AEC 201 Farm Management Economics(1+1)

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Farm Management Economics

CHAPTER - I Introduction to Farm Management

A farm is a business unit/firm which combines resources to produce agricultural products. Each enterprise is a part of a farm. It is the buyer of resources and seller of products.

Literally, farm means a geographical area with definite boundaries where agricultural production activities (crop, livestock, poultry etc) are taken up under a common management.

Management may be defined as the allocation of scarce resource for fulfillment of goal(s) in world characterized with risk and uncertainty.

Farm Management: Definition

There are many definitions on farm management; some authors consider farm management as an 'Art'. Art' means skill or dexterity not only in the physical but also in the mental sense. Some farmers are more efficient or skillful in performing certain jobs than others. Those authors who define farm management as an 'art' consider individual's skill (human factor) as the most important factor determining the performance of farm business.

According to Gray "Farm management is the art of managing a farm successfully, as measured by the test of profitableness".

Boss defined Farm management is the art of applying business and scientific principles to the organization and operation of a farm.

Farm management is also considered as a 'Science'. Science is the systematized knowledge on certain phenomena and such a body of knowledge is obtained through systematic observation and testing of facts. So, when scientific procedures are employed to identify, analyse and find solutions to the farm business problems 'Farm management' can be considered as a science.

According to Heady and Jenson, "Farm Management concerns with the allocation of limited resources within the individual farm. It is a science of choice and decision making and thus a field requiring studied judgment".

Warren defined "Farm management as the science of organization and management of the farm enterprises for the purpose of securing the greatest continuous profit".

Farm Management as 'business'

A business is an enterprise organized and operated primarily for profit. Farming could also be considered as a business if profit is the main goal. Farmer, as an entrepreneur has to apply business principles in organizing and operating his farm to get the maximum advantage from his limited resources.

Moor House defined "Farm management as the study which deals with the business phase of farming".

According to Holms Farm management is the study of principles underlying the farmer functioning as a business proprietor.

Management As A Scientific Procedure (Decision Making Process)

The concept of management as a decision making process /procedure relates to the scientific method of problem solving.

It involves the following eight steps.

1. Setting of goals or objectives	Goals should be realistic, attainable and specific
	Recognize the multiple and shifting nature of goals
	Have a hierarchy of goals – goals have different weights
	Recognize the time dimension of goals - short term & long term goals.
2.Recognition and definition of problem/opportunity	Select a problem/opportunity when solved promise a high pay – off in terms of a goal.
	Understand the relative importance and urgency of the problem.
3. Gathering & Organization of facts	Many ways to solve a problem and thus many sets of data.
	Determine the more important information
	Source: neighbors, Govt. agencies, Agrl. Universities, input supplying, firms, marketing, agencies, newspapers, magazines, market reports, Farm records etc.
4.Analysis	Technical and economic relationships.
	Recognize the qualitative factors and rank them.
	Analysis may be supplemented with intuition and tempered with judgement based on experience – Art of management
	Consider the consequences of the alternatives.
5. Decision making	Select the alternative that appears more desirable and consistent with the goal of the business, resources and

	strength and weakness of the business.
6. Implementation (Acting on decisions)	Commit resources
	Supervise and Monitor
	The ability to adjust the plan of execution is an important part of successful decision implementation.
7.Acceptance of responsibility	The outcome may be good or bad
	The farmer must bear the consequences
8. Evaluation	Assess the impact of the decision
	Did the outcome approximate the expectation? If not, why? What are the factors responsible for the gap?
	Have these factors been considered in the analysis?
	If not, are they sufficiently important to be included in the next time when similar decision is made?
	Is the farmer satisfied or a new activity called for?

Source: Osburn, D.D. and Schneeberger, **Modern Agriculture Management**, 1978 PP. 9-14

Characteristics of farming as business

Farming is generally practiced in relatively small and scattered units except in the case of large scale plantations.

1. As compared to non farm activities, farming is highly influenced by natural factors such as climate, rainfall, soil etc.
2. Farm products are highly heterogeneous and maintaining uniform quality is very difficult.
3. Farm production is seasonal whereas consumption is through out the year and the demand is also inelastic for product such as food grains.
4. Farm products are bulky in relation to their value and some products such as fruits, vegetables; milk etc are highly perishable resulting in high per unit cost of marketing.
5. Many farm products are produced as joint products (Eg) grain and straw, cotton seed and lint and hence it is somewhat difficult to distribute the costs and returns between the joint products.
6. In farming the time lag between investment and getting returns is generally larger compared to non farm activities.
7. Land is the most important asset for farmers and a major share on total investment is on land.
8. Farmers are price takers both in factor and product markets since the contribution of individual farmer to total supply of products or demand for factors is negligible.
9. Generally farmers are owners of land and other fixed assets and they are also the managers of the farm business performing various function.
10. Indian farming is semi commercialized. Farmers produce for the market and also to meet their family requirement.
11. Farm and home are closely linked but it is not so in non-farm business.

