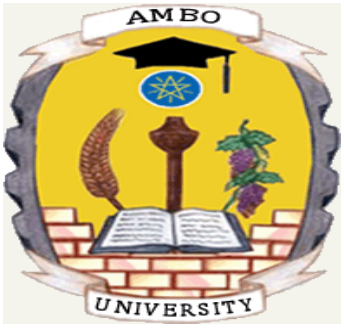
AMBO UNIVERSITY WOLISO CAMPUS

SHOOL OF BUSINESS AND ECONOMICS



DEPARTMENT OF AGRICULTURAL ECONOMICS

COURSE TILTLE: FARM MANAGEMENT

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1. INTRODUCTION TO FARM MANAGEMENT

1.1 Definitions, principles and concepts of Farm Management

Farm management is a science which deals with the proper combination of and operation of production factors including land, labor and capital and the choice of crop and livestock enterprises to bring about the maximum of continues return to the most elementary operation units of farming.

FM as a subject matter is the application of agricultural science, business and economic principles in farming from the point of view of an individual farmer.

FM can also be defined as it is the sub branch of agricultural economics which deals with decision making on the organization and operation on a farm for securing maximum continuous net income consistent with the welfare of the family. Thus, in simple words, farm management can be defined as a science which deals with judicious decisions on the use of scarce farm resources, having alternative uses to obtain the maximum profit and family satisfaction on continuous basis from the farm as a whole and under sound farming programs.

FM seeks to help the farmer in deciding problems like?

- What to produce? (Selection of profitable enterprises) and How much to produce? (Enterprise mix and resource use level)
- How to produce? (selection of least cost production method)
- For whom to produce? (selection of consumer)\

In other words, FM tries to answer the basic economic questions related to a given farm conditions. Thus, FM may in short be called a science of decision making or a science of choice.

Some Preliminary Concepts

Farm Define: is the smallest unit of agriculture which may consist of one or more plots cultivated by one farmer or group of farmers in common for raising crop and livestock enterprise. It is a producing unit as well as a consuming unit.

Family Farm Defined: A family holding (farm) may be defined briefly as being equivalent, according to local conditions and under the existing conditions to techniques, either to plough unit or to work unit for a family of average size.

Agriculture defined: the sum total of the practices of crop production and live stock rising on individual farms is called agriculture. Hence, the agricultural production is the sum of contribution of the individual farm unit, and the development of agriculture means their sum of developments of millions of farm units.

Farm firm: the farm is a firm because production is organized for profit maximization. On the other hand, it is a house hold unit demanding maximum satisfaction of the farm family. In this case the manager of the farm comes to understanding with the twin objective by linking one with the other.

Stock and flow inputs: stock inputs are resources which are consumed during the production period, like seed, fertilizer, pesticide and the like. They can be stored if not used currently, for future use. As against this, flow inputs like labor and management, and if not used cannot be stored for the next season.

1.2. Why We Study Farm Management?

1.3 Objectives and scope of farm management

The central theory of farm management is the theory of optimal decision making in the o0rganization and operation of a farm for profit maximization.

Looking at the farm structure as a whole, it is apparent the objectives of farm management are those that have to do with the two aspects of the same farm as producing unit and as a consuming unit along with the harmonization of their behavior and goals. Broadly speaking the objectives of farm management are:

1. To study the existing resources – land, labor, capital and managerial skill-and the production pattern of the farm
2. To perform the strategic task of finding out the deviation of the resources from their optimum utilization
3. To explain the means and the procedure of moving from the existing combination of resources to their optimum use for profit maximization
4. To outline conditions that would simultaneously obtain its objectives of profit maximization and maximization of family satisfaction through optimum use of resource and judicious income distribution

Scope of farm management

Farm management is generally consider to fall in the field of micro economics that means in a way concerned with the problems of resources allocation in the agricultural sector, and even the economy as a whole, the primary concern of farm management is the farm as a unit. It deals with the allocation of resources at the level of an individual farm. It covers the whole aspect of individual farm business which has bearing in the economic efficiency of the farm these includes all production, finance and marketing activities

1.4. Nature and Characteristics of Farm Management Science

Farm management is basically both an applied and pure science because it deals with collection, analysis and explanation of factors and the discovery of principles (theory). It is an applied science because the ascertainments and solutions of farm management problems (technology) are within its scope. ***Farm management*** has the following distinguishing characteristics from their fields of agricultural science.

i. **Practical science** : it is practical science, because while dealing with facts of other physical and biological sciences it aims at testing the applicability of those facts and findings and showing how to put these results to use on a given farm situation

ii. **Profitability oriented**: biological fields like agronomy and plant breeding concern themselves with distaining the maximum yield per unit irrespective of the profitability of input used. However, the farm management specialist always considers with the profitability of the farm

iii. **Integrating science or interdisciplinary science**: it involves different disciplines to decision. Making the facts and findings of coordinated for the solution of various problems of individual farmers with the view to achieving desired goals.

iv. **Broader field**: it uses more than one discipline to make decisions it gathers knowledge from many other sciences for making decision and farm management specialists have to know the broad principles of all other concerned sciences in addition to specialization in the business farm management.

v. **Farm unit as a whole**: in farm management analysis a farm as a whole is considered to be the unit for making decisions because the objective is to maximize the return from the whole farm instead of only improving the returns from a particular enterprise or practice

1.5. Farm Decision Making

As indicated before, farm management is concerned with the allocation of limited resources among a number of alternative uses which requires a manager to make decision. A manager, first, must consider the resources available for attaining goals which have been set. Limits are placed on goal attainment because most managers are faced with a limited amount of resources.

The **process of making a decision** can be formalized in to a logical and orderly series of steps. Important steps in farm decision making process are:

Following these steps will not ensure a perfect decision. It will however, ensure that the decision is made in logical and organized manner

Identify and define the problem: a manager must constantly be on the alert to identify the problems and to identify them as quickly as possible. Most problems will not go away by them selves and represent an opportunity to increase the profitability of the business through wise decision making.

Collecting relevant data and information: once a problem has been identified the next step should be to gather a data, information and facts, and to make observations which pertain to the specific problem.

Identifying and analyzing alternatives: once the relevant information is available the manager can begin listing alternatives which are potential solutions to the problem. Several may become apparent during the process of collecting data and transforming data into information. Each alternative should be analyzed in a logical and organized manner to insure accuracy and to prevent something from being overlooked.

Making decision: choosing the best solution to a problem is not always easy, nor is the best solution always oblivious. Sometimes the best solution is the best solution is to do nothing or to go back, redefine the problem and go through the decision making steps again. These are legitimate decisions but they should not be used as way to avoid making a decision when a promising alternative is available. After all the pros and cons of each alternative are weighed, one may not appear to be definitely better than other. The one showing the greatest increase in expected profit will normally be selected. Uncertainty and risks should be considered if several alternatives have nearly the same potential effect on profit

Implementing decisions: selecting the best alternatives will not give the desire result unless the decision is correctly and promptly implemented. Resources may need to be acquired and organized. These require some physical actions to be taken.

1.6. Some farm management problems in developing countries

Farm management problems in developing countries may vary from place to place depending largely upon the degree of agricultural development and the availability of resources. The following are some of the most common problems in the field of farm management

1. ***Small size of farm business***: the average land size or operational holding in Ethiopia is small, the holdings are fragmented too. Excessive pressure of population creates unfavorable man land ratio in most parts of the country. This combined with excessive family labor, which depends upon agriculture, has weakened the financial position of the farmer and limited the scope for business expansion.

2. ***Farm as a household***: in most parts of the country family farms perpetuate the traditional combination of crops and methods of cultivations. Thus the equation between agricultural labor and household labor becomes an identity. This makes difficult for the farmer to introduce business content and incorporate new management idea in his farm operations. Home management thus heavily influenced and gets influenced by farm decisions.

3. ***Inadequate Capital***: capital shortage is peculiar feature of farming in developing countries. Most often, peasant agriculture (which is mostly subsistence) is labor intensive and characterized by serious deficiency of capital. Generally small size of farms, problems of tenure ship and no remunerative prices have set the farmer under perpetual poverty. New technologies demand higher inputs such as more fertilizers, plant protection measures, irrigation and better seeds as well as investment in power and machinery. Small farmers cannot meet financial requirements from their own funds. Hence, low cost, adequate and timely credit is their most pressing need if they have to have to put their firm-farms on growth paths.

4. ***Under-employment of factors of production***: under-employment of factors of production in developing countries emanate from:

   a. Small size of the farms,
   b. Large family labor supply,
   c. Seasonal nature of production
   d. Lack of subsidiary or supporting rural industries.
5. ***Slow adoption of innovation***: small farmers are usually conservative and sometimes skeptical of new technologies and methods. The rate of adoption however, depends; largely on the farmers' willingness and ability to use the new information (once they get it effective they will become eager to adopt it). However, since established attitudes and values do not change overnight, the extension take time to get the research results commercially adopted and existed on the farms. It calls for training and substantial financial requirements.
6. ***Inadequate of input supplies***: farmers may be willing to introduce change yet they may face the difficulty in obtaining the required inputs of required quality, insufficient quantity, and on time to sustain the introduced changes. Shortages of foreign exchange in developing countries seriously limit importation of needed supplies and materials. Domestic industries generally lack raw materials, skills, capital or a combination of these to manufacture the needed farm supplies for inputs. No fertilizer, tractor, insecticides, etc. manufacture is yet introduced in the country.

7. ***Managerial skill***: the most and difficult problem for many years has been the managerial skill of large number of small scale farmers in the country. This is necessary to make millions of ultimate users of research results develop progressive attitudes and be responsive to the technological charges. Education of farmers on a mass scale is thus most important. Even illiterate people can be educated through demonstration of the application of new techniques and better ways of the inputs available.

8. Communication and markets: these two are important elements of infrastructure necessary for introducing economic content in the farm organizations. Lack of adequate communication system and the regulated market organization stand as a major bottleneck in the way of improving the

management of farms on business lines. Substantial investments therefore need to be made on roads, marketing systems, and other communication facilities in almost all parts of the country

1.7. Characteristics of farming as a Business

1.7.1. Characteristics of Farming

Farming as a business has many distinguishing features from most other industries in its management methods and practices. The major differences between farming and other industries are:

1. ***Primary forces of production***: Agriculture is primarily biological in nature. A slight change in the environment may cause serious difficulties. One day cold, for example, may destroy the whole of standing crop. Unforeseen changes in the environment such as plant or animal diseases and storm can cause a considerable damage. Most of the other industries are less likely to be affected by such circumstances.

2. ***Size of the production unit***: Farming is a small sized business as it gives little scope for the division of labor. In this business the farmer id both the laborer and the capitalist.

3. ***Heavy dependency upon climatic factors***: Weather changes may involve readjustments. As a result of dependency on climatic factors, management practices in farming must be much more flexible than in other industries.

4. ***Frequency and speed if decisions***: Farming requires many and speedy decisions on the part of the farmers and the farm workers.

5. ***Change in price:*** Agricultural prices and production usually move in opposite directions. Because of the effects of climatic and biological factors, a relatively large volumes of production of a given farm commodities is usually followed by a decrease in price, and a smaller volume results in increased in prices.

6. ***Fixed and variable costs***: Of the total costs, portion of fixed costs is more in agriculture than in other industries. This high proportion of fixed costs tends to make the adjustments in production more difficult.

7. ***Inelastic demand for farm products***: Agriculture deals with production of food and raw materials. As a standard of living improve and income increases, the demand for agricultural products will increase less rapidly than that of industrial products. On the other hand, if increased production comes from the decreased marginal returns phase, costs will go high. Higher production May reduce prices so low that total returns might not increase or even may decrease.

2. PRODUCTION RELATIONSHIPS

Pre-test questions

- What are inputs and outputs?
- Can you mention the basic production decisions in farm business?
- What does a production function represent in farm production?
- State the possible types of production relations.

Production function is defined as the technical relationship between inputs and output indicating the maximum amount of output that can be produced using alternative amounts of variable inputs in combination with one or more fixed inputs under a given state of technology. It is usually presumed that unique production functions can be constructed for every production technology. The relationship of output to inputs is non-monetary; that is, a production function relates physical inputs to physical outputs, and prices and costs are not reflected in the function.

Forms and Types of Production Functions

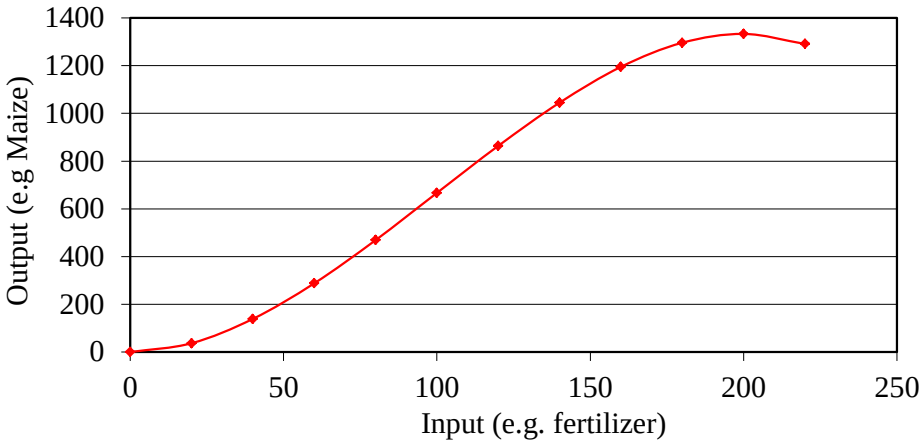
Production Function Forms

Production functions can be expressed in three forms: tabular, graphic and algebraic forms.

Tabular form: Production function can be expressed in the form of a table where one column represents input and the other indicates the corresponding total output for each input level. The two columns constitute production function.

Input (x)	Output (y)
0	2
10	5
20	11
30	18
40	25

Graphical Form: The production function can also be illustrated in the form of a graph. In graphical form the horizontal axis (X-axis) represents input and the vertical axis (Y- axis) represents the output.



From the graph above, we notice that:

- the production function is a continuous curve
- inputs and outputs are perfectly divisible (otherwise, it would look like a series of dots)
- inputs and outputs are homogenous

Algebraic Form: Algebraically production function can be expressed as Y= f(X). Where 'Y' represents dependent variable - output (yield of crop, livestock enterprise) and 'X' represents independent variable- input (seeds, fertilizers, manure etc), 'f =' denotes function. When all inputs in the production process individually expressed, the function is represented as $Y=f(X_1, X_2, X_3, X_4 \ldots\ldots\ldots X_n)$. In the case of single variable production function, only one variable is allowed to vary keeping others constant, the function can be expressed as:

$Y=f(X_1 \mid X_2, X_3 \ldots\ldots\ldots X_n)$. The vertical line used mark between variable and fixed input type. In such expression all inputs before the line represent variable type. The function denotes that the output Y depends on the variable input X_1, with all other inputs held constant. If more than one variable input is varied and others are held constant, the relationship can be expressed as:

$Y=f(X_1, X_2 \mid X_3, X_4 \ldots\ldots\ldots X_n)$

There are different functional forms to represent production function. Some of the functional forms include:

Linear production function, Y= a+bX

Quadratic equation, $Y = a+bX \pm cX^2$

The constant 'a' represents the amount of product obtained from the fixed factor if none of the variable input is applied, while 'b' is the amount of output produced for each unit of X (input) applied.

Exponential function, $Y = AX_1^{b1} X_2^{b2}$ -commonly known as Cobb-Douglas production function

The representation of the various symbols used in the above function is given below

Y- Dependent variable,

a - constant,

b - Coefficient,

X's - independent variable

Types of Production Functions

Continuous Production Function: A production function applicable for those inputs which can be split up in to smaller units. All those inputs which are measurable result in continuous production function. Example: Fertilizers, Seeds, Plant protection chemicals, Manures, Feeds, etc.

Discontinuous or discrete Production Function: Such a function is obtained for resources or work units which are used or done in whole numbers. In other words, production function is discrete if inputs cannot be broken in to smaller units. Alternately stated, discrete production function is obtained for those inputs which are counted. Example: Ploughing, Weeding, Irrigation etc.

Short Run Production Function (SRPF): Production Function in which some inputs or resources are fixed. $Y= f (X_1 | X_2, X_3,\ldots\ldots\ldots\ldots..,Xn)$ Eg: Law of Diminishing returns or Law of variable proportions

Long Run Production Function (LRPF): Production function which permits variability in all factors of production. $Y = f (X_1, X_2, X_3\ldots Xn)$.

Production Relations

Production of farm commodities involves numerous relationships between resources and products. Some of these relationships are simple, others are complex. Knowledge of these relationships is essential as they provide the tools or means by which the problems of production or resource use can be analyzed. The major production relationships include: Factor -Product relationship, Factor -Factor relationship and Product-Product relationship

Factor-Product Relations

The Factor-Product Relations deal with the production efficiency of resources. The rate at which the factors are transformed in to products is studied by this relationship. The central goal of this relationship is optimization of production. The relationship is known as input-output relationship by farm management specialists and fertilizer responsive curve by agronomists. Factor-Product relationship guides the producer in making the decision on 'how much to produce?' It helps the producer to decide the optimum input level to use and optimum output level to produce. The decision on the optimal levels of input and output is made by using price ratio as the choice indicator. Algebraically, this relationship can be expressed as

$Y = f (X_1 / X_2, X_3\ldots\ldots\ldots\ldots\ldots X_n)$

The factor - product relationship or the amount of a resource that should be used and consequently the amount of output that should be produced is directly related to the operation of law of diminishing returns. This law explains how the amount of product obtained changes as the

amount of one of the resources is varied keeping other resources fixed. It is also known as law of variable proportions or principle of added costs and added returns.

The law of diminishing returns states:
An increase in capital and labor applied in the cultivation of land causes in general less than proportionate increase in the amount of produce raised, unless it happens to coincide with the improvements in the arts of agriculture

If the quantity of one of productive service is increased by equal increments, with the quantity of other resource services held constant, the increments to total product may increase at first but will decrease after certain point

The Law originally developed by early economists to describe the relationship between output and a variable input keeping all other inputs constant if increasing amount of one input is added to a production process while all others are constant, additional output will eventually decline the law implies there is a "right" level of variable input to use with the combination of fixed inputs

Limitations:
The law of diminishing returns fails to operate under certain situations. They are called limitations of the law. These limitations under which the law doesn't hold include: improved methods of cultivation, new soils and insufficient capital.

