrastructure, the European Commission would normally also require ethical approval from a European Member State, which is usually the home country of the responsible researcher or of the project coordinator. It is also important that researchers maintain transparency when applying for

national ethical and regulatory approval so that a review body is fully aware that the methodology they are considering is part of a larger multidisciplinary and multinational project and that data and results (and often tissue samples) are likely to be shared across the consortium.

When seeking to identify and address all the ethical issues in a complex multidisciplinary research project, researchers may find it helpful to consult an ethics advisor or set up an ethics advisory board to ensure consistency and best practice across the consortium.

14.4 Fundamental Ethical Considerations Applying to All Types of Research

- Informed Consent
- Data protection and data security
- Vulnerability
- Developing Countries
- Research on animals
- Potential implications
- Potential for misuse

14.4.1 Informed Consent

Prior informed consent almost always required for any research involving human subjects. Every participant has to be provided with information sheets and consent forms describing, in terms they can readily understand; the purpose of the research, the duration of their participation and procedures and any substances to be used. They should also be told if any genetic tests will be carried out, how any incidental findings will be handled, how their data and samples will be stored and what will happen to the data and samples at the end of the research project and how their confidentiality will be protected. All foreseeable risks and benefits should be made clear to participants together with insurance provisions and compensation in case of injury. They should be informed of who is funding the study and what will happen to the results of the research and any IPR that may result. Finally it must be made clear to participants that their participation is voluntary and that they have the right to withdraw themselves and their data at any time without prejudice.

14.4.2 Data Protection and Data Security

Privacy issues arise from the collection and sharing of a person's uniquely identifiable data. Therefore effective measures are needed to secure such data and prevent its improper disclosure. There are some types of data which are particularly sensitive

and personal and their disclosure could give rise to great distress to the individual and could in some cases result in discrimination or worse. Information fitting into this category includes health data, criminal justice information, personal financial information, genetic information, information about where the person lives or works, their sexual preferences and their political views.

Therefore it is important that researchers collect only data that are necessary for their research and the data should be kept no longer than is necessary or required by regulations. Data protection and storage measures should be explained in research protocols including details of anonymisation and coding procedures. Researchers must be aware of national and international regulations relating to data protection to ensure that data are processed in accordance with data subjects' rights and for multinational research, that regulatory requirements for cross-border transfers of data and tissues are observed. It is also important to be aware that informed consent is needed for any future or secondary use of data, unless the data are fully anonymised so that there is no possibility of individuals being identified.

14.4.3 Research Involving Children

Many food-related research projects have an interest in the impact of diet, habits and associated environmental issues on children. However research involving children have particular ethical issues that need to be addressed as children are considered to be a particularly vulnerable group and are not themselves able to consent to their involvement in research. Use of children in a research project must always be justified. The researcher needs to demonstrate that similar results cannot be obtained using adults and other alternatives should also be considered. In order to involve a child in a research project the informed consent of their parental or legal guardian is required. Wherever possible the child should also be provided with an age-appropriate information sheet and their *assent* should also be sought. A child's refusal to participate must be respected except where it would severely increase the child's health risk.

International guidelines, including the Council of Europe Convention on Human Rights and Biomedicine make clear that it is only permissible for children to be involved in research if they are subjected to no more than minimum risk and minimum burden. There should also be the possibility of real and direct benefit to the children involved or (exceptionally) to the group of children that they represent.

14.4.4 Vulnerable Research Subjects

This implies that the research participants in question may be at some sort of power disadvantage or otherwise be susceptible to inappropriate influence. Examples of vulnerable populations include prisoners, incompetent adults, incapacitated groups, immigrant and/or minority groups. Children are also considered vulnerable. Many

of the same ethical considerations apply as for research on children. For example research involving vulnerable groups should be justified and an explanation given as to why the research could not be carried out on non-vulnerable populations. Informed consent must be obtained from the individual (if competent) or a valid legal representative and the interests of the individual should take precedence over those of society.

14.4.5 Research in Developing Countries

Although many developing country populations would object to being described as "vulnerable", some of the ethical considerations are relevant. It is important that researchers from developed countries are able to justify conducting research in a developing country rather than their own country and be able to identify potential benefits to the local community and how they might share in any longer-term benefits (such as IPR) arising from the research. It is important to be aware of local cultural context and take this into account in developing the research methodology. Identification of any vulnerable populations (sex workers, orphans, migrants etc.) is also important and procedures for confidentiality and data security must take into account cultural issues related to these vulnerable groups.

Of course individual informed consents must be obtained but it may also be necessary to obtain community consents. Researchers must also ensure that any benefits offered to participants do not amount to undue inducement to participate. For example, financial compensation for participation should not be disproportionate to normal earning power.

Ethical approval for research should always be sought from local or national ethics committees in the country where the research is carried out. Researchers should always try to identify the appropriate local ethics review board. However, particularly for non-medical research it may be the case that there is no appropriate local or national review body for the type of research being conducted. In such cases the researcher from the developed country should as a minimum have the proposal reviewed in their own country of origin in order to transparently validate the ethics of their research and ensure that standards of care and cross-border transfer of biological materials and/or data are in accordance with international requirements.