Farm environment

A farm's environment consists of many interacting factors. Some of these factors are natural, such as climate, ecology, and others are man made (economical, institutional, social

and political). The interactions of these various factors create risk and uncertainty for the farmer. The farmers must function and make decisions with in the context of their uncertain environment. Though an individual farmer has little or no control over his environment, his environment presents him with opportunities and a farmer has to make the best choice. The opportunities and choices may vary between regions.

The objective of farm management is to achieve specific goal(s) within the more limited frame work imposed by the constraints – natural and man made factors mentioned above.

Goals of Farm Management

Profit maximization is the main goal of any business. When farming is considered as a business, earning maximum profit continuously from the farm as a whole is an important goal. Though maximum profit is an important goal it is not the only goal. Farmers have multiple goals. Minimizing the cost of production, maintaining liquidity, production of certain products for family consumption, growth in farm business, increasing the net worth, avoiding losses, reducing borrowing are other goals. Since farm business and farm family are closely linked, family goals are also equally important. Leisure, maintaining the health of family and maintaining the prestige in the society are some of the family goals. According to E.O. Heady, "high level of living and maximum satisfaction for the family is the final goals. Good family living is the best goal for majority of farmers. Farm management is concerned with increasing profit as a means to achieve the goal of high level of standard of living. The farm business goals should be consistent with the family goals. Many farmers are trying to obtain at least a minimum level of income to meet the family and business expenses. This behavior is known as 'satisfying behavior' which is consistent with maximum profit.

Nature and scope of farm management

Farm management concerns with the allocation of scarce resources within the individual farm and hence it is a micro approach. It deals with the organization and operation of individual farm business. But agricultural economics consider the problems of farmers as a whole (macro level). Farm management is practical oriented since it applies the facts and findings of other agricultural sciences in the farm by selecting the suitable technologies considering the resource availability. It integrates the findings of various agricultural sciences to solve problems. Farm Management is concerned with profit. i.e., the economic efficiency (yield that maximizes the profit) whereas other sciences are interested in physical efficiency i.e., maximum yield. Farm Management tries to maximize the profit from the whole farm instead of a particular enterprise.

Farmers are generally responsible for all areas of management as compared to the managers of non-farm business. The scope of farm management can be viewed in terms of problem it solves. The economic principles are employed to find answers to the problems of what to produce? How to produce? And how much to produce? The recent development in agricultural production technologies (new varieties, new inputs) and changes in Government policies have provided number of alternatives to which the scarce farm resources can be allocated. The share of purchased inputs in farming is increasing and the changing cost-price relationship plays an important role in deciding the profitability of farming. The farmers are operating the business in a dynamic environment and the principle and methods of Farm Management guide the farmers in the decision making process.

Farm Management research provides valuable information to the Government in the formulation of suitable policies on factor-product pricing, farm mechanization, input supply, marketing, farm labour etc.,

Farm Management teaching provides resource persons for farm management research, teaching and farm management extension. Advanced training, seminars and workshop in farm management help the farm management scientists and teachers to update their knowledge.

Farm management extension helps the farmers to improve their managerial capacity.