Why the law of diminishing returns operates in agriculture?
The law of diminishing returns is applicable not only to agriculture but also manufacturing industries. This law is as universal as the law of life itself. If the industry is expanded too much, supervision will become difficult and the costs will go up. The law of diminishing returns, therefore, sets in. The only difference is that in agriculture it sets in earlier and in industry much later. There are several reasons for the operation of law of diminishing returns in agriculture. Among them is:

- Excessive dependence on weather
- Limited scope for mechanization
- Soil gets exhausted due to continuous cultivation
- Cultivation extends to inferior lands

Concepts of product curves
Total product (TP): Amount of product which results from different quantities of variable input. Total product indicates the technical efficiency of fixed resources.

Average Product (AP): It is the ratio of total product to the quantity of input used in producing that quantity of product. AP= Y/X where Y is total product and X is total input. Average product indicates the technical efficiency of variable input.

Marginal product (MP): Additional quantity of output resulting from an additional unit of input used. MP = Change in total product / Change in input level ($\Delta Y/\Delta X$) for discrete change.

Total Physical Product (TPP): It is the Total Product (TP) expressed in terms of physical units like Kgs, quintals, etc. Similarly if AP and MP are expressed in terms of physical units, they are called Average Physical Product (APP) and Marginal Physical Product (MPP) respectively.

Total Value Product (TVP): Expression of TPP in terms of monetary value is known as Total Value Product. TVP = $TPP*P_y$ or $Y*P_y$

Average Value Product (AVP): The expression of Average Physical Product in money value. AVP = APP * P_y

Marginal Value Product (MVP): When MPP is expressed in terms of money value; it is called Marginal Value Product. MVP = MPP * P_y or $(\Delta Y/\Delta X) * P_y$ or $\Delta Y * P_y / \Delta X$

Relationships between Total Product (TP) and Marginal Product (MP):

- If Total Product is increasing, the Marginal Product is positive.
- If Total Product remains constant, the Marginal Product is zero.
- If Total Product is decreasing, Marginal Product is negative.
- As long as Marginal Product increases, the Total Product increases at increasing rate.
- When the Marginal Product remains constant, the Total Product increases at constant rate.
- When the Marginal Product declines, the Total Product increases at decreasing rate.
- When Marginal Product is zero, the Total Product is at maximum.
- When marginal product is less than zero (negative), total physical product is declining at increasing rate.

Relationship between Marginal and Average Product

- If Marginal Product is more than Average Product, Average Product is increasing.
- If Marginal Product is equal with the Average Product, Average Product is Maximum.
- When Marginal Product is less than Average Product, Average Product is decreasing.

Table 1: Relationship between TP, AP and MP

Input (X)	Total Product (Y)	Average Product (AP= Y/X)	Marginal Product (MP=ΔY/ΔX	Remark
0	1	-	-	Increasing Returns
1	2	2	1	
2	5	2.5	3	
3	9	3	4	
4	14	3.5	5	Constant Returns
5	19	3.8	5	
6	23	3.83	4	Decreasing Returns
7	26	3.71	3	
8	28	3.5	2	
9	29	3.22	1	

10	29	2.9	0	
11	28	2.54	-1	Negative Returns
12	29	2.16	-2	

Three Regions of Production Function

The production function showing total, average and marginal product can be divided into three regions or stages or zones in such a manner that one can locate the zone of production function in which the production decisions are rational or not. The three sages are shown in the figure below.

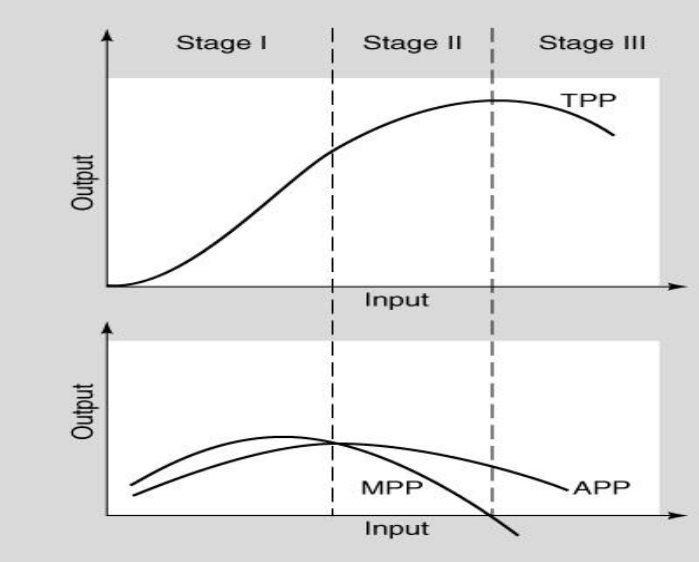


Figure 1: Stages of production

Stage I: In this stage, the average rate at which variable input (X) is transformed into product (Y) increases until it reaches its maximum (i.e., Y/X is at its maximum). This maximum indicates the **end of Stage I.**

The first stage starts from the origin i.e., zero input level. In this zone, Marginal Physical Product is more than Average Physical Product and the Average Physical Product increases throughout zone. Marginal Physical Product (MPP) is increasing up to the point of inflection and then declines. Since the marginal Physical Product increases up to the point of inflection, the Total Physical Product (TPP) increases at increasing rate. After the point of inflection, the Total Physical Product increases at decreasing rate. Elasticity of production is greater than unity up to maximum Average Physical Product (APP) and becomes one at the end of the zone (MPP = APP). In this zone fixed resources are in abundant quantity relative to variable resources. The technical efficiency of variable resource is increasing throughout this zone as indicated by Average Physical Product. The technical efficiency of fixed resource is also increasing as reflected by the increasing Total Physical Product. Marginal Value Product is more than Marginal Factor Cost (MVP >MFC) and Marginal revenue is more than marginal cost (MR >

MC). This is irrational or sub-optimal zone of production. And this zone ends at the point where MPP=APP or where APP is Maximum.

For Economic decisions Stage **I** is irrational zone of production. Any level of resource use falling in this region is uneconomical. The technical efficiency of variable resource is increasing throughout the zone (APP is increasing). Therefore, it is not reasonable to stop using an input when its efficiency is increasing. Which means more products can be obtained from the same resource by reorganizing the combination of fixed and variable inputs. For this reason, it is called irrational zone of production.

Stage II: The second zone starts from where the technical efficiency of variable resource is maximum i.e., APP is Maximum (MPP=APP)

- In this zone Marginal Physical Product is less than Average Physical Product. Therefore, the APP is decreasing throughout this zone.
- Marginal Physical Product is decreasing throughout this zone.
- As the MPP declines, the Total Physical Product increases but at a decreasing rate.
- Elasticity of production is less than one between maximum APP and maximum TPP and becomes zero at the end of this zone.
- In this zone variable resource is more relative to fixed factors.
- The technical efficiency of variable resource is declining as indicated by declining APP.
- The technical efficiency of fixed resource is increasing as reflected by increasing TPP.
- The condition Marginal Value Product is equal to Marginal Factor Cost (MVP=MFC) and Marginal Revenue is equal to Marginal Cost (MR= MC) exists in this stage
- This is rational zone of production in which the producer should operate to attain his objective of profit maximization.
- This zone ends at the point where Total Physical Product is at maximum or Marginal Physical Product is zero.

Stage II is rational zone of production. The area within the boundaries of this region is of economic relevance. Optimum point must be somewhere in this rational zone. It can, however, be located only when input and output prices are known.

Stage III: This zone starts from where the technical efficiency of fixed resource is maximum (TPP is Maximum). In Stage II:

- Average Physical Product is declining but remains positive
- Marginal Physical Product becomes negative
- The Total Physical Product declines at faster rate since MPP is negative.
- Elasticity of production is less than zero (Ep < 0)
- In this zone variable resource is in excess capacity
- The technical efficiency of variable resource is decreasing (declining APP)
- The technical efficiency of fixed resource is also decreasing (declining TPP)
- Marginal Value Product is less than Marginal Factor Cost (MVP < MFC)

- Marginal Revenue is less than Marginal Cost (MR < MC)
- This zone is irrational zone of production.

Producer should never operate in this zone even if the resources are available at free of cost.

Stage III is also an area of irrational production. TPP is decreasing at increasing rate and MPP is negative. Since the additional quantities of resource reduces the total output, it is not profitable zone even if the additional quantities of resources are available at free of cost. If farmer operates in this zone, he will incur double loss, that is, reduced production and unnecessary additional cost of inputs.

In summary, for a Factor-Product type production relation, the optimal use of variable factor is the level for which the VMP is equal to the factor price. It is located in stage II. The economic meaning of the optimal solution would mean:
Increasing use of a factor by one unit is profitable if the increase in the total revenue resulting from increased input (= the VMP) is higher than the increase in cost (i.e., the price P_x paid for one unit of the factor). If this condition fulfilled profit is maximized.

Factor-Factor Relations

This relationship deals with the resource combination and resource substitution. Cost minimization is the goal of factor-factor relationship. Under factor-factor relationship, output is kept constant while inputs are varied in quantity. This relationship guides the producer for a decision on 'how to produce'. Such a relation is explained by the principle of factor substitution or principle of substitution between inputs. Factor-Factor relationship is concerned with the determination of least cost combination of resources. The choice indicators are the physical substitution ratio and price ratio. It is expressed algebraically as:
$Y = f(X_{1,} X_{2,} / X_3, X_{4...} X_n)$, where we consider two variable inputs

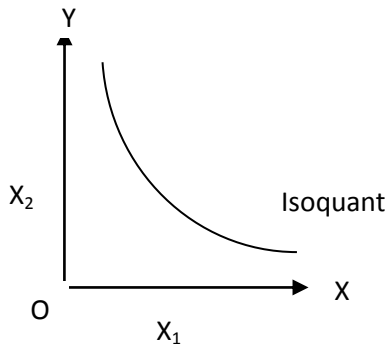
In the production process inputs are substitutable. For instance capital can be substituted for labor and vice versa; grain can be substituted for fodder and vice versa. The producer has to choose that input or inputs, practice or practices which produce a given output with minimum cost. The producer aims at cost minimization through choice of inputs and their combinations.

Concept of Isoquants:

X_1	X_2	Output
3	20	60

The relationship between two factors and output cannot be presented with a two dimensional graph. Three variables can be presented in a three dimensional diagram giving a production surface. An isoquant is a convenient method for compressing three dimensional picture of production into two dimensions. Hence, *isoquant is defined as all possible combinations of two resources (X_1 and X_2) physically capable of producing the same quantity of output.* Isoquants are also known as isoproduct curves or equal product curves or product indifference curves. Graphical representation of isoquant is given below.

4	15	60
6	10	60
10	6	60
15	4	60
20	3	60



Isoquant Map or Isoproduct Contour

If a number of isoquants are drawn on one graph it is known as isoquant map. Isoquant map indicates the shape of production surface which in turn indicates the output response to the inputs.

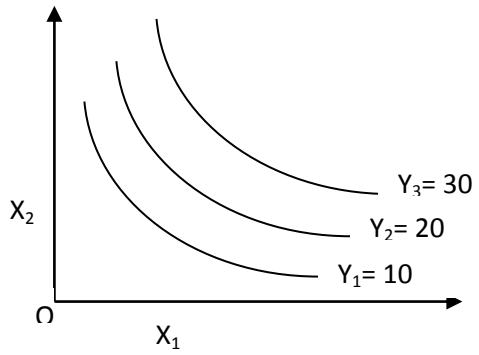


Figure 2: Isoquant Map

Isoquants further from the origin represent higher production level. The Y's in the graph are ordered as $Y_1 < Y_2 < Y_3$

Characteristics of Isoquant

- Slope downwards from left to right or negatively sloped
- Convex to the origin
- Nonintersecting
- Isoquants lying above and to the right of another represent higher level of output
- The slope of isoquant denotes the marginal rate of technical substitution (MRTS).

Marginal Rate of Technical Substitution (MRTS)

MRTS refers to the amount by which one resource is reduced as another resource is increased by one unit. Or the rate of exchange between some units of X_1 and X_2 which are equally preferred. MRTS can be represented as:

MRTS X_1 for $X_2 = \Delta X_2/\Delta X_1$

MRTS X_1 for $X_2 = \Delta X_1/\Delta X_2$

$$\text{Marginal Rate of Technical Substitution} = \frac{\text{Number of units of replaced resource}}{\text{Number units of added resource}}$$

MRTS gives the slope of Isoquant. Substitutes indicate a range of input combinations which will produce a given level of output. When one factor is reduced in quantity, a second factor must always be increased. Hence MRTS is always less than zero or it is negative.

Types of factor substitution

The shape of isoquant and production surface will depend up on the manner in which the variable inputs are combined to produce a particular level of output. There can be three such categories of input combinations.

Fixed Proportion combination of inputs: Under fixed combination, to produce a given level of output, inputs are combined together in fixed proportion. Isoquants are 'L' shaped. It is difficult to find examples of inputs which combine only in fixed proportions in agriculture. An approximation to this situation is provided by tractor and driver combination. To operate another tractor, normally we need another driver.

Constant rate of Substitution: For each one unit gain in one factor, a constant quantity of another factor must be sacrificed. When factors substitute at constant rate, isoquants are linear & negatively sloped.

Decreasing Rate of substitution: Every subsequent increase in the use of one factor in the production process can replace less and less of the other factor. In other words, each one unit increase in one factor requires smaller and smaller sacrifice in another factor.

Ex: Capital and labour, concentrates and green fodder, organic and inorganic fertilizers etc. Isoquants are convex to the origin when inputs substitute for each other at decreasing rate. Decreasing rate of factor substitution is more common in agricultural production.

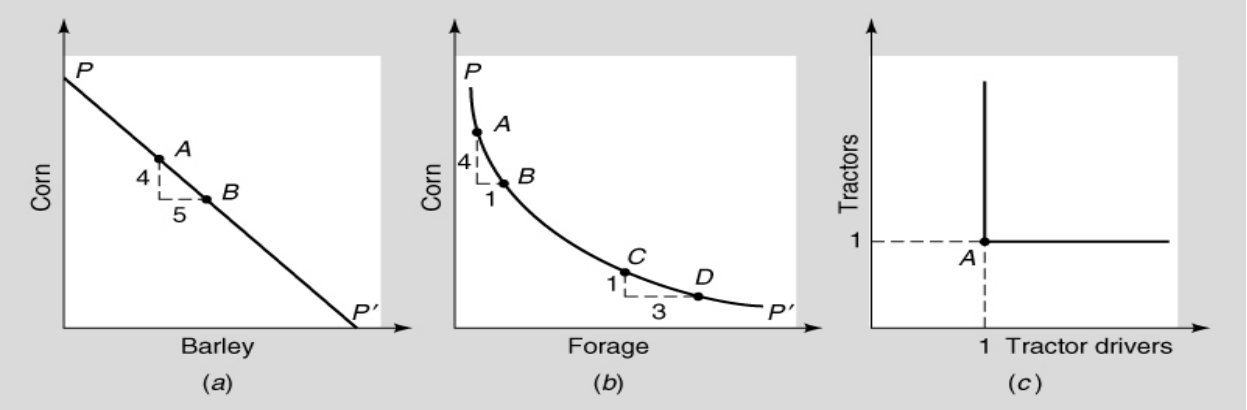


Figure 3: Input Substitution Types

Isocost Line (price line or budget line)

Isocost line defines all possible combinations of two resources (X_1 and X_2) which can be purchased with a given outlay of funds. Isocost line is used in the concept of optimal input combination in the production process.

Characteristics of Isocost line:

As the total outlay increases, the isocost line moves farther away from the origin.

Isocost line is a straight line because input prices do not change with the quantity purchased.

The slope of isocost line determined as the ratio of factor prices.

Least Cost Combination of inputs

There are innumerable possible combinations of factors which can be used to produce a particular level of output. The problem is to find out a combination of inputs which cost the least;

a cost minimization problem. There are three methods to find out the least cost combination of inputs. These methods are explained below.

1. ***Simple Arithmetical calculations (presented in Table)***

Units of X_1	Units of X_2	cost of X_1 (price 3 Birr/unit)	Cost of X_2 (Price 2 Birr/unit)	Total Cost
10	3	30	6	36
7	5	21	10	31
5	6	15	12	27
3	**8**	**9**	**16**	**25**
2	12	6	24	30

One possible way to determine the least cost combination is to compute the cost of all possible combinations of inputs and then select the combination with minimum cost. This method is suitable where a limited number of combinations produce a particular level of output. The above table shows five combinations of inputs which can produce a given level of output. The price per unit of X_1 is Birr 3 and of X_2 is Birr 2. The total cost of each combination of inputs is computed and given in the column with Total Cost. Out of five combinations, 3 units of X_1 and 8 units of X_2 is the least cost combination of inputs at a cost of Birr 25 to produce the specified unit of a product.

2. ***Algebraic method:***

Compute Marginal Rate of technical substitution

MRTS = Number of units of replaced resource / Number of units of added resource

MRTS X_1 for $X_2 = \Delta X_2/\Delta X_1$

MRTS X2 for X1 = $\Delta X_1/\Delta X_2$

Compute Price Ratio (PR)

PR=Price per unit of added resource/Price per unit of replaced resource

PR=Px_1/Px_2 if MRTS X_1X_2 or PR= Px2/ Px1 if MRTS X_2X_1

Least combination occurs at a point where MRTS and PR are equal. i.e.

$\Delta X_2/\Delta X_1$= P x_1/Px_2 MRTS X_1X_2

$\Delta X_1/\Delta X_2$= Px_2/ P x_1 MRTS X_2X_1

The same can be expressed as

ΔX_2* Px_2= Px_1*ΔX_1 or ΔX_1*Px_1 =ΔX_2*Px_2

The least cost combination is obtained when Marginal Rate of substitution is equal to Price Ratio. If they cannot be exactly equal because of the choices available in the table, take closer figures without letting the price ratio exceed the substitution ratio.