14.4.6 Animal Research

All research involving animals should be justified. This would normally be either in terms of potential benefits to human health and welfare or benefit to the species in question. Use of animals for purposes not related to these objectives is more difficult to justify and may be subject to closer ethical scrutiny. Researchers should justify the appropriateness of the species selected as a research subject and demonstrate that

they have considered alternatives (e.g. tissue cultures) to the use of animals. They should also specify the numbers of animals they intend to use and justify this in terms of statistical requirements. Humane endpoints and levels of suffering should also be specified. All researchers using animals need to demonstrate that they are aware of the "3Rs" principles of Reduction (maximising data from minimum numbers of animals), Replacement (with non-animal methods wherever possible) and Refinement (minimise pain and suffering and improve animal welfare).

14.4.7 Potential Implications of Research Results

Research funders such as the European Commission are increasingly asking researchers to consider any ethical issues that might arise should their research project be successful and if identified, say how they might mitigate any negative consequences or demonstrate a risk/benefit assessment. This could include research outcomes which may be potentially damaging for some sectors of society. For example the impact of successful bio-prospecting or other exploitation of global commons on the local economy and food security in developing countries or other disadvantaged communities or the impact of new food production processes on traditional methods and cultural diversity.

14.4.8 Potential for Misuse

In the same way applicants for research funding are being asked to consider whether the results of their research might be open to misuse. Sometimes known as 'dual use' this refers to whether research outcomes might have military applications, be exploited for terrorist or criminal purposes or indeed be used to disadvantage or attack particular groups or segments of society. Where this is a possibility researchers are usually expected to give some thoughts as to how such misuse may be prevented.

14.5 Ethical Principles for Different Categories of Food-Related Research

1. **Food related research equivalent to medical research**
   This includes research to obtaining evidence for health claims, for example for functional foods or nutrigenomics. This type of research normally involves clinical trial methodologies and could also include Phase 1 safety studies in humans. Food allergy research and nutriogenomics research may require medical interventions and genomics studies requiring compliance with genetic research regulations. Modern neuropsychology of food choice, food habits and sensory

analysis often involves use of MRI scans and related technologies which may be classed as medical interventions. Pharmacokinetic and pharmacodynamic studies may require human tissue sampling and of course animals are routinely used in food safety assessments.

2. **Observational studies including ethnography and photographic methods**
   Some types of observational research, particularly involving large groups of consumers for example, may make prior written consent from every individual present impractical and it could render effective research impossible. It could be argued that such individual consent to an observational study may not be necessary if the research is conducted in a 'public space'. In such cases in particular, observational studies should be fully justified and measures to protect privacy of both consenting and non-consenting subjects need to be clearly explained. In addition the context of the research and associated risk/benefit assessment need to be taken into account. For example, observational studies in public places such as restaurants, canteens or supermarkets would not have as strict prior informed requirements as research in private homes, small social or cultural groups. On the other hand observational studies in a hospital ward treating eating disorders would require rigorous prior informed consent procedures and strong confidentiality and privacy protections. Where photographs, video or audio recording are used it must be remembered that this may make individuals instantly identifiable and must be treated as identifiable data requiring their individual informed consent to use, publish or release the material to third parties. Where consent cannot be obtained individuals should be removed from the record or rendered unidentifiable. However observational studies should always be submitted to an ethics review committee which can decide on the extent of informed consent requirements based on the potential risks and benefits of the study.
3. **Covert research**
   These are studies that either require the subjects to be unaware that they are being observed or research that withholds information about the research methods or objectives. This may be justified if full disclosure would influence research outcomes. However, it should only be undertaken if it is impossible to obtain data with overt methods, risks to participants are minimal, anonymity can be guaranteed and the research has sufficient societal importance to justify it taking place. In such cases subsequent consent should wherever possible be obtained before the data or results are published. In any event, full justification should be provided to a Research Ethics Committee (REC) for their approval before the research commences.
4. **New technologies and web-based research**
   Social networks, internet chat rooms, texting, tweeting and emails provide potentially rich sources of data collection for food research. People may be much more willing to participate in studies via these media than in face-to-face interviews. This may be particularly true of vulnerable groups, including children. However it does raise a number of new ethical issues around recruitment, consent, privacy as well as authenticity of data. For example, how can parental consent to participation of minors in an online survey or chat room workshop be assured? In some cases the Internet persona may not be same as the person's actual identity

which raises further questions about the authenticity of consent. One might also ask whether consent for use of data gathered from e.g. chat rooms, self-help groups etc. require any prior informed consent as it could be argued that these constitute a "public space". One could argue that in such cases most people should be aware that their "public space" data might be used by others without their permission. However this argument might not be considered valid for vulnerable groups or those unable to consent such as children.

These technologies represent new and exciting opportunities for gathering research data. However it is important that careful consideration is given to the development of an appropriate code of ethics.