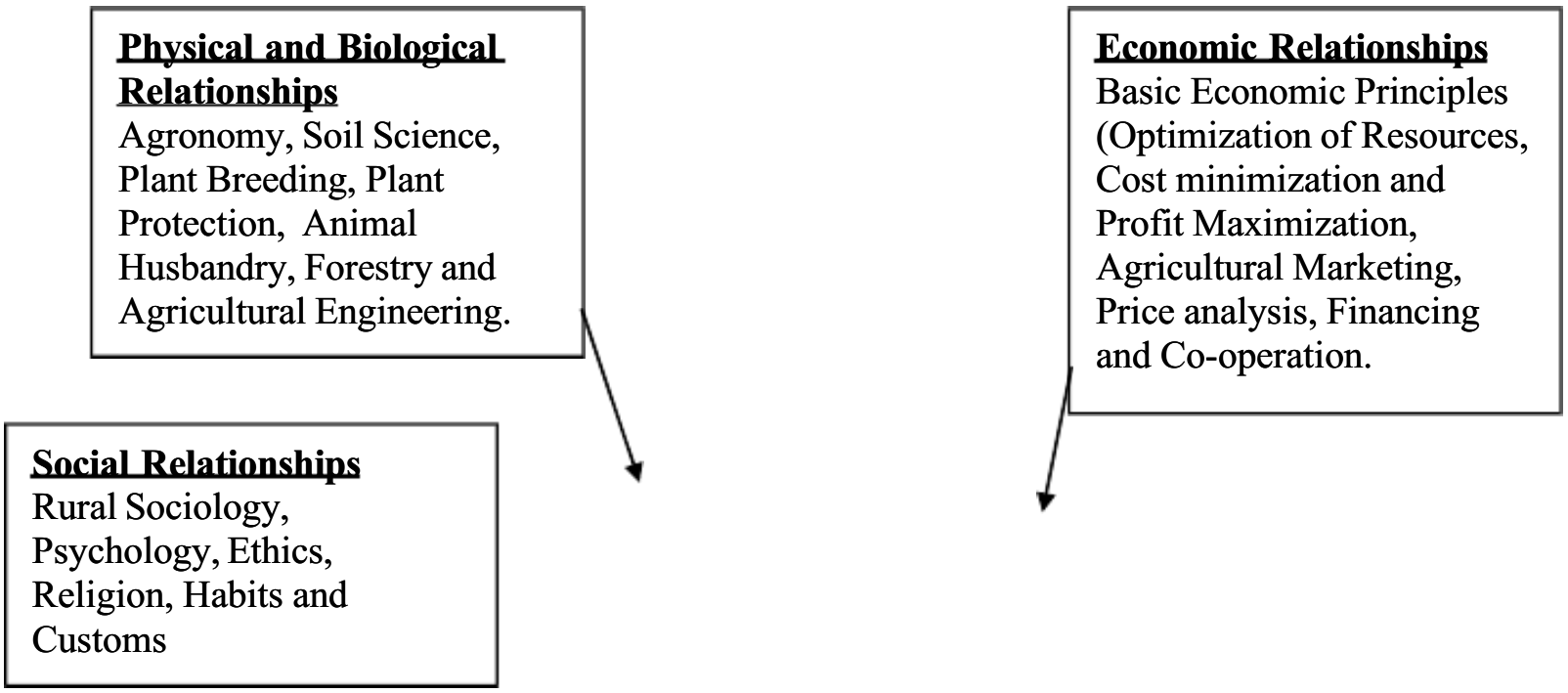
Relationship between Farm Management and Other Sciences

Farm management is an integral part of agricultural production economics. Farm management is an intra farm science whereas agricultural production economics is an inter farm or inter region science. The distinction sometimes made between production economics and farm management is based on macro and micro level content respectively. In so far as various agricultural economic problems regarding agricultural finance, land tenure, marketing, etc. are concerned at farm level. The field of specialization related to each problem becomes an integral part of farm management.

Farm management is closely related with other social sciences like physiology and sociology (Fig.1). Farmer's ability to bear risk and uncertainty is influenced by his psychological characteristics. His decisions are also influenced by the customs, habits and cultural values of the society in which he lives. The acceptance of new production techniques and methods in farming is influenced by political decisions of the government like restriction or encouragement of growing of crops, ceiling on land holding, price policies etc.

Statistcis is another science that helps in providing methods and procedures by which data regarding specific farm problems can be collected, analyzed and evaluated.

Farm Management relies closely on other branches of agricultural sciences such as agronomy, soil science, plant protection studies, animal husbandry, agricultural engineering, forestry, etc. These physical and biological sciences are not directly concerned with economic efficiency. They provide input-output relationships in their respective areas in physical terms, i.e. they define production possibilities within which various choices can be made. It is the risk of the farm management specialist and agricultural economist to determine how and to what extent the findings of these sciences should be used in farm business management.