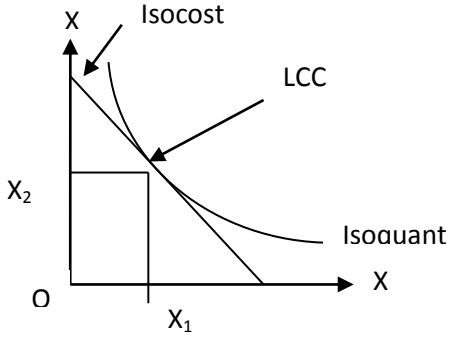
Units of X_1	Units of X_2	MRTSX_2 X_1	PR = Px_2 /Px_1
10	3	-	0.67
7	5	(7-10) /(4-3) = 3.00	0.67
5	6	(5-7) /(6-5) = 2.00	0.67
3	8	(3-5) / (8-6) = 1.00	0.67

2	12	(2-3) /(12-8) = 0.25	0.67

Price of X_1 is Birr 3 per unit, and price of X_2 is Birr 2 per unit

3. ***Graphical Method:***

Since the slope of isoquant indicates MRTS and the slope of isocost line indicates factor price ratio, minimum cost for a given output will be indicated by the tangency of these isoclines (isocost and isoquant lines). For this purpose, isocost line and isoquant are drawn on the same graph.. The least cost combination will be at the point where isocost line is tangent to the isoquant line i.e., slope of isoquant=slope of isocost line i.e. MRTS=PR



Product-Product Relations

Product-Product relationship deals with resource allocation among competing enterprises (individual crop production and animal rearing). The goal of Product-Product relationship is profit maximization through optimal combination of enterprises. Under Product-Product relationship, inputs are kept constant while products (outputs) are varied. This relationship guides the producer in deciding on 'What to produce?' Product-Product relationship is explained by the principle of product substitution. The relationship is concerned with the determination of optimum combination of production (enterprises). The choice indicators are product substitution ratio and price ratio. Algebraically, product-product relation is expressed as:

$Y_1=f(Y_2, Y_3 \ldots Y_n)$

Production Possibility Curve (PPC)

Production Possibility Curve is a convenient device for depicting two production functions on a single graph. Production Possibility Curve represents all possible combinations of two products that could be produced with a given amounts of inputs. Production Possibility Curve is known as Opportunity Curve because it represents all production possibilities or opportunities available with limited resources. It is called Isoresouce Curve or Isofactor curve because each output combination on this curve has the same resource requirement. It is also called Transformation curve as it indicates the rate of transformation of one product into another.

How to draw Production Possibility Curve

Production Possibility Curve can be drawn either directly from production function or from total cost curve. The method of drawing Production Possibility Curve from Production Function is explained below.

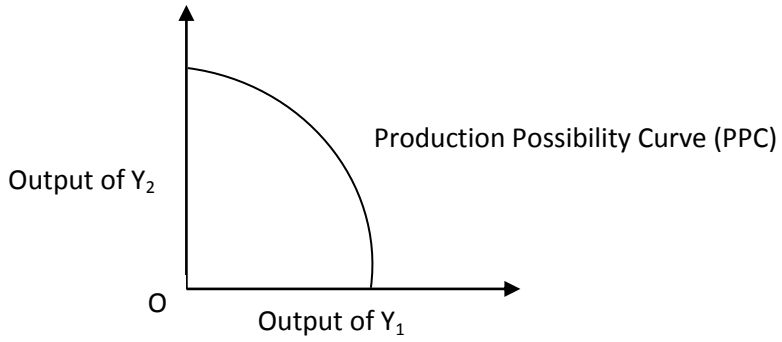
A farmer has five acres of land and wants to produce two products namely cotton (Y_1) and Maize (Y_2). Assume all other inputs are fixed. Now the farmer has to decide how much of land input to use for each product. This implies that amount of land that can be used to produce Cotton (Y_1) depends upon the amount of land used to produce Maize (Y_2).

Therefore, $Y_1 = f(Y_2)$

The allocation of land resource between the two products and the output from different doses of land input are presented below

Allocation of Land in Acres		Output in quintals	
Y_1	Y_2	Y_1	Y_2
0	5	0	60
1	4	8	48
2	3	15	36
3	2	21	24
4	1	26	12
5	0	30	0

As evident from the above data, if all 5 acres of land are used in the production of Y_2 we obtain 60 quintals of Y_2 and do not get any of Y_1. On the other hand, if all the five acres of land are used in the production of Y_1 we can obtain 30 quintals of Y_1 and do not get any of Y_2. But these are the two extreme production possibilities. In between the two, there are many other production possibilities. Plotting these two points on a graph, we get the Production Possibility Curve.



Production Possibility Curve

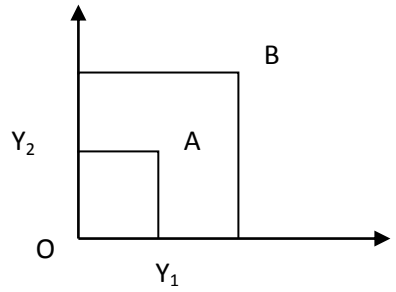
Types of Product-Product Relationships or Enterprise Relationship

Farm commodities bear several physical relationships to one another. These basic product relationships include:

1) Joint Products: such relationship happen when two products are produced through single production process. As a rule the two are combined products. Production of one (main product)

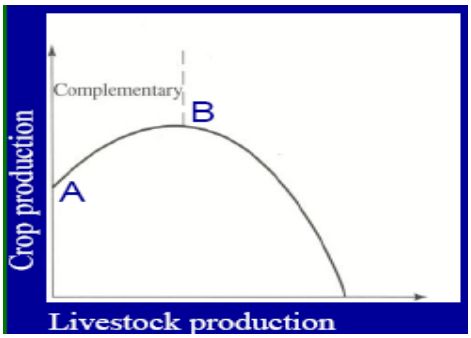
without the other (by-product) is not possible. The level of production of one decides the level of production of another. Most farm commodities are joint products.

Ex: Wheat and Straw, cattle and manure, beef and hides, mutton and wool etc.



Graphically the quantities of Y_1 and Y_2 that can be produced at different levels of resources will be shown as points AB in the figure.

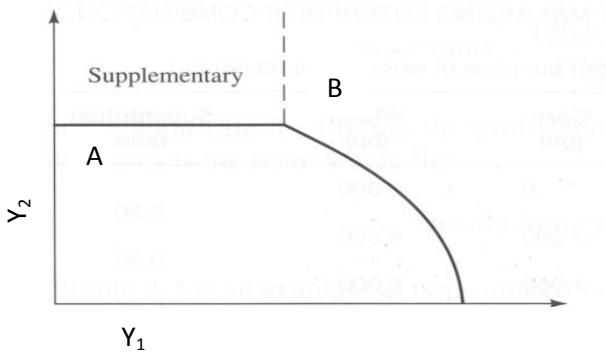
2) Complementary enterprises: Complementarity between two enterprises exists when increasing the production from one enterprise increases the production of the other enterprise. Change in the level of production of one enterprise causes change in the other enterprise in the same direction. That is when increase in output of one product, with resources held constant, also results in an increase in the output of the other product. Temporarily, the two enterprises do not compete for resources but contribute to the mutual production by providing an element of production required by each other. The marginal rate of product substitution is positive (> 0). Ex: crops and livestock enterprises.



As shown in the figure, range of complementarities is from point A to point B when increase in the production of one enterprise (crop) followed by increase in the production of the other enterprise (Livestock). After point B the enterprises will become competitive. All complementary relationships should be taken advantage by producing both products up to the point where the products become competitive.

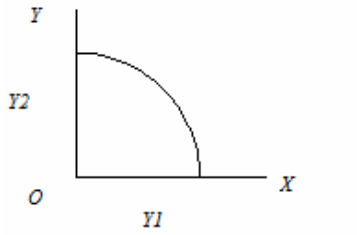
3) Supplementary enterprises: Supplementarity exists between enterprises when increase or decrease in the output of one product does not affect the production level of the other product. They do not compete for resources but make use of resources when they are not being utilized by one enterprise. The marginal rate of product substitution is zero. For example, small poultry or

dairy or piggery enterprise is supplementary on the farm. All supplementary relationships should be taken advantage by producing both products up to the point where the products become competitive.



The two products (Y_1 and Y_2) stay supplementary from A to B as shown in the graph. After point B they become competitive enterprises.

4) Competitive enterprises: This relationship exists when increase or decrease in the production of one product affect the production of other product inversely. That is when there is an increase in output of one product, with resources held constant; production of the other product decreases. Competitive enterprises compete for the same resources. Two enterprises are competitive in the use of given resources if output of one can be increased only through sacrifice in the production of another. The marginal rate of product substitution is negative (< 0)



Marginal rate of product substitution (MRPS)

The term marginal rate of product substitution under the product-product relationship has the same meaning as MRTS under the factor-factor relationship. Marginal rate of the product substitution refers to the absolute change in one product associated with a change by one unit of the competing product. The quantity of one product to be sacrificed so as to gain another product by one unit is given by MRPS.

MRPS = Number of units of replaced product / Number of units of added product

MRPSY1 for Y2 = $\Delta Y_2/\Delta Y_1$

MRPSY2 for Y1 = $\Delta Y_1/\Delta Y_2$

Types of Product Substitution

When two products are competitive, they substitute either at constant rate or increasing rate or at decreasing rate.

1) Constant rate of Substitution:

For each one unit increase or gain in one product, a constant quantity of another product must be decreased or sacrificed. When products substitute at constant rate, the Production Possibility Curve is linear and negatively sloped. Or Production Possibility Curve is linear when products substitute at constant rate. When two products substitute at constant rate, only one of the two products will be economical to produce depending on their relative prices. This is to say that specialization is the general pattern of production under constant rate of product substitution. This relationship can be expressed as

$\Delta_1 Y_2/\Delta_1 Y_1 = \Delta_2 Y_2/\Delta_2 Y_1 = \ldots\ldots = \Delta_n Y_2/\Delta_n Y_1$

Y_1	Y_2	ΔY_1	ΔY_2	$\Delta Y_2/\Delta Y_1$
16	2	-	-	-
12	4	4	2	0.5
8	6	4	2	0.5
4	8	4	2	0.5

2) Increasing rate of product substitution:

Each unit increase in the output of one product is accompanied by larger and larger sacrifice (decrease) in the level of production of other product. Increasing rates of substitution holds true when the production for each independent commodity is one of decreasing resource productivity (decreasing returns) and non-homogeneity in quality of limited resource. The production Possibility Curve is concave to the origin when product substitutes at the increasing rate. Increasing rate of the product substitution is common in agricultural production. The general pattern of production is diversification i.e., profits are maximized by producing both products.

$\Delta_1 Y_2/\Delta_1 Y_1 < \Delta_2 Y_2/\Delta_2 Y_1 < \ldots\ldots < \Delta_n Y_2/\Delta_n Y_1$

Y_1	Y_2	ΔY_1	ΔY_2	$\Delta Y_2/\Delta Y_1$
1	14	-	-	-
2	11	1	3	3
3	7	1	4	4
4	2	1	5	5

3) Decreasing rate of Product Substitution:

Each unit increase in the output of one product is accompanied by lesser and lesser decrease in the production of another product. This type of product substitution holds good under conditions of increasing returns. Production Possibility Curve is convex to the origin when products substitute at decreasing rate. This relationship is algebraically expressed as

$\Delta_1 Y_2/\Delta_1 Y_1 > \Delta_2 Y_2/\Delta_2 Y_1 > \ldots\ldots > \Delta_n Y_2/\Delta_n Y_1$

Y_1	Y_2	ΔY_1	ΔY_2	$\Delta Y_2/\Delta Y_1$
1	10	-	-	-
2	6	1	4	4
3	3	1	3	3
4	1	1	2	2

IsoRevenue Line

Isorevenue line represents all possible combination of two products which would yield an equal (same) revenue or income. Let R is the revenue from two products Y_1 and Y_2 and the prices for both products is given as Py_1 and Py_2 respectively. The Isorevenue equation will be given as:

$R = Y_1 * Py_1 + Y_2 * Py_2$, the line is linear as long as prices for both products do not change

Characteristics:

Isorevenue line is a straight line because product prices do not change with quantity sold.

As the total revenue increases, the isorevenue line moves away from the origin.

The slope indicates ratio of product (output) prices. As long as product prices remain constant, the isorevenue line showing different total revenues are parallel. But change in either price will change the slope.

Determination of optimum combination of products (Economic decision):

The Economic optimum combination of the two products can be determined through three different ways:

1) Algebraic Method:

There are three steps to determine the optimum product combination through algebraic method.

a) Compute Marginal Rate of Product Substitution

MRPS =Number of units of replaced product/Number of units of added product

MRPSY1 for Y2 = $\Delta Y_2/\Delta Y_1$

MRPSY2 for Y1 = $\Delta Y_1/\Delta Y_2$

b) Workout price ratio (PR)

Price Ratio (PR) = Price per unit of added product/Price per unit of replaced product

PR= P y_1/Py_2 if it is $MRPSY_1Y_2$

PR= Py_2/ Py_1 if it is $MRPSY_2Y_1$

c) Find the combination at a point where substitution ration (MRPS) is equal to price ratio (PR). This gives us the Optimum combination of enterprises.

$$\frac{\text{Number of units replaced product}}{\text{Number of units of added product}} = \frac{\text{Price per unit of added product}}{\text{Price per unit of replaced product}}$$

$\Delta Y_2/\Delta Y_1 = Py_1/Py_2$ or $\Delta Y_1/\Delta Y_2 = Py_2/Py_1$

For profit maximization, a rational producer should operate in the range where two products are competitive and within this range the choice of products should depend upon the MRS and PR.

2) Graphic Method:

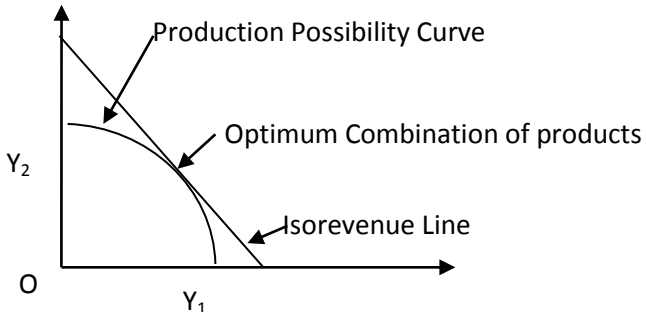
In this method follow the procedure given below to find the optimal product combination.

Draw production possibility curve and isorevenue line on one graph.

Slope of production possibility curve indicates MRPS and the slope of isorevenue line indicate price ratio of products.

The point of optimum combination of products is at a point where the isorevenue line is tangent to the production possibility curve.

At the tangency point, slope of the isorevenue line and the slope of the production possibility curve will be the same. In other words, the MRPS=PR which gives the optimum combination.



3) Tabular Method:

Compute total revenue for each possible output combination and then select that combination of outputs which yields maximum total revenue. This method is useful only when we have few combinations.

Y_1	Y_2	Revenue from Y_1 (Py_1=50)	Revenue from Y_2 (Py_2=80)	Total Revenue
8	2	400	160	560
5	3	250	240	490
6	4	300	320	620
4	5	200	400	600
3	7	150	560	710

Accordingly, the optimum combination includes 3 units of Y_1 and 7 units of Y_2 where the revenue at this combination is the maximum as indicated in the table.

Table 2: Summary of basic production relationships

Factor – Product	Factor – Factor	Product – Product
Deals with resource use efficiency	Deals with resource combination and resource substitution	Deals with resource allocation among enterprises
Optimization of the production is the goal	Cost minimization is the goal	Profit optimization is the goal
Answers the question 'How much to produce?'	Answers the question 'How to produce?'	Answers the question 'What to produce?'
Considers single variable production function	Inputs or resources varied keeping the output constant	Output of products are varied keeping the resource constant
Guides in the determination of optimum input to use and optimum output to produce	Concerned with the determination of Least cost combination of resources	Helps in the determination of optimum combination of products
Price ratios are choice indicator	Substitution ratio and Price ratio are the choice indicators.	Substitution ratio and price ratios are choice indicators
Explained by the law of diminishing returns	Explained by the principle of factor substitution	Explained by the principle of product substitution
$Y=f(X_1 \mid X_2, X_3 \ldots\ldots X_n)$	$Y = f(X_1 X_2 / X_3, X_4 \ldots X_n)$	$Y1=f(Y_2, Y_3, \ldots\ldots Y_n)$

Continuous Assessment

Quiz, test and Assignment

Summary

Production function is a technical relationship between inputs and output in the production process. Production functions can be represented in different forms (tabular, graph, and algebraic) and also categorized in to different types (continuous, discontinuous, short-run and long-run). A production function has three regions which are used to identify product curves.

3. THEORY OF COST

Pre-test question

- What is cost?
- What are the components of costs in agriculture?

Meaning of farm costs

Cost concepts are of profound importance in farm business since they enable us to make choices among present alternative actions. For each possible present action, the measure of the present and future forsaken opportunities is the "cost." The sacrifice is made inevitable when the present action is taken and in this sense, the present action involves present cost.

We can define cost in strict business connotations as the *change in equity* that is caused by the performance of some specified operations. In everyday usage, farm costs comprise expenditures in money and imputed terms, which a farm operator incurs in the operation of his business. This simplistic definition often masks a lot of complexities that are found in allocating costs in farm business. These complexities are such that various measures of costs are employed in clearly determining net returns in practice, as opposed to the simplified notions in production theory.

Allocation of costs

Production processes do not always yield only one product or output. As a matter of fact, many farm enterprises give joint products. Joint products are interdependent in supply, since more of one product generally involves more of the other. In fact, a higher price of one of the products of joint outputs will, by inducing a larger output, also lead to an increased output of the other commodity. Thus, the supply of a good is dependent not only on its own price, but that of other goods -- especially of joint product goods. In fact, the ratio in which joint products are produced is variable, justifying why they also are substitutable at the same time as they are joint.

One problem which plagues farm producers is how one should allocate the costs of the common resources employed in producing each of the joint products. For example, hides and meat are produced from one steer fed on a ration of mixed feeds. The problematic question is: what portion of the cost of feed is the cost of the hide and what portion is the cost of beef? This boils down to the relevant and specific question: Can a "common" cost be allocated among joint products?