5. **Developing country research**
In addition to the ethical principles discussed earlier, where food research is carried out in developing countries it is important to establish the principle of equal partnership with and identification of benefit to the local population. Researchers should also ensure that their research also conforms to the Convention on Biological Diversity, in particular in relation to benefit sharing of local genetic resources such as food products or natural or derived nutriceuticals.
6. **Research in emergency situations, unstable regimes and conflict zones**
Where research is carried out in hazardous situations such as these there are two important considerations that need to be addressed. The first is to do with the actual or potential risks to researchers carrying out the study. This is particularly important when relatively junior researchers are tasked with carrying out the work. There should always be a risk assessment including health, safety and security aspects and all equipment provided should be appropriate to the situation. Adequate insurance should be in place and the researchers concerned should be made aware that their participation is voluntary.

A second factor to be considered in these situations is the potential risk to local participants. It may well be that participation in the research may put their health at risk or put them at risk of other harms or reprisals. In some cases it may put their lives in danger. Therefore all participants must be made fully aware of any personal risk as part of the consent process. Because data security and confidentiality may be particularly important the procedures for these should be very rigorous with any identifiable data being kept especially secure.
7. **Nutriogenomics**
Nutriogenomics is the study of how genetic and cellular processes relate to nutrition and health. It includes the study of how individuals with particular genetic profiles metabolise and utilise particular foods as well as the way in which particular food components may act on gene expression. It can therefore provide important insight into how individuals (and indeed groups) with particular genetic profiles respond to certain diets. This is an area that has great commercial interest and potential for leading to the development of functional foods.

Research in the area of nutrigenomics may combine human genetic data with for example, attitudinal data in order to determine which consumers may "purchase" nutrigenomics services. This could present a conflict between the regulatory requirements for handling genetic data and those for handling non-medical data.

One solution is to apply the most stringent ethical requirements to all data collection. However this may present some practical problems, for example in situations where ethics committees with the appropriate experience do not exist.

8. **Novel foods, Functional foods and health claims**
   Nanotechnology, nutrigenomics and genetic modification applied to functional foods development raises all of the issues associated with clinical trials research, especially in the light of existing and emerging legislation regarding health-claim labelling such as the EU Regulation No 1924/2006 "to ensure a high level of protection for consumers and to facilitate their choice" and to achieve "free movement of foods and create … equal conditions of competition" [2].
9. **Nanotechnology and Genetic Modification (GM) applied to Foods**
   Both nanotechnology and gene technologies are perceived to harbour unknown risks. Therefore transparency and labelling of nano-based foods and GM foods are essential. Consumers should have the right of informed choice and the possibility of 'exit' in order to avoid such foods if they consider them to present a risk to themselves, others or the environment. This requires accurate and transparent labelling of products together with clinically tested health claims for functional foods.

Safety is an important issue. There is an ethical requirement to develop novel risk analysis paradigms for nanotechnology (for example, associated with the unknown environmental fate of nano-particles, such as nano-biocides like nano-silver particles, or the unknown effects of the bioaccumulation of nanoparticles on human tissues) and there are similar ethical issues associated with these applications in the food area specifically. Therefore any use of nanotechnology products in food or food packaging must be safety tested on a case by case basis and uncertainties made clear. Similarly, ethical implications of the intended environmental release or non-contained use of potentially bioactive materials also need to be considered. It is relevant to note that all normal procedures regarding animal experimentation need to be adhered to with regard to toxicity testing, including the need to develop appropriate in vitro procedures where this is feasible.

14.5.1 Other Food-Related Ethical Issues

In addition to ethical issues associated with food research, there are a number of other food-related areas where ethical issues arise. These would include food security, emergency food aid, food-related development aid, health claims and food marketing and labelling

14.5.2 Food Security

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" [3].

Although the world is capable of producing enough food to feed around 900 million people are chronically hungry and up to two billion suffer food insecurity intermittently. How therefore can fairness in food distribution be improved? How can we improve justice in balancing economic, environmental and access to food pressures? Should basic food entitlements for the global poor be built into food trade and distribution mechanisms? To what extend does emergency food aid from the international community damage local food security in the longer term?

14.5.3 Global Food Marketing and Trade

To what extent do global trade regulations contribute to, or militate against relief of poverty and hunger? To what extent do import and safety regulations in the developed world *unfairly* disadvantage producers and manufacturers in the developing world?

14.5.4 Sustainable Food Production and Distribution

Climate change threatens global food supply. Some agricultural practices contribute adversely to climate change. Consequently there is an ethical argument for embracing low greenhouse gas (GHG) farming practices. This would have to be developed at a global level with appropriate support and compensation for developing countries.

Intensive farming of animals may increase meat supply but increasingly raises concerns about animal welfare and safety issues associated with the risk of zoonoses. Therefore ethically sustainable meat production requires high standards of animal welfare. Alternative sources of meat and other protein also need to be investigated. This might include for example, insect protein or tissue cultures. Both these alternatives are likely to face an issue of public acceptability.

In most of these areas, there are many conflicting issues and interests. As a result there is still a considerable way to go to establish and implement internationally agreed ethical approaches and many questions still remain to be answered.

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