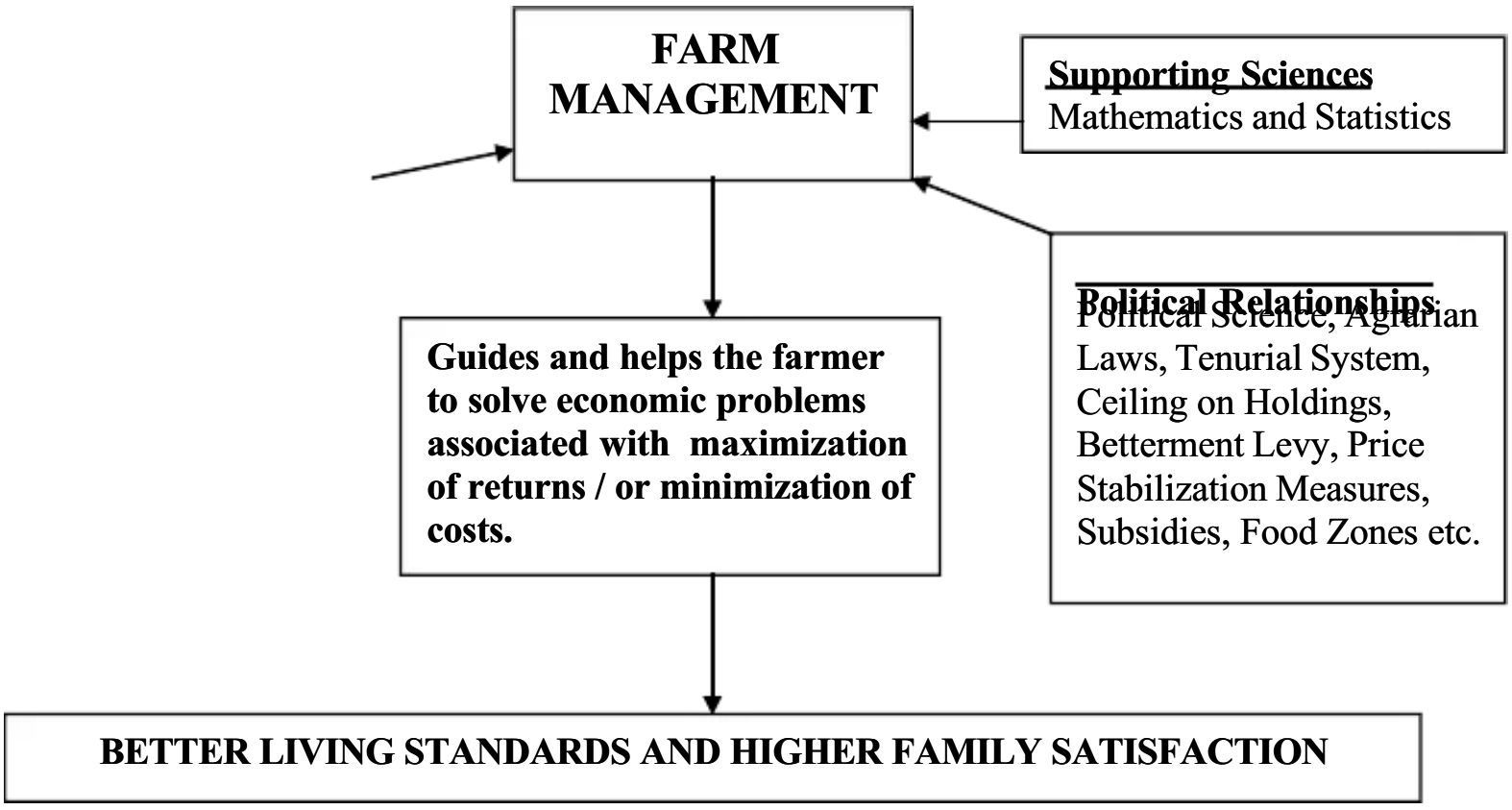


Fig. 1 Relationship between Farm Management and Other Sciences

Farm Management decisions:

Farm management decisions may be grouped under **three major categories.**

I. Production decision: A farmer has to decide 1. What to produce? (Combination of enterprises) 2. How to produce? (Combination of inputs/selecting the technology or process.) 3. How much to produce? (The optimum level of output in each enterprise.)

II. Marketing decisions:

a) Selling product:		
1.	How to sell?	Deciding the buyer – selling directly to consumer/retailer/ wholesaler or through commission agents or through Regulated markets or Co-operatives? Or to a pre-harvest contractor?
2.	Where to sell?	Deciding the place of selling – in the farm / in village or near by town market?
3.	When to sell?	Deciding the time of sale-immediately after harvest or after few weeks or month to take advantage of price variations and considering the cost of storage.
4.	Credit or cash sale?	Selling for immediate cash or credit.

b)Buying of input:

1.	When to buy?	The time of buying
2	From which agency?	Private dealer / Co-operatives / Govt. or from other farmers?
3	Quantity and Quality?	Buying in bulk or in small quantities. What should be the quality of input?
4	Credit or cash purchase?	Credit or cash purchase?
5	In the case of capital assets such as machinery or equipments a farmer has to decide whether to hire or lease or own it?	

III. Financing Decisions:

A farmer has to decide whether to borrow or not; if decided to borrow he has to decide:

1. The purpose
2. the amount of credit
3. the time of borrowing
4. the source of borrowing
5. security given
6. mode of repayment etc.

The production, marketing and financing decisions are closely related to each other. For example, production decision can not be taken without considering marketing and financial arrangements.