The valid answer to this specific question will depend on how we treat each product. In other words, which of the two joint products is treated as a residual or by-product helps us to decide the different allocation of costs. Thus, by calling one of the two products the "basic" product, and the other, the "by-product", we can implicitly as well as explicitly assign the "common costs" between the two goods. This, it must be stressed, is merely an arbitrary allocation which depends solely on which product one calls the basic product.

Another problem which plagues farm operators is how to assess the costs of unpaid inputs. The farm inputs that are conventionally referred to as unpaid or non-cash inputs are operator and family labor services plus farmer-owned or farmer-supplied inputs. Although the measurement in physical terms per se of each of these inputs presents some problems, the role of judgment becomes magnified when we have to weigh these items by constant prices in order to make aggregation possible. The fact that these inputs are not bought and sold as are most other farm inputs, complicates the determination of what prices we should consider most appropriate to use as weights.

Three techniques are usually adopted in deriving prices for unpaid labor and capital inputs in farm business. The first technique is that of deducting from gross income all expenses other than unpaid capital and labor and to call the residual the value of the composite unpaid factors. The second technique is to assign to unpaid labor and capital inputs the prices paid for the labor and capital that are purchased, and used in the way most similar to that of the unpaid inputs. In other words, we use the per unit price of hired farm labor and borrowed farm capital to estimate the prices of the unpaid inputs, which means using hired farm wage rates and interest rates on borrowed capital as price weights for the unpaid labor and capital respectively. The third technique is that of using a combination of the first and second techniques. This implies deducting from the composite residual either labor or capital costs calculated at the rate which uses the second technique, the rest of the residual is then associated with either unpaid labor or unpaid capital, as the case may be.

Agricultural cost functions

Cost functions represent the mathematical presentation of the relationships between total cost of production and the output produced. The costs of production might also be defined not in terms of the use of the input, but in terms of the output. To do this, some basic terms need to be explained.

Variable costs (*VC*) are the costs of production that vary with the level of output produced by the farmer. For example, in the production of corn, with the time period being a single production season, variable costs might be thought of as the costs associated with the purchase of the variable inputs used to produce the corn. Examples of variable costs include the costs associated with the purchase of inputs such as seed, fertilizer, herbicides, insecticides, and so on. In the case of livestock production within a single production season, a major variable cost item is feed.

Fixed costs (*FC*) are the costs that must be incurred by the farmer whether or not production takes place. Examples of fixed-cost items include payments for land purchases, and depreciation on farm machinery, buildings, and equipment.

The categorization of a cost item as fixed or variable is often not entirely clear. The fertilizer and seed a farmer uses can only be treated as a variable cost item prior to the time in which it is placed in the ground. Once the item has been used, it is sometimes called a sunk, or unrecoverable, cost, in that a farmer cannot decide to sell seed and fertilizers already used and recover the purchase price.

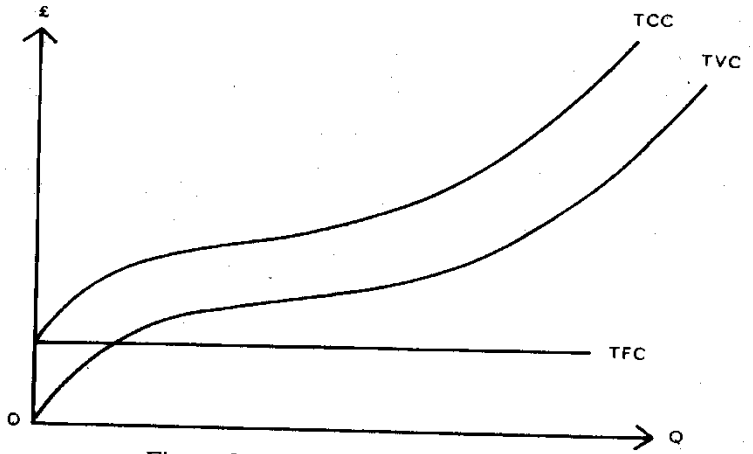


Figure 8.2. *Generalized cost function.*

Although depreciation on farm machinery is normally treated as a fixed cost, given sufficient time, the farmer does have the option of selling the machinery so that the depreciation would no longer be incurred. Payments for the purchase of land would not be made if the farmer elected to sell the land. The categorization of farm labor is very difficult. A farm laborer on an annual salary might be treated as a fixed cost which the farmer incurs whether or not production takes place. But if the laborer is laid off, the cost is no longer fixed. Temporary workers hired on an hourly basis might be more easily categorized as a variable cost.

Over a very short period of time, perhaps during a few weeks within a single production season, a farmer might not be able to make any adjustment in the amounts of any of the inputs being used. For this length of time, all costs could be treated as fixed. Thus the categorization of each input as a fixed- or variable-cost item cannot be made without explicit reference to the particular period involved. A distinction between fixed and variable costs has thus been made on the basis of the period involved, with the proportion of fixed to variable costs increasing as the length of time is shortened, and declining as the length of time increases.

Some economists define the long run as a period of time of sufficient length such that the size of plant (in the case of farming, the farm) can be altered. Production takes place on a short-run average cost curve (*SRAC*) that is U shaped, with the manager equating marginal revenue (the price of the output in the purely competitive model) with short-run marginal cost (*SRMC*). There

exists a series of short-run marginal and average cost curves corresponding to the size of the particular plant (farm). Given sufficient time, the size of the plant can be altered. Farmers can buy and sell land, machinery, and equipment. Long -run average cost (*LRAC*) can be derived by drawing an envelope curve which comes tangent to each short run average cost curve (Figure 6.2).

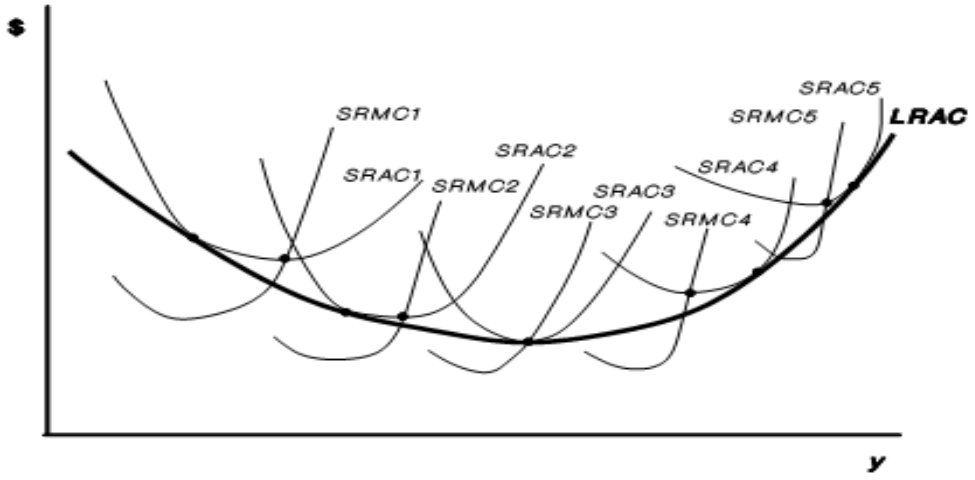


Figure 6.2 Short and Long-Run Average and Marginal Cost with Envelope Long-Run Average Cost

Variable costs are normally expressed per unit of output(*y*) rather than per unit of input(*x*). This is because there is usually more than one variable cost item involved in the production of agricultural commodities. A general expression for a variable cost function is:

$$VC=g(y)$$

Since fixed costs do not vary with output, fixed costs are equal to some constant money value *k*; that is:

$$FC=k$$

Total costs (*TC*) are the sum of fixed plus variable costs.

$$TC=VC + FC \text{ or,}$$

$$TC= g(y) + k$$

Average variable cost (*AVC*) is the variable cost per unit of output

$$AVC = VC/y = g(y)/y$$

Average fixed cost is equal to fixed cost per unit of output

$$AFC = FC/y = k/y$$

There are two ways to obtain average cost (*AC*), sometimes also called average total cost (*ATC*). One way is to divide total cost (*TC*) by output (*y*)

$$AC=ATC=TC/y$$

Another way is to sum average variable cost (*AVC*) and average fixed cost (*AFC*)

$$AC=ATC=AVC + AFC$$

$$AC=ATC=VC/y +FC/y$$

Marginal cost is defined as the change in total cost, or total variable cost, resulting from an incremental change in output.

$$MC = \Delta TC/\Delta y = \Delta VC/\Delta y$$

Since the value for fixed costs (*FC*) is a constant *k*, *MC* will be the same irrespective of whether it is based on total costs or total variable cost.

4. FARM PLANNING AND BUDGETING

Farm planning is deliberate and conscious effort on the part of the farmer or farm manager. It helps him/her to think about the farm programs in advance and just them according to new knowledge of technological developments, challenges in physical and economic situations, price structure, *etc*. a farm organization can succeed in effective utilization of resources when its management decides in advance of its objective and method of achieving them. Without planning and coordinated effort of management, the outcome of any farm business activities becomes wastage of resources.

4.1.1. What is farm planning?

Definition: farm planning is a process to allocate the scarce resources of the farm and to organize the farm production in such a way that to increase the resources use efficiency, the production and the income of the farmer.

In general, it is an approach which introduces desirable changes in farm organizations and operations and makes the farm viable unit by making rational decision regarding the organization and operation of a farm business. It tells how best to make use opportunities to a farmer to channelize his scarce resources.

Planning is also organizing, as a plan represents a particular way of combining or organizing resources to produce some combination and quantity of agricultural products. Land, labor and capital do not automatically produce wheat, maize or any other products. These resources must be organized in to the proper combinations, the proper amounts and at the proper time for the desirable production to occur.

In the sense of farm plan, it is to the farmer what the architect's designs and specifications are to the building contractor. Thus a farm plan contains the usual adage of "what, how much, when, where, who, and how" of a situation.

Almost all agricultural products can produce using different combination of inputs and different techniques of production.

4.1.2. Objectives of farm planning

Actually, on the maturity of farms, there is underutilization as well as over utilization of the existing farm resources. Due to this, usually farm organizations fail to get maximum net gain. This indicates the need for reorganize the farm structure for proper allocation of resources to obtain optimum production and net income. This calls for proper planning activity.

Farmers may have some personal preferences and motivations that must be taken care of in practical planning, which may includes maximizing security, minimizing risk, minimizing investment, etc.

However the main objective of farm planning is the improvement in the standard of living of the farmer and its immediate goal is to get the greatest return in terms of cash and food, for his effort both in the short and long run.

4.1.3. Why farm planning

The following concrete reasons explain the paramount importance of farm planning.

Income improvement: farm planning primarily concerned with making choices and decisions: selecting the most profitable alternative from all possible alternatives and seek to present an opportunity to cultivators his level of income. It is this opportunity of income maximization that induces farmers to adopt desirable changes. Such income maximization could be achieved from a given bundle of resources by re-organizing present type of production as well as introducing changes in technology.

Focuses attention on farm organization goal's: farm planning helps the manager to focus attention on the organization's goals and activities. This makes it easier to apply and coordinate the resources of the farm more effectively. The whole organization is forced to embracer

identical goals and participates in achieving them. It also enables the farm manager to outline in advance an orderly sequence of steps for the realization of organizations goals and to avoid a needless overlapping of activities.

Educational process: farm planning is an educational tool to bring about a change in the outlook of the cultivators and the extension workers. Knowledge of the latest technological advances in agriculture is pre-requisite for better farm planning; so farmers or farm managers keep their information up -to -date through this forced action situation of farm planning process. This acts as a self- educating tool for the farmers.

Desirable organizational change: Planning helps to introduce desirable changes in farm organizations and operations and also it makes the farm available unit. In this broad sense, it may mean any contemplate change in the method or practices followed on the farm. The advantage of farm planning lies in its treating the farm as an operational unit and tailoring the recommendation to fit in to the individual farmer's opportunities, limitations, problems, and resource position.

Minimizes risk and uncertainty: By providing a more rational and fact based procedure for making decision; farm planning allows managers and organizations to minimize risk and uncertainty.

Facilitates control: In planning, the farm manager gets goal and develops plan to accomplish these goals. These goals and plan then become standards or bench marks against which performance can be measured. The function of control is to ensure that the activities confirm to the plans. Thus, control can be exercised only if there is plan.

Basically farm planning helps the cultivator do the following things in an organized, systematic and effective way:

1. It helps to identify problems faced by all framers or managers. Some problems can be identified through planning are how much to produce, how to produce, and what to produce. It also enabled managers to list alternatives which are potential solutions to the problem.

2. Forces farmers to define specific objectives. Farm planning enables manager, to specify objectives towards which future operations should be directed.

3. It helps him to examine carefully his existing resource situation and past experiences as a basis for deciding which of the new alternative enterprises and methods fits his situation the best.
4. It forces farmers to think forward systematically
5. Defines responsibility
6. Effective communications
7. Helps to make rational decision

Farm planning is thus a process of making decisions regarding the organization and operation of farm business so that it results in a continuous maximization of net returns of farm business.

4.1.4. Feature of a Good Farm Plan

A good farm plan should insure maximization of the objectives envisaged. Since the primary objective is to achieve maximum profits on a continuing basis, a good farm plan should ensure the organization of an enterprise and allocation of resources in such a way that it helps to increase and stabilize farm earnings.

The long run objective of farming could be to build up the production potential by taking up new investments, increasing the farming net worth so that a greater stream of income can be ensured. Thus a good farm plan should help maintain and improve soil fertility, decide about the investments, and put these in a phased manner depending up on the availability of resources. This in turn involves getting, using and pay back the credit. In addition a good farm plan provides estimates of resources required in both physical and monetary terms, the later stretching in it how much credit is needed.

Particularly a good farm plan should take in to account risks and the variability in resource endowment of individual farm organizations. Another important aspect of a good farm plan is that it utilizes the farmer's knowledge, training, experience and takes in to account of farmer's likes and dislikes.

A good farm plan should also gives consideration on efficient marketing facilities and envisages sufficient flexibility in the farm organization to accommodate such as new production technique, new equipment, or altogether a new line of production, etc.

Thus in forward looking plans, account must be taken of the fact that the managerial ability varies from farm to farm that institutional factors are often involved, and farmers may have different objectives. However, the edge of farm management to be in the lead, 'farm a management to be a forward looking approach", "farm management to be dynamic", are judged by the feasibility and soundness of the farm plan.

4.1.5. Basic Steps in Farm Planning

In developing an optimum farm plan with the following steps are generally followed.

Inventory of farm resources: Prepare a complete list of the farm resources which limit the size of the different enterprises; such as: land, animals, buildings, machinery, and liquid capital, etc. This helps for assessment of actual resource limitations and production capabilities of the farm. To these resources, possibilities of hiring or borrowing are added. These restrictions lay down a frame work, within which a farm is considered.

Analysis of the existing farm plan: obtain full information on how each resource is being utilized and what are the outputs obtained from various enterprises adopted on farm. In other words, examine the present plan followed by cultivators, for its costs and returns and resource use pattern.

a. Work out the variable costs such as hired labor, seed water charge, fertilizers, *etc*. for each enterprise.
b. Work out the gross income from various enterprises by multiplying physical yields times price per unit commodities.
c. Workout the return to fixed farm resources in respect of each enterprise.

With the help of these returns to the fixed farm resources from various enterprises, the total returns to the fixed farm resources from existing plan of the farmers are analyzed.

Identification of the weakness of the present plan: A careful analysis of resource use in the existing plan will throw up the imbalances. The various weaknesses in the existing plan will act as a guide line for bringing about improvements in the alternative plan e.g, relatively more area under less profitable crop or low level of use of yield increasing technology, *etc*.

List out the risks of production on that farm: Make a list of all such risks involved in agricultural production on that particular farm and bear in mind in developing alternative plan. To the extent possible, provide for effective steps for eliminating such risks.

Forecasting: I order to decide where one wants to go, it is necessary to have information about what the future will look like. Planning is deciding what is to be done in the future against established background of the estimated future facts. Thus although the future is full of uncertainties, the manager must make certain assumptions about in order to plan properly. These assumptions are based on forecast of the future.

Establishment objectives: The next step in planning is to establish objectives for the farm organization and for each enterprise. Objectives specify the expected results and indicate the end points of what is to be done, where the primary emphasis is to be placed, and what is to be accomplished by the management.

Prepare the alternative plan: There may be a number of alternative plans a given farm organization. Within the frame work of resource restrictions and keeping in view the weakness of the existing plan and the possibilities of incorporating modern technology, a few alternative farm plans may be developed. Alternative plans can be worked out which may vary in the amount of risk involved, labor requirements and features as well as probable net income.

Analysis and selection of the final plan: Ideally we should evaluate alternative plan on various points such as probable income, amount of risk involved, labor and capital requirements, *etc*. the farm manager should select the final plan for his farm which he feels will give him and his family the highest level of satisfaction in respect of these and other variables.

4.2. Farm Budgeting

Budgeting involves the preparation of advance estimates of expenses and incomes of farm business and as such does not involve planning but generally different alternative systems are budgeted at the same time and the latter does involve planning to help choose the best alternative farming systems. Hence, planning and budgeting cannot be divorced from each other.

Farm budgeting is a method of analyzing plans for the use of agricultural resources at the command of the decision maker. A farm budget is a statement giving an estimate of all the farm

receipts and expenses to be incurred for the agricultural year. In other words, it is the expression of the farm in monetary terms by estimation of receipts, expenses and net income of a farm or a particular enterprise.

Basically budgeting involves two steps:

a. Preparation of description and specification of the proposed plans, and
b. Estimation of the expected cost and returns.

Types of budgeting

There are different types of budgeting, each of which is adapted to a particular size, purpose and type of planning problems. Basically the following types of budgets are known to exist:

a. Partial budget,
b. Enterprise budget,
c. Whole farm (complete) budget

(A) Partial budgeting

A partial budget is a budget, which predicts only the changes in income and expenditure resulting from a policy decision. It is used to calculate the expected change in profit for a proposed change in the farm business. It has to show only that part of the financial information which will be affected by the change being contemplated.

A partial budget contains only those income and expense items, which will change if the proposed modification in the farm plan is implemented. Only the changes in income and expenses are included and not the total values. The final result is an estimate of the increase or decrease in profit. To make this estimate, a partial budget systematically organizes the answers to four questions relating to the proposed change.

1/ What new or additional costs will be incurred?
2/ What current income will be lost or reduced?
3/ What new or additional income will be received?
4/ What current costs will be reduced or eliminated?

The first two questions identify changes which will reduce profit by either increasing costs or reducing income. Similarly, the last two questions identify factors which will increase profit by generating additional income or lowering costs. By comparing the total reduction in profit found by answering the first two questions with the total increase in profit shown by the answers to the last two, the net change in profit can be computed. A positive value indicates the proposed change in the farm plan will be profitable. However, the manager may want to consider additional factors such as additional risk uncertainty, and capital requirements before implementing the change.

Conditions on which to use partial budgeting

Partial budgeting involves changing some parts of the main program and comparing the gains and revenue to the extra cost of such modification. Partial budgeting, therefore, examines two issues, *i.e*. the extra returns or increases of produce gained by a modification of a plan or a change in the production technology and the extra cost or the amount of produce sacrificed in the modification of the plan or change in the technology. Partial budgeting may be use to choose a plan out of a series of plans or modified plans.

Partial budgets can be used to assess the merits of the following three general types of changes in the farm plan.

1. **Enterprise substitution**: this includes a complete or partial substitution of one enterprise for another. For example, substituting 50 hectares of wheat land for 50 hectares of barely, substituting alfalfa for all the current barely production, or replacing the beef cow hard with a stocker steer enterprise.

2. Input substitution or level: changes involving the substitution of one input for another or the total amount of input to be used are easily analyzed with a partial budget. A change in an item or factors of production such as an increase in animal feed this may involve adoption of new farm practices. Examples would include substituting machinery for labor by purchasing large machinery; changing livestock feed rational, owning harvesting equipment instead of hiring a custom operator, and increasing or decreasing fertilizer or chemical usage.

3. Size or scalar of operation: the expansion of an existing enterprise or size of operation included in this category would be changes in total size of the farm business or in the size of a

single enterprise. For example, buying or renting additional land, purchasing additional beef cows, or expanding the swine enterprise.

These three types of changes are not mutually exclusive, as any single proposal might include a combination of two or more. It is important to remember that partial budgeting only compares two alternatives.

The difference of partial budgeting from other techniques

A partial budget differs from an enterprise budget in that several enterprises might be involved in the change, but a partial budget is not-suitable for preparing of a plan for the whole farm partial budgeting therefore intermediate in scope between enterprise budgeting and whole farm planning. It is useful to think of partial budgeting as a type of marginal analysis, as it is best adapted to analyzing relatively small changes in the whole farm plan.

In this type of budget, the items of income and expenditure that will not change are ignoring. Only the changes in income and expenses are included and not the total values, but in the case of enterprise and complete budgeting the total values are included budgets because they are simpler and more applicable.

Limitation of partial budgeting

1/ Partial budget can be used to analyze a part of the whole farm plan.

2/ It is not suitable for preparing of a plan for the whole farm.

The partial budget format

1) **The contents of the partial budget will comprise** items of income, which will increase: what new or additional income will receive? A proposed change may cause an increase in total farm income if a new enterprise is adding, if an enterprise is being expanded, or if the change will cause yields or production levels to increase.
2) Items of income which will decrease what current income will be lost or reduce? Income may be reduced if the proposed change would eliminate an enterprise, or cause a reduction in yield or production levels.
3) Items of expenditure which will decrease what current costs will be reduced or eliminated.

4) Items to be incurred? A proposed change may cause additional costs to increase because of a new or expanded enterprise requiring the purchase of additional inputs, or a new input will be purchased as a substitute for another. Any additional fixed costs should be included as well as additional variable costs.
5) Net increase or decrease in profit.

Gain	Cost
a. additional income: expected additional returns that would accrue from the change under consideration	d. Reduced income: return that will no longer be received after the change has been made
b. reduced expenses: the savings in cost which will no longer be incurred if the changes are made	e. Additional expenses: additional direct costs that would occur in year's business as a result of the change.
c. Total gain: additional income (a) plus reduced cost (b)	f. Total cost: reduced income (d) plus additional expenses (e).
No change (change in net income): the difference between total gain (c) and total cost (f) is net farm income. A positive difference indicates that the proposed change plan has higher expected net income than the base plan and vice versa.	

Example1: Supposing the addition of 50 beef cows to an existing herd needs additional 60 hectares of forage, which is currently in grain production and will have to be converted to forage production. There will be additional fixed costs including additional interest on the increased investment in beef cows, depreciation on bulls and additional property taxes. Herd replacements are assumed to be raised, so there is no depreciation included on the cows. Variable costs will also increase as shown, including and annual change for fertilizer and maintenance costs on the new 60 hectares of pasture. Income from the grain now being produced on the 60 hectares of land has no longer received and this reduced income is estimated in Br. 280,00, making the total annual additional costs and reduced income equal Br. 35,215.Additional income will be received from the sale of cull cows, steer calves, and heifer calves several items are important in estimating this income in addition to carefully estimating prices and weights.

a) It is unrealistic to assume every cow will wean a calf every year , and this example assumes 46 calves from the 50 cows.

b) This example assumes herd replacements are raised rather than purchased, so 6 heifer calves must be retained each year to replace the 6 cull cows, which are sold. This is reflected by only 17 heifer calves being sold each year compared with 23 steer calves.

The reduced costs include expenses, which will no longer be incurred from planting the 60 hectares of grain no reduction in machinery fixed costs included, as the machinery complement is assumed to be no different after the proposed change. Labor cost are also assumed to be unaffected by the change, so no additional or reduced costs for labor are included.

The total additional income and reduced costs are 48,730 birr. or +13, 515 birr more than the total additional costs and reduced income, indicating the proposed change would be profitable.

Table 3-13 Partial budget for adding 50 beef cows

Additional cost	Br	Additional income	Br
Fixed cost	Br	6 cull cows (300gk/cow) 2Br/kg	3600
Interest on cow herd	2500	23 steer calves (280kg/heed/2Br/kg)	12880
Bull depreciation	200	17 heifer calves (200lg/head/3Br/kg)	10200
Taxes	0		
Variable costs			
veterinary and health	500		
Feed and hay	2000		
Hauling	200		
Miscellaneous	100		
Pasture maintenance	1500		
Interest on variable costs	215		

Total additional costs	7215	Total additional income	26680
Reduced income		Reduced costs	
Grain production (40t, 700br/t)	28,000	Fertilizer	12000
		Seed	3000
		Chemicals	1000
		Machinery cost	5000
		Interest on variable costs	1050
		Total reduced cost	22050
Total annual additional costs and reduced income	35,215	Total annual additional income and reduced costs.	48,730
		Net change in profit	+13515

B) <u>Enterprise Budgeting</u>

.**An enterprise**: is defined as a single crop or livestock commodity. Wheat, corn, coffee, etc are examples of crop enterprises/ commodities and dairy cattle, beef cattle, pig (swine) production, etc are examples of livestock enterprises.

An Enterprise budget: is an estimate of all income, expenses and profit/ loss associated with a specific enterprise.

How Enterprises can be compared?

Each enterprise budget is developed in the basis of a small common unit such as 1 lecture for crops or 1 head for livestock. This permits easier comparison of the profit for alternative and competing enterprises. The estimated profit can be compared with the estimated per hectare profit for other crops and used to select the more profitable crops and crop combinations to be grown each year.

Enterprise budgets are developed to aid farmers in evaluating alternative plans. They represent common, workable combinations of inputs that can achieve a given output. Amount of seeds, types and quantities of fertilizer, chemicals, and other items reflect local extension service recommendations and the experience of many farmers. The specific combinations of inputs and prices presented will not likely precisely reflect any given farm. In practice, actual cost will be higher or lower than shown. Thus the most important column is " your Budget".

An enterprise budget has the following characteristics?

- It estimates costs and returns expected for a single enterprise.
- It represents one combination of inputs such as seed, chemicals, and fertilizer to produce some level of output. It is not the only combination of inputs that can be used to produce this crop. For example, soil type and extent of prior fertility build up can cause fertilized requirements to vary widely.
- It is a written plan for a future cause of action including estimated costs and returns for that particular farm.
- It provides a format and a basis for developing farm budgets appropriate for a given situation.

C) <u>Complete / Whole farm budgeting</u>

Definition and description of whole farm budgeting: A whole farm budget is a summary of the expected income, expenses, and profit for a given farm plan. It considers the costs and returns of operating: the whole farm or particular crop and livestock enterprises in order to derive the net returns. Complete budgeting is especially useful for someone planning to enter farming to have an idea of the profitability of the particular farm enterprise. A farmer who is planning to reorganize his farm or switch entirely to new forms of farming may find complete budgeting useful also to estimate net returns or profit. In general, the whole farm budget could be used to compare alternative plans for profitability, and estimate the operating capital and total input requirements. It can also be used for further cash flow budgeting and controlling.

A Complete or whole farm budget is necessary where:

a. the farmer wants to start a new farm, and

b. both the direct costs and the fixed or semi fixed costs are all likely to be affected.

A complete budget, as the name implies, covers every item of expenditure and income. In preparing a complete farm budget, the following steps that have advocated:

1. Formulation of farm objectives

2.Take the farm inventory which may include farm buildings, land, land improvements, e.g. irrigation, breeding stock.

- Uses of whole farm/complete budgeting

In addition to providing an estimate of net farm income, a whole farm budget has several other potential uses.

1/ It provides a basis for comparing alternative plans for profitability. This can be particularly useful when planning for growth and expansion.

2/The cash expenses in the budget provide an estimate of the operating capital the business will need during the year.

3/ Much of the information needed to complete the cash flow budget has already been gathered and organized in the whole farm budget.

4/ A detailed whole farm budget showing the estimated profit can be used to help establish credit and borrow the necessary operating capital.

5/ The worksheets used to prepare the budget contain estimates of total input requirements orders for inputs such as fertilizer, seed chemicals, and feed can be placed using this information.

6/ The whole farm budget can also be used as part of a system for monitoring and controlling the business during the year.

Complete Budgeting

The whole farm plan discussed earlier does not provide full and details information on sources and amounts of income, types and amount of expenses and the total expected profit for the farm business plan. A whole farm budget is needed to provide additional details and the final estimate of profit. Therefore, a whole farm budget is a summary of the expected income, expenses and profit for a given farm plan. It considers the cost and returns of all the crop and livestock enterprises in order to derive the net return of the whole farm.

Steps for complete budgeting: Basically, it consists of two steps:

1. Preparing a plan that includes the area of each crop, the number of each class of livestock and the production methods. The proposed plan is based on subjective judgment, experience and intuition coupled with technical considerations. For example, an agronomist may have suggested

a new crop rotation or a livestock specialist may have suggested the introduction of a goat enterprise. Thus, several alternative plans may be prepared.

2. Budgeting the expected costs, including common costs and returns to financially evaluate each plan and find which is the best in terms of expected net farm income.

Table: Whole farm budget showing projected income, expenses and profit

No.	**Description**		
1	**Income**		
	Cotton	54000	
	Milo	43000	
	Wheat	13500	
	Stocker steers	40000	
	Total income		**150000**
2	**Variable expenses**		
	Fertilizer	11900	
	Seed	3600	
	Chemical	7900	
	Fuel, oil, greases	4050	
	Machinery repair	2650	
	Feed purchase	1600	
	Feeder livestock purchase	29000	
	Custom machine hire	10250	
	Operating interest	7340	
	Miscellaneous	2450	
	Total variable expenses		**80740**
	Gross margin (1-2)		**69760**
3	Fixed expenses		
	Property taxes	2600	
	Interest on debt	22000	
	Insurances	1250	
	Machinery depreciation	7200	
	Building depreciation	3200	
	Other fixed costs	3000	
	Total fixed expenses		**39250**
4	**Total expense(2+3)**		**119990**
5	**Net farm income(1-4)**		**30510**

For a given whole farm budget (Table 4.5), the total farm income is calculated for each of the enterprises included in the plan. The next step is to estimate the variable costs by type or category such as seed, fertilizer, and repairs etc. many of these variable costs are the same as those used to estimate the enterprise budget needed in the planning procedure. The total cost for each variable input can be found by calculating the total for each enterprise and then summing across the enterprises.

Notice that some variable cost items such as building repairs, auto and pickup expenses, utilities, and other farm overhead expenses are very difficult to allocate for specific enterprises and they are affected little by the final enterprise combination. It these and similar expenses are not included in the calculation of gross margins of an enterprise budget, they must be included in the complete budget. These will make income above total variable expenses of a combination of enterprises, grater then the total gross margin in the whole farm plan.

The budget in table 4.5 shows an estimated profit or net farm income of the whole farm if the price and yield estimates are actually realized. Changes in any of these factors will obviously affect the actual profit received from operating the farm under this plan. The estimated profit also needs to be carefully interpreted.

Difference of complete budget with other methods

What makes complete budgeting differ from partial budgeting? When the proposed changes in the farm business are so weeping, they affect the whole farming system and the technique of complete budgeting to be used. However, complete budgeting is not to be divorced from partial budgeting. These two are mutually complementary, i.e the partial budgeting technique should be used at various stages of complete budgeting in order to decide the changes to effected in the farm organization. in fact complete budgeting is not to be and cannot be disturbed very often, but some changes or improvements have to be made quit frequently where partial budgeting comes into operations.

Enterprise budget is used to estimate the profitability of a single enterprise while complete budgeting is for the entire farm, which may consist of several enterprises. Some cost items that are too difficult to allocate for specific enterprises usually overlooked in the computation of an enterprise budget that must be included in the whole farm budget.

Uses of complete budgeting

- In addition to providing an estimate of net farm income, a whole farm budget has several potential uses, such as;
- It provides a basis for comparing alternative plans for profitability. This can be particularly useful when planning for growth and expansion.

- The cash expenses in the budget provide an estimate of the operating capital the business will need during the year.
- A detailed whole farm budget showing the estimated profit can be used to help establish credit and borrow the necessary operating capital.
- The worksheets use to prepare the budget contain estimates of total input requirements. Orders for inputs such as fertilizer, seed, chemicals and feed can be placed using this information.
- It is often used in situations where it is realized that the proposed adjustments in the business will have an impact on several aspects of the business operations because of the interrelationships that exists between different enterprises.
- It is useful for someone who is planning to enter in to farming business to have an idea of the profitability of the particular farm enterprise.
- A farmer who is planning to recognize his farm or switch entirely to new forms of farming organization may find complete budgeting useful to estimate the net return or profit of the business.

Criticisms of budgeting

It was mentioned that budgeting is one of the most important farm planning tool which can be used to select the most profitable plan among a number of alternative plans. However, it also subjected to certain criticisms.

Several criticisms can be made on budgeting of these most of them are equally applied to all budgeting techniques. One of the techniques is that budgeting assumes a linear relationship between input and output that virtually ignores diminishing returns and complimentary relationships between enterprises. If the necessary information is given, however, allowance can be made for these aspects.

5. FARM BUSINESS ANALYSIS

5.1. Farm Records and Analysis

5.1.1. Farm Records and account

Now a day, great emphasis is given for record keeping on the farm. This emphasis is correct. Presently, many farmers are in financial difficulties. The purpose of keeping records is not just to accumulate masses of information. Rather, it is to use this information to compare and distinguish trends in the farm business. These trends help farmers make sensible managerial decisions: Is this enterprise profitable? Or can I afford to purchase a new tractor/ or should I change my enterprise mix? Records are useful only if they are used. Simply keeping them is not sufficient.

Farm business analysis is the name given to a technique based on computation and interpretation of a variety of efficiency measures for the farm under study. The results of the analysis are then compared with standards derived from a group of farms of similar size and type. This comparison is then used to highlight organizational weaknesses and strengths of the farm business.

If farm accounts are available, this system of farm business analysis can be a useful tool. The subject of farm business analysis is dealt under different names, *i.e.*, Farm Accountancy, Farm Records and Accounts or Farm Book Keeping. Their objectives are basically the same but the difference lies in the methods of treatment or approaches.

Farm accountancy is defined as the art and as the science of recording business transactions in books in regular and systematic manner so that their nature, extent and financial effects can be readily ascertained at any time of the year.

Farm Book Keeping is known as a system of records written to furnish a history of the business transactions, with special reference to its financial side. Farm accounting, on the usual sense is an application of the accounting principles to the business of farming.

The main objectives of farm business analysis are to answer such questions as:

- How does the business perform at a certain time?
- Where are the weaknesses? and
- What improvements are possible?

There are some subsidiary objectives too, such as providing background information for farm policies and for getting credit facilities.

The following are three major steps or stages of farm business analysis:

- Keeping proper recording of accounts and activities;
- Analysis and interpretation of results; and
- Presentation of results.

5.1.2. Advantages of farm records and accounts

Advantages of keeping farm records include the following:

1. ***It is a means to higher incomes***: to obtain higher incomes, farmers must have good knowledge about present and potential gross income and operating costs. The best way to obtain such knowledge is to keep records and accounts would enable the farmer to:
    - The financial status of his farm at a point in time;
    - The magnitude and sources of gain or losses over time ;
    - Identify the better sources of income and items of cost;
    - Keep a check on unproductive expenditure; and
    - Examine comparative profitability of and costs involved for different enterprises; *etc*.

The combined knowledge of all these enables the farmer increases his income.

2. ***It is a basis for diagnosis and planning***: Diagnosis of management problems is the pre-requisite of sound planning. Records and accounts provide the basic information needed for identifying the source of problems.

3. ***It is a way to improve managerial ability***: It helps to acquire business habits which can be of help in taking advantage of changes in the economic environment. The farmer gets a better insight into his business which helps him in finding out the defects, which can be set right by exercising better control and effective economies. In addition, farmers can avoid mistakes and losses than usually arise from dependence only on his memory of guidance.

4. **It is a basis for credit acquisition and management**: properly kept records and accounts can demonstrate and authenticate the production and income potentials and credits worthiness of the farmer. Thus, lending agencies can help the farmer in meeting his credit needs more readily and he/she can manage his/her credit utilization properly.

5. **It guides to a better management and future decisions**: Farm records and accounts provide information on Farm-household economy. This is especially important in the rural areas of

Ethiopia where farm and home management are so closely integrated. Analysis of farm records provides good guidance for the allocation of resources between production improvement and immediate family welfare.