Farm management decisions can also be classified according to their major characteristics.

1. Strategic (organization) Vs Tactical (operational) decisions

Strategic decisions are long run in nature and are infrequently made, broader in scope, involves heavy investments and have longer effect on the farm business eg; decisions on buying land, digging wells, construction of building etc.

Tactical decisions are very frequently made, narrow in scope, uses the shortest period of time eg: decision on selecting a particular variety of crop or input or method of applying inputs.

1. **Importance**: Certain decisions have more impact on cost and returns than other decisions
2. **Frequency:** Some decisions are taken more frequently than other decisions.
3. **Imminence.** Some decision can be postponed while other cannot be postponed.
4. **Revokability**: Some decisions can be easily reversed, where as others can be changed only at considerable expenses.

Management functions

Farmers as managers have to perform three important functions, they are:

1. Making decisions
2. Implementing the decisions and
3. Assuming financial responsibility

Factors affecting managerial capacity

1. Personal traits and characteristics affect managerial performance (e.g. willingness to learn, analytical ability, ambition, initiative, integrity and reliability, age, health etc).
2. Education, training and experience influence performance.
3. Family characteristics and goals exerts important influence on managerial capacity (e.g. age and sex composition of family members and family goals)
4. Control over farm resources (land, labour, capital) influence management decisions.

PRINCIPLES OF PRODUCTION ECONOMICS

Production Economics, also known as 'theory of the firm' is one of the divisions of microeconomics. The principles of production economics guide the producers in making decision in the production of goods and services. Farmers as producers have to use their limited resources most efficiently and in the process of allocating the limited resources among competing alternative they have to decide.

i. What to produce?- (What crops/livestock activities should be taken up – combination of enterprises/activities.
ii. How to produce?- deciding the technology or process by which a particular produce should be produced – combination of inputs for producing a product.
iii. How much to produce? – deciding the level of output of an activity

The criteria or rules provided by production economics guide producers in finding answers to the above said problems.

Concepts in Production Economics

Production: It is the process of transforming input(s) in to output(s). For example, the services of land and labour, seeds, water, manures and fertilizers are converted in to crop products.

Inputs / resources:

Factors used in the production process are known as inputs or resources.

Resources can be grouped in to three major categories viz Natural resources, human resources and manufactured (man made) resources.

Resources provided by nature (land, water, solar energy) are known as natural resources. The services provided by human beings both physical and mental work constitute the human resource. Man made resources such as building, machineries, fertilizers etc, are known as manufactured resources or capital resources i.e. produced means of production.

Flow/stock resources

Flow resources: The resources, if their services are not used, can not be stocked for future use. i.e. As and when the flow comes it should be utilized Eg. Human labour and sunshine.

Stock resources can be stored and used in future eg. Machine.

Resources Vs Resource Services:

Some resources such as seed, fertilizers, water are completely transformed into output in a given production period, where as for certain resources, only the services are used and the resource provides the services for many production periods e.g. Buildings & machineries.

Fixed Vs Variable Resources

Fixed resources: The level of certain resources (land, buildings, machineries) does not change with the level of output over a production period. The quantity of these resources is fixed irrespective of the output level.

Variable resources: The resource whose use vary with the level of output in a given production period is known as variable resources Eg. Seeds, fertilizer, water, labour.

Some fixed resource such as machineries may have variable use.

Short run Vs Long run

Short run is a period or length of time in which at least one input is fixed. Long run is a period in which all inputs are variable. It is also known as planning period.

Product or output: The outcome of any production process is the output or product. When two or more products are produced from a production process they are known as joint products eg; rice and straw, cotton seed and lint.

Chapter II Factor – Product Relationship

Production function

The mathematical expression of technical relationship between input and output is known as production function. It indicates the amount of output obtained from a given amount of input, at a given level of technology during given period of time. Since the amount of output depends on the quantities of input(s), the output is a dependent variable and inputs are independent variables. For example, the output of rice depends on the area under rice (land), quantity of seeds (plants), water, manures, fertilizers, human labour, and other inputs applied during the production process. The relationship between rice yield and the inputs can be written as.

$R = f(L,S,W,M,F,H)$

Where, R = rice output, L,S,W,M,F and H represent the input-land, seeds, water, manures, fertilizer and human labour, respectively. Traditionally the alphabet 'Y' is used to denote output and 'X' to denote input

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6,)$,

Short run production function vs long run production function

Short run production function is obtained when at least one input is held at constant level – one input is fixed. In the production function $Y=f(X_1,X_2,/X_3)$, the inputs before/ie X_1 and X_2 are variable and X_3(land) is fixed. This means that the output 'Y' can be increased by increasing labour and capital inputs when land areas is held at constant level. The long run production function is one in which all inputs are variable. In the long run, producers can increase the output by increasing all inputs.