6. **It is a basis for research**: Research requires precise and correct data which is possible only if proper records and accounts are maintained on the farms included in the study.

7. **Basis for policy formulation**: farmers need to continuously feed the facts for state and national policy makers. Appropriate policies on the issues of land, price, crop insurance policies, *etc*. can be designed by using these facts and based on the objectives reality of the farms. Records and accounts are, thus, inputs for understanding the fact and for examining and developing sound policies.

5.1.3. Problems and Difficulties in Farm Accounting

Most of the Ethiopian farmers do not know how to maintain farm accounts due to lack of education, business orientation and time required to do this job. The following are some the specific difficulties in maintaining accounts in Ethiopia:

1. **Subsistence nature of Farming**: Farming as a business is relatively a small size operation in Ethiopia. Farmers cannot engage a trained accountant or farm manager for helping them in farm accounting. The subsistence nature of farming does not produce enough incentive for keeping the records.
2. **Farming is a laborious work**: farming requires a lot of physical labor, in addition to the mental work of management. In the daily routine, the farmer usually gets exhausted in the evening and does not feel like sitting at the desk to complete the records and accounts.
3. **Triple role of farmers**: Ethiopian farmers (head of the farm household) play a triple role in running their farm business, *i.e*., that of a manager, a financer and a laborer. The farmer needs therefore, to know his wage as a laborer, his returns to capital and his management role. Such complex records which would give information are difficult to maintain.
4. **Illiteracy and lack of business awareness**: the very low level of literacy among the Ethiopian farmers is one of the factors that hinder the development of the required level of business awareness on the part of the producers as they do not realize the need for records and accounts.

5. **Inadequate extension services**: Sufficient number of trained specialists in farm management who could help farmers maintain accost of their business are not available.
6. **Complicated nature of agribusiness**: Agricultural business is a biological industry and is always subject to weather and other natural uncertainties. It requires an accounting system which can handle various complexities involved in the business of farming. Such complicated accounts are difficult to maintain.
7. **Non-availability of suitable farm record books**: Lack of standardized, easy to understand and maintain account books also stand in the way of willingness of the producers or farmers to keep records. Standard farm record books need to be developed and they should be simple and easy to understand and available in local languages.
8. **Fear of taxation**: Farmers are always afraid of taxes. They fear that if they maintain records and accounts and their incomes show up high, some sort of tax may be levied on them

5.1.4. Parts of Farm Records

The kinds of records to keep will depend upon what information one wishes to have. Therefore, in this sub-section, we will discuss about the parts of farm record system.

5.1.4.1. Parts of a farm record system: There are three parts of a farm record system:

1. Physical farm records;
2. Financial farm records, and
3. Supplementary farm Records.

Physical farm records: are related to the **physical aspects** of the operation of a farm business. They do not indicate the financial position or the outcome of the farm business, but simply record the physical efficiency or performance of the farm. To implement the financial records and the financial decisions, the physical data recording concerning the farm and its performance are essential. The main use of physical farm records is:

- To check performance of enterprise,
- For controlling the business,
- To detect weakness and strengths to guide future decisions, and
- To provide planning and budgeting data.

Physical farm records normally include the following:

- Farm map, contour map, *etc*.

- Land utilization records.
- Crop production and disposal record.
- Livestock production and disposal record.
- Labor records, daily work diary.
- Machine use records.
- Feed records, *etc*.

Financial Records: these are mainly related to the **financial aspects** of the operation of a farm business. They are required to provide information regarding the profitability of the whole farm business over a given period. In addition, financial records enable financial analysis to be carried out to reveal the economic strengths and weaknesses of the farming system, and to provide data to help in the preparation of revised plans and budgets. The financial record may include the following:

- Farm cash or farm financial record
- Classified farm cash accounts and annual business analysis (credit and debt accounts)
- Capital asset and sale register
- Cash sale register
- Credit sale register
- Wage register
- Funds borrowed and repayments register
- Purchase register
- Farm expenses paid in kind register
- Non-farm income record.

Supplementary records: supplement the two records

- Sanction register, Auction register**,** Hire register**,** Climate (weather) condition, soil type, agro-ecological condition, *etc.*

5.1.4.2. The main Characteristics of a good farm record book

i. It should be simple and easy to understand;

ii. It should be suitable forms for recording the type of information the farmer wants to record;

iii. It should have provision for an itemization and classification of all entries;
iv. It should have adequate space for itemization all entries, and the lines and spaces sufficiently wide for writing without crowding; and
v. It should have adequate instructions for recording and analysis of recorded data.

5.1.5. Farm Inventory

Farm inventory is a list of all of the physical property and financial resources of a business along with values at a specified date. In other words, it is the complete list of farmer's assets. It is first step in farm accounting.

The purposes of preparing farm inventory are the following:

1. A complete farm inventory, taken at the beginning of each season, will give a list of all the assets with their values. It shows what amount of capital accumulation goes back into the business. The farm inventory is a necessary step in complete farm accounting.
2. It reveals the changes in net worth through comparison of a farm inventories take at the beginning of the year with another assembled at the end of the year. The inventory provides a basis for computing growth in net worth.
3. It enables you to work out the measures of income. Certain management or efficiency measures depend on accurate inventory.
4. It enables to determine the depreciation costs.
5. It serves as a basis of income statement and balance sheet. It provides net income data and serves as a basis for farm business analysis.

Method of valuation of inventory

The choice if valuation method will depend on the type and nature of property (asset) and (ii) the purpose if inventory. The following methods are employed to value inventory. They are:

1. Net market price 2. Income capitalization 3. Cost or market price 4. Farm production cost 5. Cost less depreciation.

1. **Net market Price method**

This method places a value on inventory item equals to its current market price (price times quantity inventoried) less marketing costs such as transportation and others. E.g. If current market price of a crop is 100 Birr/Q, marketing cost is 15 Birr/Q, thus net market price of the crop is = 100-15 = 85 Birr. This method works well for items which could or will be sold in a

relatively short period of time and whose current market prices are easily obtained during inventory (those in the stock or on the farm during inventory) and has little meaning when applied to building or machinery for which no actual market may exist.

2. **The income capitalization method** may be used for those assets whose contribution to the income of the business can be measured and which have long life; *i.e.,* their contribution will be made over a long period of time. The capitalization formula has been developed for this purpose.

$$v = \frac{R_1}{1+r} + \frac{R_2}{(1+r)^2} + \cdots \cdot \frac{R_n}{(1+r)^n}$$

Where: *v* is the value of the asset, R refers to income in the year indicated by the subscript, and r is the rate of interest.

For example: if the asset produces birr 100 for three consequent years and that the going rate of interest is five percent, the value of these asset can be calculated as:

$$v = \frac{100}{1+0.05} + \frac{100}{(1+.05)^2} + \frac{100}{(1+.05)^3}$$

v= Birr 272.32

In the event the annual incomes were to contribute indefinitely instead of the three years in the example, a less complicated formula can be calculated as:

$$v = \frac{R}{r}$$

The second formula shows to be identical to the first formula when the time period becomes infinitely long.

The capitalization formula is presented for better understanding of the valuation problem. Ideally, it could be used to value land and, in fact, some variation of it is often used by professional appraisers. However, in practice neither the annual income nor the interest nor the rate is known with accuracy. As a result, it is often used in combination with other methods such as the market price when land is valued.

3. **Lower if cost or market price**: this requires valuing an item at both its current market price and its original cost and then used whichever values is lower. This approach minimizes the

chance if planning too high value on any items due to inflation. Hence, this method is used mainly for assets that serve for a longer period to avoid the influences of inflation.

4. **Farm production cost**: items produced on the farm and still on hand or on the farm when the inventory is taken each is valued at their farm production cost. In this method, cost of production incurred up to the day of inventory is taken (future costs are ignored). This method applies to crops, raised livestock, *etc.*

5. **Cost less depreciation**: This method allows current valuation to be equal to the original cost less the total accumulated depreciation from purchases date of inventory and is applicable for doing lasting items such as machinery, building, breeding livestock, *etc*.

- **Depreciation:** Depreciation involves prorating the original cost of an asset over its useful life. In other words, it is a decline in value of capital equipment due to use, wear and tear and obsolescence. It is a business expense and can be viewed from two different but related view points.

- First, it represents a loss in value because the item is used in the business to produce income, and
- Second, it is an accounting procedure to spread the original cost of an asset over the item's useful life.

It is not appropriate or correct to deduct the full purchase price as an expense in the year of purchase, as the item will be used to generate income for many years. Instead, the purchase price less salvage value is allocated or spread over time through the business expense called depreciation.

Methods of computing depreciation

Before introducing the methods of computing depreciation, let's see the following basic terms.

Useful life: is the expected number of years the item will be used in the business. It may be the age at which the item will be completely worn out if the manager expects to own it that long, or it may be a short period if it will be sold before then.

Salvage value: refers to the item's value at the end of its assigned useful life. It is also known as terminal value, scrap value or junk value. Salvage value might be be zero if the item owned until

completely worn out and will have no junk or scrap value at that time. A positive salvage value should be assigned to an item if it will have some value as scrap or will be sold before completely worn out.

The major methods of computation of depreciation include the following:

1. Straight line method
2. Diminishing balance method
3. Sum-of-the-years-digits method

Straight line method

Straight line method of computing depreciation is the most widely used and the easiest to use. It is easy, simple and usually very satisfactory for most purposes. This method assumes that assets are used more or less to the same extent every year and therefore, equal amounts of costs on account of their use can be charged every year. The formula used to compute depreciation is:

$$\text{Annual Depreciation} = \frac{\text{Original cost}(C) - \text{Salvage value }(S)}{\text{Useful life }(n)}$$

Example: Assume a certain farm business has purchased a new tractor for 100,000 Birr. The tractor is assigned a salvage value of 2,000 Birr and has an estimated useful life of 10 years. Compute:

a. The total anticipated depreciation of the tractor.
b. The annual depreciation of the tractor using both methods.
c. The book value or remaining value of the tractor for the first two years of its useful life.

Solution:

a. Total anticipated depreciation = Original cost – Salvage value
   = 10,000 – 2,000
   = 8,000
b. $AD = \frac{C-S}{n} = \frac{10{,}000-2{,}000}{10} = 800$
c. Book value = Purchase price – Accumulated depreciation
   = Purchase price – n*AD

= 100,000 – (10 x 800)

= 92,000

One of the shortcomings of the straight line method of depreciation is that it underestimates depreciation during the earlier years of useful life of the asset and overestimate depreciation during the later years of service of the item.

Diminishing balance method

Using the diminishing or declining balance method, a fixed rate of depreciation (R) is used for every year and applied to the value of the asset at the beginning of the year. There are several way of determining the fixed rate (R) of depreciation. However, the most common one is the double declining balance method (DDBM). The 'double' comes from using a depreciation rate which is double the straight line rate. This percentage rate is deducted every year from the diminishing balance till the asset reached the salvage value and no further depreciation is possible.

Annual depreciation rate can be computed from the equation:

$$\text{Annual Depreciation} = (\text{Book value at the beginning of the year}) * \text{R}$$

Where: R is equal to two times the straight line percentage rate.

The percentage rate remains constant each year, but is multiplied by the book value, which declines each year by an amount equal to the previous year's depreciation. Notice also that the percentage rate is multiplied by each year's book value and not cost minus salvage value as with straight line method.

Example: A machine is purchased for 10,000 Birr and has a salvage value of 2,000 Birr and 10 years of useful life.

The R will be 20%, i.e., 2 x 10%.

Year 1: 10,000 x 20% = 2,000, Book or remaining value = 10,000 – 2,000 = 8,000.

Year 2: 8,000 x 20% = 1,600, Book or remaining value = 8,000 – 1,600 = 6,400.

Year 3: 6,400 x 20% = 1,280, Book or remaining value = 6,400 – 1,280 = 5,120, and so on.

The main shortcoming of this method overestimates depreciation during the earlier years of the useful life of the asset and underestimates depreciation during the later years of the asset.

Sum-of-the-years-digit method

Annual depreciation is determined by multiplying a fraction times the amount to be depreciated (cost less the salvage value). The formula used to compute annual depreciation is:

$$\text{Annual Depreciation} = \frac{\text{Cost} - \text{Salvage value}}{\text{SOYD}}$$

Where: SOYD is the sum of all the numbers from 1 through the estimated useful life.
For example, for a five year useful life SOYD will be 1+2+3+4+5 = 15 and it would be 55 for a 10 year useful; life.

By way of example, a machine is purchased for 92,000 Birr and has a salvage value of 9,200 Birr and a useful life of 10 years. Compute the annual depreciation and the remaining value for all years using a straight line method.

Solution:

Year	Value at the beginning of the year	Annual depreciation	Remaining balance (value at the beginning of the year less annual depreciation)
1	92,000	15,054.55	76,945.55
2	76,945.55	13,549.09	63,396.46
3	63,396.46	12043.64	51,352.82
4	51.352.82	10,538.18	40,814.64
5	40,814.64	9,032.73	31,781.91
6	31,781.91	7,527.27	24,254.64
7	24,254.64	6,021.82	18,232.82
8	18,232.82	4,516.36	13,716.46
9	13,716.46	3,010.90	10,705.56
10	10,705.56	1,505.45	9,200.11

Notice that the annual depreciation is highest in the first year and declines by a constant amount each year thereafter.

5.2. Farm Financial Analysis

A farmer cannot possibly make intelligent decisions on the allocation and use of capital unless adequate information regarding the current financial condition and past progress of the operation is at hand. Some smart farmers assemble considerable information from observation coupled with income and expenses transactions involved in operating the business. However, as the size of the farm business increases, new technology becomes available and cash expenses consume an increasingly large part of gross income, more complete records, which is properly summarized and analyzed, are needed to provide a reliable basis for sound managerial decisions. The most widely used financial statements which will be discussed in this section are the balance sheet and income statement.

5.2.1. Balance Sheet and Its Analysis

The balance sheet is a systematic organization of everything 'owned'(*i.e.,* assets) and 'owed' (*i.e.,* liability) by a business or individual at a given point in time (usually at the end of the accounting month or year and this serves as opening balance sheet for the coming year). It is a listing of assets and liabilities concluding with an estimate of net worth or owner's equity or capital.

Net worth = Total assets- total liabilities

Therefore, the primary purpose (use) of balance sheet is to measure the financial strength and position of the business. The balance sheet is called a balance sheet because the value of the assets is always equal to the sum of the liabilities and the net worth or equities.
The general format of a balance sheet is as follows.

Asset	Liabilities

Current asset	Birr	xxxx	Current liabilities	Birr	xxxxx
Intermediate asset		xxxx	Intermediate liabilities		xxxxx
Fixed asset		xxxx	Long-term liabilities		xxxxx
			Total liabilities	Birr	xxxxx
			Net worth		xxxxx
Total Asset	**Birr**	**xxxx**	Total liabilities and net worth	**Birr**	**xxx**

Assets: are physical, financial and intangible rights of a business. An asset can have value for one or both of two reasons. First, it can be sold to generate cash. Second, it can be used to produce other goods which can be sold to provide cash income at some future time. On the balance sheet statement of a farm, assets are usually divided into three categories. This division is based on liquidity and useful life.

Current Asset: the more liquid assets are listed in the current asset category. They will be either used up or sold in the next years as a normal part of business activities, and their sale will not disrupt future production activities. Certain items are included in current asset. Cash on hand and checking account and saving account balances are the most liquid of all assets. Current assets also include readily marketable stocks and bonds, accounts or notes receivable (which represent money owed to the business because of loans granted or services rendered), feed, grain supplies on hand and feeder livestock or livestock held primarily for sale. The cash value of life insurance, any prepaid expenses, and the value of growing crops would also be included.

Intermediate assets: as the name implies, these assets are intermediate in liquidity and useful life. They have a useful life greater than 1 year but generally less than 7 to 10 years and are less liquid than current assets as their sale affects the future income potential of the business. The most important intermediate assets on a farm balance sheet are machinery, equipment and breeding livestock. Most intermediate assets are characterized by being depreciable. They are not purchased for resale in a relatively short period of time, but to be used over time to produce other salable products.

Fixed Assets: real estate or land, permanent buildings are most important fixed assets on farms and ranches. Fixed asset are the least liquid of all assets; they have a useful life greater than 10 years, and their sale would seriously affect the ongoing nature of business. For example, if all the owned land and buildings were sold the business might be totally eliminated making the business unable to continue.

Liabilities: are obligations or debt owed to someone else. It represents an outsiders claim against one or more of the business assets. As with the assets, liabilities divided in to three categories, with time or the length of the loan being the primary difference between categories. Another relationship between the grouping of assets and liabilities are that a loan in any liability category will generally have been obtained to finance the production or purchase of an asset in the corresponding asset category.

Current liability: are those financial obligations which will become due and payable with one year from the date of the balance sheet. Items included in this category are accounts payable at farms supply stores for goods and services received but not yet paid for and the full amount of the principal on any short term loans. Short term loans are those requiring complete repayment of the principal in first year or less.

Intermediate Liabilities: This liability represents loans where repayment is extended over at least two years and up to as long as 7-10 years. They would typically have some principal and interest due each year. Most intermediate liabilities will be loans for the purchase of machinery, breeding livestock, or other intermediate assets. The current year's (next year) principal payment and accrued interest would be listed as a current liability, with the remaining loan balance included as an intermediate liability. Care must be taken to subtract the principal payment included in current liabilities from the remaining loan balance to avoid double counting.

Long-Term Liabilities: loans for the purchase of real state or where land and buildings provide the collateral for the loan would be listed as long-term liabilities. They will be in the form of a farm mortgage loan or land purchase contract, and the repayment period will generally be from 10 to 40 years. As with intermediate liabilities, any principal due within the next year plus accrued interest would be listed as a current liability. Only the loan balance remaining after payment would be entered as a long-term liability.

Net Worth: represents the amount of money left for the owner of the business should all assets be sold and all liabilities paid on the date of the balance sheet. It is found by subtracting total liabilities from total assets and is, therefore, the "balancing" amount which causes total assets to be exactly equal to total liabilities plus net worth. In other words, net worth is the owner's current investment or equity in the business and is properly listed as it is money due the owner upon liquidation of the business and is properly listed as a liability as it is money due the owner

upon liquidation of the business. Another name for net worth is ***owner's equity***. Net worth will change if there is a change in an asset's value, a gift or inheritance is received, or an asset is sold for more or less than its book value on the balance sheet. Increases in net worth more commonly result from using the assets to produce crops and livestock, and the profit from this production is used in turn to purchase new assets and/or reduce liabilities. However, this process requires time, and one of the reasons for comparing a balance sheet for the beginning of the year with one for the end of the year is to study the effects of the year's production on net worth and composition of assets and liabilities.

5.2.2 Income Statement and its Analysis

The income statement is defined as a summary of income and expenses over a given time period and is the second type of financial statement needed for control function. The income statement is sometimes called an ***operating statement*** or ***profit and loss statement***. Its primary purpose is to compute profit for a given time period.

Receipts: are derived from sale of products and miscellaneous sources. Any farm products used in the home should be valued and included in the receipts. For purpose of financial analysis, *receipts from the sale of assets such as real estate or machinery are generally not considered income since such income is not really produced or earned during the year*.

Expenses: all expenses or costs involved in the operation of the business during the period covered by the income statement should be included. Thus, all operating and fixed expenses are entered. However, capital expenditures like purchase of fixed and working assets such as real estate, machinery, and breeding stock are excluded since such items usually are used in the business for several years. The depreciation that occurs on these items during the period covered by the income statement is an expense and should be included.

Net income: the net income or loss figures are useful in analysis of the business, which can be divided in the net cash income, net operating income and net farm income.

- **Net cash income** equals cash receipts less cash expenses during the year covered by the statement excluding purchased and sales of capital assets. The net cash income figure provides an indication of the annual net cash flow of the business. It is also useful in preparing the income tax return when it is made on the cash basis.

- **Net operating income** is computed by subtracting operating expenses from gross income. This measure of income facilitates the comparison of farms with various fixed-cost structures such as different mortgage debt and depreciation schedules. It also facilitates comparing operating income on the same farm over a period of years.
- **Net farm income** is computed by deducting fixed costs from net operating income. It represents an income accruing to operator and family labor, management and equity capital. Of the three measures of income, it is perhaps the most useful. It represents more accurately than the other two, so it is the true return of the business.

Financial ratio analysis

Before analyzing net farm income using these ratios, we should note the distinction between profit and profitability.

- **Profit** is a dollar value which is found by calculating net farm income.
- **Profitability** is concerned with the *size of this profit relative to the size of the business* or *the value of the resources used to produce the profit*.

A business may show a positive profit but have a poor profitability rating if this profit is small relative to the size of the business. For example, two farms with the same net farm income are not equally profitable if one used twice as much capital as the other. This sub section will analyze profitability relative to the total capital invested in the business and the return provided to the owner's labor, management and equity capital.

Income statement ratios can be divided into two categories: those that relate expenses to gross income and those that relate income to capital investment.

Expense-to-Income ratio

Expense-to-Income ratio is used to measure the input-output efficiency of the business; *i.e.*, they measure the margin by which the value of total production exceeds the production costs.

Operating ratio: as the name implies, operating ratios relate variable or operating expenses to gross income.

$$\text{Operating ratio} = \frac{\text{Total operating expenses}}{\text{Gross income}}$$

For our previous example the ratio is:

$$\text{Operating ratio} = \frac{115{,}200}{202{,}600} = 0.57$$

The result implies that the total operating expenses amount to 44% per Birr of the gross income.

Fixed ratio: it relates the fixed costs to gross income.

$$\text{Fixed ratio} = \frac{\text{Fixed expenses}}{\text{Gross income}}$$

For the previous example, the fixed ratio is:

$$\text{Fixed ratio} = \frac{40{,}550}{202{,}600} = 0.2$$

The result implies fixed expenses such as property taxes, insurance, depreciation and interest on debt amounted to 20 cents per Birr of gross income.

Gross ratio: the operating and fixed ratios comprise the gross income.

$$\text{Gross Ratio} = \frac{\text{Total expenses}}{\text{Gross income}}$$

This ratio was 0.77 for the example on hand. This is computed as 0.57 + 0.20 = 0.77.

Income-to-Investment ratio: These ratios are used to indicate the efficiency with which capital is being employed in the business. These ratios are used to indicate the efficiency which capital is being employed in the business. The capital turnover ratio is commonly used as a quick appraisal of the efficiency of capital use.

$$\text{Capital turn over} = \frac{\text{Gross income}}{\text{Average capital investment}}$$

Return to capital: the return on capital or the return to investment is a measure of profitability based on a ratio obtained by dividing the return to total capital by total farm assets. It is normally expressed as a percentage to allow easy comparison with returns from other investments. The equation is:

$$\text{Rate of Return to Capital (\%)} = \frac{\text{Return to total capital}}{\text{Total farm assets}} * 100$$

Return to capital is the return to both debt and equity capital. Therefore, net farm income must be adjusted. The interest on debt capital was deducted as an expense in calculating net farm income. This interest then must be added back to net farm income before the return to capital is computed. In other words, we calculate what net income would have been if no borrowed capital

had been used and then proceed to compute return to all capital. The calculations of adjusted net farm income of the Farmer example in Table above would be:

Net farm income	Birr 445000
Plus interest paid	28000
Equals adjusted net farm income	72100

Further adjustments are necessary, as adjusted net farm income still includes the return to the owner's labor and management as well as the return to all capital. Therefore, a return to owner's labor and management must be subtracted from adjusted net farm income to find the actual return to capital. This is done by estimating the opportunity cost of the labor and management. Assuming the opportunity cost is Birr 10,000 for the farmer's labor and Birr 5,000 for management, the calculations would be:

Adjusted net farm income	Birr 72,100
Less: opportunity cost of labor	-10,000
Less: opportunity cost of management	-5,000
Equals: return to capital	Birr 57,100

The final step is to convert this birr return to capital into a percentage of total capital invested in the business using the equation above.

$$\text{Rate of Return to Capital (\%)} = \frac{571{,}000}{602{,}500} * 100 = 9.5\%$$

Return to Labor and Management: Another of profitability is the portion of net farm income which remains to pay the owner for personal labor and management after capital is paid a return equal to its opportunity cost. The procedures-similar to-that used for return to capital except the return to labor and management is expressed in dollars and not a ratio or percentage. The return to labor and management is equal to:

Adjusted net farm income

Less opportunity cost on total capital

Equals return to labor and management

Assuming that opportunity cost of the Farmer's capital is 10%, the opportunity cost on total capital is Birr 602,500 * 10%, or birr 60,250. Therefore, the Farmer's labor and return equal to its opportunity cost.

***Return to labor*:** The return to labor and management can be used to compute a return to labor alone. Since the opportunity cost of total capital has already been subtracted from adjusted net farm income, the only remaining step is to subtract the opportunity cost of management.

Return to labor and management	Birr 11,850
Less opportunity cost of management	-5,000
Equals return to labor	Birr 6,850

Return to management: Management is often considered the residual claimant to net farm income, as its opportunity cost is difficult to estimate. The return to management can be found by subtracting the opportunity cost of labor from the return to labor and management.

Return to labor and management	Birr 11,850
Less opportunity cost of labor	-10,000
Equals return to management	Birr 1,850

Return to Equity: perhaps the most important measure of profitability is return to equity. The return to capital was a return to both debt and equity capital and a business owner may be more interested in the return to personal or equity capital invested in the business. It is this capital which would be available for alternative in investments should the business be liquidated, and it is useful to compare its return with returns from alternative investments. The formula is:

$$\text{Rate of Return to Equity (\%)} = \frac{\text{Return to equity}}{\text{Net worth}}$$

The calculation of return to equity begins directly with net farm income, as no adjustment is needed for any interest expense. Interest is the payment or return to borrowed capital, which must properly be deducted as an expense before the return to equity is computed. This has been done when computing net farm income. However, the opportunity cost of labor and management must be subtracted to find the dollar return to equity. Continuing with the same example, the Birr return to equity would be

Net farm income	Birr 44,100
Less opportunity cost of own labor	-10,000
Less opportunity cost of management	-5,000
Equals returns to equity	Birr 29,100

For the above example, the farmers return to equity would be:

$$\text{Rate of Return to Equity (\%)} = \frac{29{,}100}{318{,}000} * 100 = 9.2\%$$

5.3. Farm Efficiency Measures

Efficiency measures are designed to visualize the outcomes as envisaged by the objectives or goals of an activity in relation to the efforts made. In farm management, the efforts constitute the use and allocation of various scarce resources among alternative uses and the goal is profit maximization on a continuous basis. Thus, the efficiency measures are the tools of farm management analysis which help to measure the returns to particular segments of the farm business as returns to particular factors of production or returns from particular activities as well as the overall efficiency of the farm business.

5.3.1. What is efficiency?

Efficiency is defined as the ratio of output to input. It shows how much profitable the farming business is. There are several measures available to explain the efficiency of the business as a whole, and in part thereof. When examined together, they help to point out the weaknesses in the farm business and provide a guideline as to which part of the business deserves special attention for making improvements. They also help realize the strong points of the farm organization which may be further strengthened.

While using efficiency measures, cautions should be taken at the time of comparing the farms. This is especially important in developing countries where farming is of a diversified nature and individual farm business experiences are of wide variations in soil types, resource constraints, management ability of the farmer, *etc*. Thus, one farm may be more efficient in terms of efficiency measures related to lands and less efficient in terms of efficiency measures related to capital then other farm if the relative scarcities of land and capital between the two farms are opposite to each other, *i.e*., one farm may be more capital-intensive than the other. In such a situation, a return to capital is a better efficiency measure for capital-intensive or highly capitalized farms. Similarly, returns to land is a more appropriate efficiency measure of farm situations which are land and labor-intensive.

In general, a "measuring stick" is necessary to provide guides and standards for appraising accuracy of decisions regarding the use of resources. One method of production is said to be more efficient than the other when it yields a greater valuable output per unit of a valuable input.

5.3.2. Types of Efficiency Measures

Various efficiency measures which are developed to express the technical efficiency in various farms are the following:

1. Physical efficiency measures, and
2. Value efficiency measures (financial efficiency measures).

They can be further classified as:

1. ratio measures, and
2. Aggregate or absolute measures.

Physical Efficiency Measures

a. Aggregate

- Total area of the farm
- Number of livestock owned
- Total production

b. Ratio measure

i. Land use efficiency

- Yield per hectare
- Production efficiency
- Crop yield index
- Intensity of cropping
- Percentage of land under selected crops

ii. Labor efficiency

- Crop land (ha)/man
- Productive man-work-equivalent

iii. Machinery efficiency

- Horse power/ha

Some of these **physical measures** are explained as follows:

1. **Total area of the farm**: it measures the size (hectare) of the farm either of total land or land under crops. This is fairly satisfactory measure for comparing a given type of land and a given type of farming.
2. **Land use efficiency**: some of the indices measuring the rate of production are:
    a. **Production efficiency**: this is a measure of production efficiency of a farm with respect to any particular enterprise and can be expressed in terms of percentage as compared with the average yield of the locality.

$$\text{Production efficiency} = \frac{\text{Average yield the farm}}{\text{Average yield of the locality}}$$

    b. **Crop yield index**: is a measure of comparison of the yields of all crops on a given farm with the average yields of these crops in the locality. The relationship is expressed is in percentage terms. It is a convenience method as it combines all the yields into a single figure. Look at the following example:

Crop	Yield per ha (locality)	Yield per h (on farm)	Area under Crop	Crop yield index	Crop yield index* ha
Cotton	3 quintal	4 quintals	3	4/3x100=133	399
Wheat	10	12	8	12/10x100=120	960
Maize	10	9	6	9/10x100=90	540
Total			**17**		**1899**

$$\text{The crop yield index} = \frac{1{,}899}{17} = 11.7\%$$

    c. **Intensity of cropping**: Measures the extent of the use of land for cropping purpose during a given year. It is expressed as a percentage.

$$\text{Cropping intensity} = \frac{\text{Area cropped}}{\text{Total cultivated area}}$$

Example: If area cropped is 10 ha. Total cultivated area is 15 ha. Intensity of cropping will be 66.67%.

3. **Labor efficiency measure**: based on these measures we can determine whether the labor on a farm is more or less than what is required and whether the labor is relatively more or less efficient.
    a. **Crop hectare per man equivalent**: the significance of this measure is influenced by the varying proportion of crops with high or low labor requirements such as potatoes compared with wheat. It is one of the simplest measures and is computed by dividing total hectares in crops by man-equivalents.
    b. **Production man-work units (PMWU) per man-equivalent:** it is another good and accurate general measure of labor efficiency for all types of farms. This measure is computed by dividing total productive man-work units by the number of man equivalents on the farm. This measure can compare even farms in different type-of-farming areas with different degrees of intensity or with varying crop hectares and livestock.

A productive man work unit is the average amount of work accomplished by one man in the usual 8-hour days required under average conditions and abilities to do all the work necessary on the production of the crops.

PMWU are obtained by multiplying the hectares of each crop and number of each king of livestock by the average labor requirements per unit of each enterprise in the region.

$$\text{PMWU per Man} = \frac{\text{Total PMWU}}{\text{Man equivalent}}$$

4. **Capital efficiency**: This may be expressed in various ways.

For example, **Power, machinery and equipment costs per crop hectare:** this measure can be calculated as given in the following example. Given that the total hectare of land under crop is 50 hectares.

10% interest on power, machinery and equipment investment (20,000 Birr)……2000
Yearly repair cost (machinery and equipment)……1000
Yearly depreciation allowance ……2000
Fuel and lubricants costs……1000
Insurance premium……200
Machinery repair……1000

Other costs……600

Total =**8400**

$$\text{Machinery cost per crop hectare} = \frac{\text{Total cost}}{\text{Total crop, ha}} = \frac{8{,}400}{50} = 168 \text{ Birr/ha}$$

$$\text{Power and equipment investment per crop ha} = \frac{\text{Total machinery investment}}{\text{Total crop ha}} = \frac{20{,}000}{50}$$

$$= 400 \text{ Birr/ha}$$

NB: you can refer the previous section (balance sheet and income statement rations) for other farm efficiency measures.

5. **Measures of farm income and profit efficiency:** There are various measures which can be used to evaluate farm incomes and profits.

1. **Net cash income:** Total cash receipts from production minus total cash operating expenses.
2. **Net farm income:** Net cash income from production plus or minus change in inventory in non-depreciable items and depreciation on power machinery, livestock, buildings, *etc*.
3. **Farm earnings:** Net farm income plus the value of farm privileges (farm Products) used in home.
4. **Family labor earnings:** Farm earnings minus interest charges on farm capital.
5. **Percent returns to capital**: Ratio of farm earnings minus imputed value of the family labor to average capital investment, expressed in percent terms.
6. **Returns to management:** Family labor earnings *minus* imputed value of the family labor.

Example:

Particulars and efficiency measures	Value (Birr)
I. Cash receipt:	
Sale of crops	1700
Sale of milk	150
Sale of eggs	100
Other sales	150
i. Sub total	**2100**
ii. Cash expenses:	
Labor	500
Seeds	50
Fertilizers	200
Others	410
ii. Sub total	**1600**
iii. Change in inventory	300
iv. Farm Privileges	600

v. Interest charges@8% on average farm capital	200
vi. Imputed value of family labor	450

A. Net cash income(i -ii)	940
B. Net farm income (A+ iii)	1240
C. Farm earning (B+iv)	1860
D. Family labor earnings (C-)	1660
E. Returns to management (D – vi)	1210

Exercise:

1. Based on the information given under the balance sheet of a given hypothetical farm (see Table below), compute: The net Capital Ratio, Current Ratio, Working Capital Ratio and Debt/equity Ratio and interpret their results.

Table: Balance sheet for ABC Farm business

Balance Sheet			
Assets		Liabilities	
Current assets	30,000	Current liabilities	20,000
Working asset	60,000	Long term liability	40,000
		Total liabilities	120,000
Total assets	200,000	Total liability & Met	200,000

6. RISK AND UNCERTAINTY IN FARMING

Due to the probable changes in weather, price, pest and disease and other factors between the time the decision is made and final outcome is known (time lag between the decision making and the outcome), there are varying amount of risk and uncertainty in all farm management decisions.

Difference between risk and uncertainty

Risk is a situation in which all possible outcomes (result) of an activity are not certain (not known) but the probabilities of alternative outcome (result) are known or can be estimated.

E.g. If a farmer know that his teff crop is likely to fail in one of the four year of consecutive production period by 25% then this is a risk because even if he doesn't know the exact year he is expecting 9 know) the probability of failure in one the four years of production period.

Uncertainty is a situation where all possible outcome and the probability of the outcome are unknown or neither the outcome nor the probability are known (here nothing is known).

Types of risk and uncertainty in agriculture

The more common sources of risk can be summarized in to the general types as follows:

1. Production and technical risk:

Refers to the unpredictable impact of climate, pest disease and other natural and manmade calamities on outcome (output). It is known that for certain manufacturing firms, the use of a certain level of input will always result in a fixed and known quantity of output. That means, in manufacturing activities production can be known with certainty. However, this is not the case with most agricultural activity. Because of its nature, crop and livestock performance depends upon biological processes, which are affected by weather, soils, weeds, pests and diseases, infertile breeding livestock and other factors which make the yield not to be accurately predicted and cause yield variability. These processes cannot be predicted accurately. Farmers experience a wide range of weather conditions and refer to them simply as a "good" year, "normal" year and " bad" year.

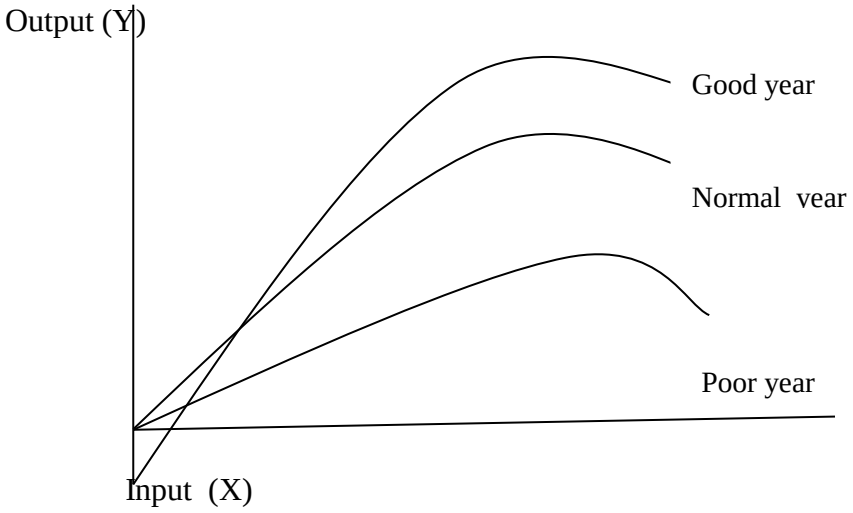


Fig 5.1. Production risk due to weather condition.