Continuous Vs discontinuous production function

Continuous production function is obtained when inputs can be split and applied in minute quantities; for example fertilizers can be applied even in grams. When inputs can be applied only in whole numbers (lumpy inputs) the resultant production function is a discontinuous one ie, one can shift from one point to another. Eg. Number of cows vs milk production.(Fig 2.1& 2.2)

A production function can be presented in a tabular from (arithmetical form) or geometrical (graphical) form) or algebraic form (mathematical) equations.

The concept of Marginalism

The words marginal, additional, incremental, rate of change or slope are often used to denote changes in inputs, outputs, costs, revenue etc. the symbol Δ is used to denote marginal changes. The term 'margin' deals with changes in variables with respect to unit change in other variables. The marginalism principle is very much useful in deciding the enterprise combination (what to produce), combination of inputs-selecting the technology (how to produce) and the level of output (how much to produce).

Types of Production Functions/Types of input – output relationship

There are three types of input – output relationship in the production of commodity one input is varied and the quantities of all other inputs are fixed. The following are the three

types of relationship between single input and single output. They are i) constant rate of return ii) increasing rate of return and iii) decreasing rate of return. The marginal productivity of the variable input determines the type relationship.

i. Constant rate of return

Every additional or marginal unit of input adds an **equal** amount to the total product than the previous unit; i.e., addition to total product is at **constant** rate.

Constant rate of return

X	Y	ΔX	ΔY
0	0	-	-
1	5	1	5
2	10	1	5
3	15	1	5
4	20	1	5
5	25	1	5

When the variable input (X) is increased by equal amount the total output (Y) increases at constant rate. In the given example, each successive unit of variable input adds 5 units of output to total product. The marginal product ($\Delta Y/\Delta X$) of each unit of input is same ie. **5 units**. ie, at the rate of 5 units/unit of input. It has limited application in agriculture example each addition of one acre of land will add the same amount of product. This constant relationship can be illustrated with a graph as in Fig 2.3(a) the production function is a straight line having the same slope throughout its entire range. This relationship can also be expressed as:

$$\frac{\Delta Y_{11}}{\Delta X_{11}} = \frac{\Delta Y_{12}}{\Delta X_{12}} \cdots\cdots = \frac{\Delta Y_{1n}}{\Delta X_{1n}}$$

ii. Increasing rate of return

Every additional or marginal unit of input adds **more** to the total product than the previous unit; i.e., addition to total product is at an **increasing** rate.

Increasing rate of return

X	Y	ΔX	ΔY
0	0	-	-
1	5	1	5
2	11	1	6
3	18	1	7
4	26	1	8
5	35	1	9

In the above example, each unit of input (X) adds more to the total output than the previous unit. The total output increases at increasing rate. The marginal product of the first unit of input is 5 while the additional output produced by 2nd, 3rd, 4th and 5th units of input are 6,7,8 and 9 respectively indicating increasing marginal physical product. This increasing relationship can be illustrated with a graph as in Fig 2.3(b) the shape of the curve will go steeper and steeper with the added inputs i.e., slope gets convex to the origin. This relationship can also be expressed as:

$$\frac{\Delta Y_{11}}{\Delta X_{11}} < \frac{\Delta Y_{12}}{\Delta X_{12}} < \ldots\ldots < \frac{\Delta Y_{1n}}{\Delta X_{1n}}$$

iii. Diminishing rate of return

Every additional or marginal unit of input adds **less** to the total product than the previous unit; i.e., addition to total product is at **Decreasing** rate.

Diminishing rate of return

X	Y	ΔX	ΔY
0	0	-	-
1	6	1	6
2	11	1	5
3	15	1	4
4	18	1	3
5	19	1	1

If each successive units of input (X) adds less and less to the total product than the previous unit, the relationship is termed as diminishing rate of return. The MPP of each successive unit of input decreases, i.e. the total output increases at diminishing rate. It could be seen from table that the first unit of input adds 6 units of output whereas the 2nd adds 5 units; the 3rd, 4th and 5th units produce an additional output of 4, 3 and 1 unit, respectively. This Decreasing relationship can be illustrated with a graph as in Fig 2.3(c) the curve is the concave to the origin. This relationship can also be expressed as:

$$\frac{\Delta Y_{11}}{\Delta X_{11}} > \frac{\Delta Y_{12}}{\Delta X_{12}} > \ldots\ldots > \frac{\Delta Y_{1n}}{\Delta X_{1n}}$$

In agricultural production, the type of input output relationship, generally, observed is the diminishing rate of return.

Different Forms of Production Function

i) Linear Production Function

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 \ldots\ldots + b_nx_n$$

Where $x^1, x^2, \ldots x^n$ are inputs, Y = output, b^1, b^2, ….. b^n are coefficients / marginal products. This function shows the constant rate return.

Example Estimated Equation

$Y = 1300 + 5X$

This shows that 1300 kg of product can be produced without applying input. And the output increases by 5kg for every increase of 1kg of input.

ii) Quadratic Form

$Y = a + bx - cx^2$

The simple quadratic equation with a minus before 'C' to denote diminishing marginal returns. It allows both declining and negative marginal productivity.

$$\text{Marginal Product} \quad \frac{dy}{dx} = b - 2cx$$

Max TPP is obtained when $X = 0.5bc^{-1}$

The elasticity is not constant but it declines with input magnitude. The elasticity equation is given below.

$$Ep = \frac{bx - 2cx^2}{a + bx - cx^2}$$

If there are two inputs the function will be

$$Y = a + b_1X_1 + b_2X_2 - b_3X_1^2 - b_4X_2^2 + b_5X_1X_2$$

Diminishing marginal returns exists for either factor alone but there is positive interaction between the two factors. (Negative or Zero interaction also may exist where diminishing marginal returns hold true for both factors).

iii) Cobb-Douglas or power function

$Y = ax^b$

Where x is the variable resource measured

Y is output

'**a**' is a constant and '**b**' defines the transformation ratio when **x** is at different magnitudes. The exponent or 'b' coefficient is the elasticity of production and can be used directly. The equation is estimated in logarithmic form. The function allows either constant, increasing or decreasing marginal productivity. It does not allow an input-output curve embracing all three.

$$MP = \frac{dy}{dx} = ba\,x^{b-1} = \frac{bax^b}{x}$$

Law of Diminishing Marginal Return (LDR)

The law of diminishing return relates to many biological and physical relationships. In agriculture the maximum amount of output that can be produced from an activity (crop or livestock) depends on the quantity of inputs used and the efficiency with which the inputs are transformed in to output. The law of diminishing return concerns with the efficiency of input use and thus determines the maximum amount of output that can be produced from an

activity, for a given technology. Though LDR explains the technical relationship between input and output it has economic implications.

Alfred Marshall considered land as fixed input and labour and capital as variable inputs in defining LDR. Marshall states **"an increase in the capital and labour applied in the cultivation of land causes in general a less than proportionate increase in the amount of produce raised, unless it happens to coincide with an improvement in the art of agriculture"**.

As more and more units of labour and capital are applied to a fixed area of land, the additional output produced by each successive unit of labour and capital declines, i.e. the total output increases at diminishing rate unless there is an improvement in the production technology. Technological improvement will improve the productivity of inputs and the operation of LDR can be postponed. Though Marshall considered land as the fixed input, any input(s) can be held at fixed level. In more general terms, the LDR can be defined as follows. When successive units of one variable input is added to a fixed level of other inputs, beyond certain level, the additional output added by each unit of input (MPP) declines. **The LDR is also known as law of variable proportion** since when a variable input is increased keeping the other inputs at fixed level, the proportion between variable and fixed input changes.

The Classical Production Function

The production function (Fig 2.4), exhibiting three stages of production, has been the traditional or standard approach for studying the economics of production and hence it is termed 'Classical production function". But, it may not be always possible to find all the three stages of production in the experimental data unless the variable input is a crucial one (ie., which is a must for production, eg: seeds) there may not be a zero production.

For the analysis of the production function Marginal Physical Product (MPP) and Average Physical Product (APP) are derived from the Total Physical Product (TPP).

TPP: It is the quantity of physical output (Y) obtained at different levels of variable input (X).

MPP: It is the additional output from each successive unit of variable input or it is the change in the TPP (ΔY) with respect to one unit increase in variable input (ΔX) ie $\Delta Y / \Delta X$.

MPP is the slope of TPP curve. It indicates the rate at which TPP increases when variable input increases. When the MPP (slope) is calculated between two points on the TPP, it is known as average of two slopes. On the other hand, the slope (MPP) at a particular point on TPP is called exact MPP. The value of average MPP are written midway between two successive TPP values.

APP: It is the average amount of output produced per unit of input at a particular level of input. It is expressed as a ratio of output to input (Y/X) and calculated by dividing the TPP by the number of units of variable input used to produce that output. APP indicates the average efficiency with which a variable input is transformed in to output.