2. Marketing or Price Risk

A major source of risk in agriculture is price variability. That means, the price of most agricultural commodities vary seasonally within a year as well as changing from year to year. Many forces cause price to fluctuate. For example, the supply of inputs and outputs are affected by a combination of production decisions made by many farmers and the resulting weather,

which result price variability. Demand for a product also affected by the level of income that consumers have, the exchange rate and other policies, the strength of the general economy and the supply of competing products, which result in price variability. In general, all of the factors leading to unpredictable shift to supply and demand of input and outputs are sources of prices uncertainties.

3. Financial Risk

Financial risk occurs when money is borrowed to finance the operation of the farm. That means, it is the risk of losing equity due to a decline in income as borrowing and the debt/equity ratio increases. Yield and price uncertainty combine to generate financial risk or uncertainty about the firm's ability to repay debt. In other words, a combination of lower than expected prices and yields can make debt repayment difficult, put a strain on the firm's cash flow, and possibly reduce equity. A series of such events can result in bankruptcy. Furthermore, this risk also caused by uncertainty about future interest rates, a lender's willingness to continue lending, and the ability of the farm to generate the cash flows necessary for debt payments.

4. Institutional Risk

Institutional risk refers to irregularities in the provision of services such as the supply of credit, purchased inputs and information, from both traditional and modern institutions. Part of institutional risk is uncertainties of government policy, programs. Rule and regulations that are subject to change creating another source of uncertainty for farmers.

5. Technological Risk

Another type of risk arises from the development and adoption of new techniques or methods of production. In fact, new crop varieties, chemicals, feed combinations, models of machines, and the like, are continually being developed by research workers and business concerns. While these new developments are usually based on approved experimental procedures, the result realized may be different on a given farm from those expected. For example, a new crop variety may have been experimentally tested for three years period and may promise a ten quintal increase in yield. However, for various reasons, a given farmer may not realize such an increase. This type of technological uncertainty may increase the farmer's risk if the new practice does not work out as anticipated.

6. Casual Risk

There are certain types of risk associated with property loss due to fire, flood, windstorms, theft, etc. which result losses in agriculture. Causality losses can generally be covered by insurance. However, income may still be reduced by the interruption of normal business activity that often follows a major loss.

7. Human or Personal risk

Individuals and their tangible nature also generate some uncertainty. Farmers must deal with spouses, neighbors, bankers, suppliers, dealers, and land lords, any of whom can change their attitude, policy, or business relationship. In addition, problems related to human health and personal relationships can also affect the farm business. Accidents, illness and death, for example, often threaten and disrupt farm performance. In many countries labor migration away from the farm is a common phenomenon that occurs as a result of poverty and food insecurity and this often brings with it additional risks of contraction of human diseases and illness. Production, price or marketing, financial, institutional and personal risks exist on most farms and are often interrelated. The ability to repay debts depends on production levels and prices received for produce sold. The financing of production depends on the ability to borrow capital, government policies and the performance of the institution to supply capital in time. Therefore, the different types of risk often need to be considered together.

Decision making under risk:

It is obvious that the existence of risk and uncertainty adds complexity to many problems of a farm and to the decision-making process. However, decisions must still be made. The manager is faced with making the best decision given the uncertainty associated with the available information. Therefore, the manager must form an 'expectation' about the output price and somehow arrive at an 'expected' value to use in the decision-making process.

Forming expected values

What the farmer thinks to get in the future for the crop or livestock product is important in farmer's decisions. For example, the price of wheat and barley that he or she expected in the future has an influence on his or her decision whether to grow the crop.

Several methods can be used to inform an expectation about future prices, yields, and other values which are not known with certainty. Once an expected value is obtained, it can be used

for planning and decision making as it becomes the "best estimate" of some unknown value which will only be determined by future events. Some of the methods that can be used to form an expectation are discussed below

The major methods used to form expected values are:

1. Average (simple and weighted average)
2. Most likely method
3. mathematical expectation

1. Average

1.1 Simple average

This is a relatively simple method to use if the past data are available. The primary problem is selecting the length of the data series to use in calculating the simple average. Should the average be for 3, 5, or 10 years? The choice is usually depend on the subjective estimate of the decision maker. Consider the following price over years for maize:

Year	Average of annual price
4 years ago	2.50
3 years ago	3.05
2 years ago	2.00
Last year	4.50
Summation	12.05
Average (expected value) = 12.05/4 = **3.01**	

1.2. Weight average: this method usually weight the more recent values heavier than the older using some predetermined weighing system on the basis of the decision maker experience, judgment and performance.

E.g. using weighted averages to form expected value:

Year	Average annual price	Weight price	Result price times weight

4 years ago	2.50	1	2.50
3 years ago	3.05	2	6.10
2 years ago	2.00	3	6.00
Last year	4.50	4	18.00
Total		10	32.60
Weighted average	32.60/10 = 3.26		

1.3. Most likely method

By this method, an expectation is formed by choosing the value most likely to occur (this is the value that is relatively sure to occur). This procedure requires knowledge of the probability associated with each possible outcome. The outcome with the highest probability would be selected on the likely to occur. Example:

Possible wheat yield (qt/ha) over 4 years	Probability
15	0.1
18	0.3
25	0.4
30	0.2
Total	**1.00**

Four possible wheat yields are shown along with probability of obtaining each yield. Using the most likely method to from an expectation, a yield of 25 quintal per ha will be selected as this yield has the highest probability and is, therefore, the most likely to occur. However, there is no assurance that this yield will occur in any given year but nit will occur 40% of the time over a long period.

2. Mathematical expectation

When either the true or subjective probability of the expected outcome are available it is possible to calculate the mathematical expectation of yield, price cost income or profit. It is given a

$E(Y) = \sum(Y_1P_1 + Y_2P_2 + Y_3P_3 + \ldots + Y_n P_n)$

Where E (Y) is the expected yield; $Y_1, Y_2, \ldots..,Y_n$ are the yield under the various states of nature (E.g. wet dry and normal years); and $P_1, P_2, P_3, \ldots, P_n$ are the respective probability of the state of nature.

Example: let's assume that there are three states of nature (based on past experience) wet, dry and normal. The probabilities of occurrence of these conditions are 0.2, 0.3 and 0.5 respectively.

Consider maize and sorghum yield in the three state of nature as in the following table:

Crop	State of Nature			Expected yield
	Wet years	Normal years	Dry years	
Maize	35	25	15	24
Sorghum	15	25	20	22

The expected yield for maize is: E(Y) = (0.2*35) + (0.5*25) + (0.5*15) = 24.

The expected yield E(Y) for sorghum is: E(Y) = (0.2 * 20) + (0.5*30) + (0.3*30) = 22. Finally these values (24 and 2 quintal) are used for planning.

Variability

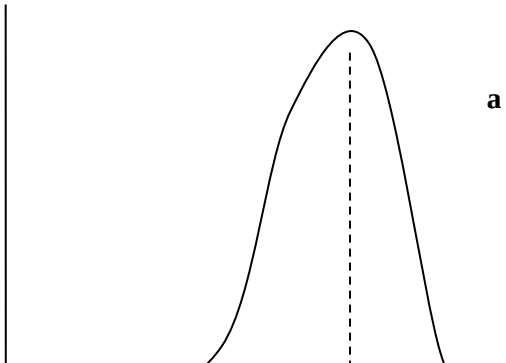
Variability or depression of possible outcome around the expected value, which may also important for a manager who select from two or more alternatives. For example, if two alternatives have the same expected value, most managers would choose the one whose potential outcomes have the last variability. Different measures of variability are discussed as follows.

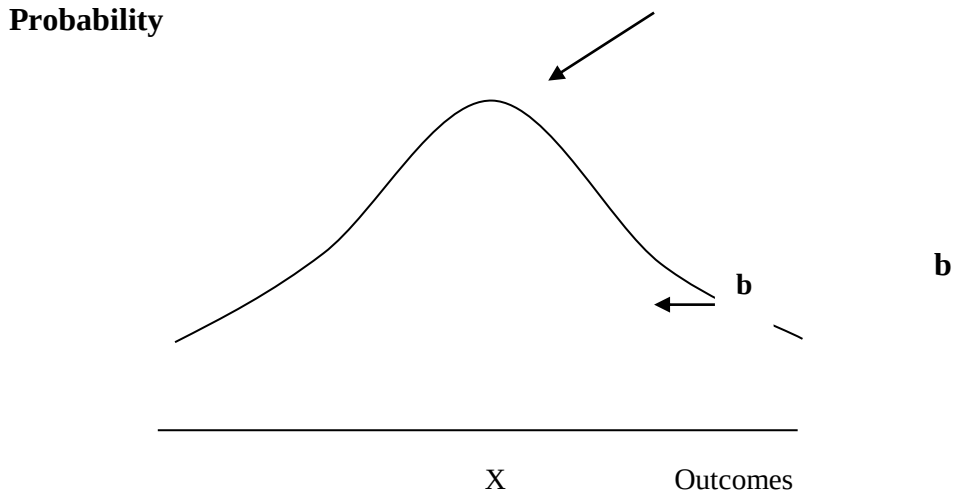
a. Range

It is a simple measure of variability that measures the difference between the lower over those and highest possible outcome or the range. Alternative with a smaller range are preferred over those with a wider range provided that their expected values and the same. The range is not considered a good measure of variability because it does not consider the probabilities associated with the extreme values in the distribution of outcomes.

b. Standard Deviation

It is a common statistical measure of variability which can be calculated from a continuous probability distribution or from a random sample of values drawn from the total population of some random variable. So, a larger standard deviation indicates a greater dispersion of possible outcomes and, therefore, a greater probability that actual outcome will be further from the mean or expected value. The figure below shows two probability distribution with the same expected value at 'X'. However, distribution 'a' has the smaller standard deviation because the possible outcomes are clustered about the expected value or the mean in 'a' fairly narrow band. Distribution 'b' has the greater standard deviation even though both distributions have the same mean or expected value. In this example, distribution 'b' would also have the greater range.





c. Coefficient of variation

The standard deviation is difficult to interpret when the probability distribution have different expected values. Probability distributions with higher expected values might be expected to have greater variability and often do. An important consideration in this situation is the relative variability. Does the probability distribution with the higher expected value really have greater variability relative to its larger value? The coefficient of variation measures variability relative to the expected value or mean of the probability distribution. This measure of variation is found by dividing the standard deviation by the mean or expected value of distribution.

$$\textbf{Coefficient of variation} = \frac{\textbf{Standard deviation}}{\textbf{Expected value or mean}}$$

It provides a method of assessing the relative of any number of probability distributions which may have greatly different expected values. *Smaller coefficients of variation mean the distribution has less variability in relation to its expected value than other distributions.*

The decision rule: The decision rule includes the following:

a. Maximin **b**. Maximax **c**. Maximize expected value d. Most likely outcome

Weather outcome	Probability	Purchase strategy		
		Buy 30	Buy 40	Buy 50
Good	0.2	6,000	6,800	800
Average	0.5	4,000	5,600	6,000
Poor	0.3	2,000	0	-2,000
Minimum value		2,000	0	-2,000

Maximum value		6,000	6,800	8,000
Expected value		3,800	4,160	4,000
Simple average		4,000	4,133	4,000

a. **Maximin rule**: this rule concentrates on the best possible outcome for each strategy. This rule says that nature will always do the worst (pessimistic approach). Therefore, the strategy with the best of the worst possible result is selected the one with the maximum of the minimum value is selected. From the above table this rule selects "buy 30 strategies as its minimum on sequence of Birr 2,000 is higher than the minimum for the "buy 40 and 50" strategy with the minimum consequence of Birr 0 and -2,000, respectively.

b. **Maximax rule**: this rule is just the opposite of maximum rule. That is, this rule selects the strategy with the highest maximum value or the maximum of the maximum value. This rule says nature will always do her best (optimistic approach). According to this rule "buy 50" strategy will be selected since its maximum value is greater than the maximum value of the other two strategies.

c. **Maximum expected value**: in this rule the decision is made by selecting strategy with the highest expected value. Accordingly, this rule selects the "buy 40" strategy since it has the highest expected value.

d. **Most likely outcome rule**: by this rule, the outcome that is most likely to occur (one with highest probability) and then the strategy with the highest consequences for that outcome will be chosen. Accordingly, the highest probability (0.5) and the corresponding highest consequence (6,000 Birr) occur in the "buy 50 strategy. Therefore, this rule selects "buy 50" strategy.

- The use of the different rules depends on the types of the decision maker's attitude towards risk and the existing financial condition of the business. There are 3 types of persons with regard to their attitude towards risk: risk averse, risk neutral and risk lover (seeker).

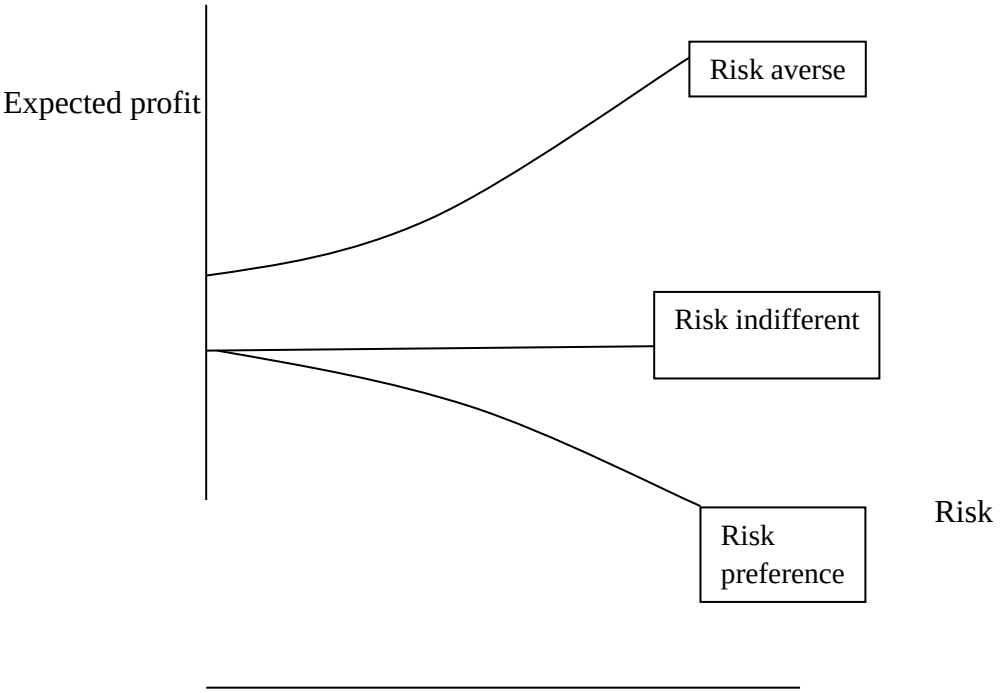
Attitudes toward Risk

Once the expected values of all alternatives have been calculated, we would expect the profit maximizing manager to select the alternative with the highest expected value. However, using maximization of profit as the criterion for decision making under risk and uncertainty situations ignores the greater variability often associated with alternatives having the higher expected

profits. The alternative selected by different managers will depend upon their attitudes toward risk. In other words, are they willing to accept an increase in risk for a higher expected profit and if so, how much?

Most mangers' exhibits risk aversion behavior. That is increased risk must be compensated for higher expected return. Moreover, individuals differ in their degree of risk aversion behavior. Some managers require greater compensation than other to assume a given increase in risk.

Three possible attitudes toward risk are illustrated in the figure below. The risk-averse manager is not willing to accept additional risk unless the expected profit is also greater. Those who are risk-indifferent do not require any increase in expected profit before they will accept a riskier alternative. They essentially ignore risk when making a decision. Managers with a preference for risk are willing to select an alternative with a lower expected profit in order to assume (enjoy?) more risk. They are sometimes referred to as "**risk lovers or risk seeker**." While there are people who prefer riskier alternatives or are indifferent toward risk, most are risk averse. They are aware of and consider trade-off between increased risk and higher expected profit and risk for each of five alternatives have been plotted and connected with a smooth curve.



Risk management strategies

Risk is unavoidable in all walks of life and it is not something to be afraid of. It is often said that, in business, no risk means no gain as profit is often considered as the reward for risk bearing. The task is to manage risk effectively, with in the capacity of the individual, business or group to withstand adverse outcomes. Most farmers use a combination of production, marketing and financial responses in their risk management strategy.

There are 3 general and perhaps related reasons why risk- averse manager would be interested in taking steps to reduce risk and uncertainty.

a) To reduce the variability of income over time

b) To ensure some minimum income level to meet family living expenses and other fixed expenses.

c) To survive the business.

Several techniques can be used to reduce the risk and uncertainty associated is variable income

1. Production responses include:

- Choosing low risk enterprises
- Diversification (growing many things)
- Growing crops on different plots
- selection of stable enterprise
- Maintaining flexibility over time and in durable assets
- Keep reserves of seed and fodder
- Insurance

2. Market-related responses

- Obtaining market information
- Spreading sales over time: proportional sales in different seasons
- Contract farming
- Contract sales

- Minimum price contracts (government interference in the market by fixing floor price for farm products to benefit the farmer)

3. Financial risk can be minimized by
   - Maintain high equity ratio
   - Maintain credit worthiness
   - Maintain a cash reserve
   - Maintain tangible assets (assets which will easily change into cash)
   - Maintain social network (is deferent organization)
   - Off-farm employment.
4. Personal risk responses
   - Medical and life insurance
   - Maintaining good personal health
   - Backup labor and management

_____/////_____

Good luck!