Elasticity of production (E_P). It refers to the percentage change in output in response to a percentage change in variable input.

$$Ep = \frac{\text{\% change in output}}{\text{\% change in input}}$$

$$or \frac{\Delta Y}{Y} / \frac{X}{\Delta X} = \frac{\Delta Y}{\Delta X} x \frac{X}{Y}$$

$$\frac{\Delta Y}{\Delta X} = MPP$$

Y/ X = APP and hence X/Y = 1/APP

Ep = MPP/APP

Though MPP and APP are expressed in physical units, Ep is a mere number with out any unit.

The classical production function can be divided in to three regions.

CHARACTERISTICS OF TPP, MPP & APP

Product curve	I Region	II Region	III Region
TPP	Increases at increasing rate and then increases at decreasing rate	Increases at decreasing rate	Decreases
MPP	Increases and then decreases but > APP	Decreases and positive but < APP	Negative
APP	Increases but> MPP reaches the maximum when intersects MPP	Decreases and positive but >MPP	Decreases positive
Ep	>1	<1 but positive	< 0

Region –I : It starts from origin extends to the input level which results in the maximum **APP, (0 to MPP = APP)**

Region –II : It extends from the input denoting maximum **APP** to the input unit corresponding to maximum **TPP (MPP = APP to MPP = 0)**

Region –III : It extends from the input denoting maximum **TPP** to all inputs having negative **MPP** (beyond **MPP**=0).

Relationship between TPP, MPP and APP

Since both MPP and APP are derived from TPP, they are closely related.

TPP and MPP: As long as MPP increases, TPP increases at increasing rate, when MPP declines but positive, TPP increases at decreasing rate. When MPP is 0, TPP reaches its maximum, when MPP is negative TPP decreases.

MPP and APP: The average efficiency of variable input (APP) depends on the productivity (MPP) of each successive units of the variable input. As long as the MPP > APP, APP is increasing, when MPP = APP, APP is at its maximum when MPP is < APP, APP declines.

Rational and Irrational regions of the production function:

In the first region, the average productivity of the variable input increases continuously as more and more input units are added. So when the average productivity increases it is not rational to limit the input application in this region. Hence region I is considered as **irrational region for decision making.**

In the third region, the total physical product declines because of the negative marginal productivity of the inputs. It is not rational to add input units when the TPP decreases, even if the input is free of cost. Application of input in the third stage results in double loss due to increased input cost and loss due to reduced value of output.

The second region is the rational region or decision making region. Information on input and output prices is necessary to decide the optimum level of input. The particular level of input which maximizes the profit is the optimum amount of input and the corresponding level of output is the optimum output.

Technical efficiency and economic efficiency

Technical efficiency is measured by the physical ratio of output to input. The greater the ratio, the greater the degree of technical efficiency.

Economic efficiency is related to the objective relevant to the economic unit (Farm). If profit is the main objective then economic efficiency is achieved when resources are used to give maximum profit.

DECISION RULE FOR PROFIT MAXIMIZATION

Profit is the difference between total value product (TVP) and total input cost (TIC). TVP is found by multiplying the total output (TPP) by the price/ unit of the output (Py). Total input cost (TIC) is worked out by multiplying the total quantity of inputs (X) by the price / unit of the input (Px). Profit = TVP – TIC. Profit is maximum when the difference between TVP and TIC is the greater.

It is always profitable to increase the application of a variable input as long as the value of the added output (MVP) is greater than value of added input (MIC). MVP is worked out by multiplying added output by the price of the output (Py). MIC is calculated by multiplying the added input unit (Δx) by the price of that input (Px). The rule for profit maximization is that MVP should be declining.

$$MVP = \Delta Y.Py, \qquad MIC = \Delta X.PX$$

$$\Delta Y.Py = \Delta X.Px \quad or \quad \Delta Y / \Delta X = Px / Py$$

i.e, MPP of X should be equal to the ratio of the input price (Px) and output price (Py). To justify the application of an additional unit of input the MPP of that unit of input should be equal to the price ratio Px/Py. For example, if Px = Rs.10 and Py = Rs.5, then Px/Py = 10/5 = 2 i.e. the price of X is two times greater than the price of Y. Therefore, to justify the application of an additional unit of input, the MPP of that unit of input should at least be 2 so that the value of that 2 units of output. ie, Rs.10(2x5) will be equal to the price of the input (Rs.10.).

The optimum level of input use can also be worked by a simple method. For each level of input use, the total input cost (TIC) and the value of the corresponding level of output (TVP) have to be worked out and the profit, ie, the difference between TVP and TIC has to be calculated. **The particular level of input that gives the maximum profit should be selected as the optimum level.**

TECHNOLOGICAL CHANGE AND PRODUCTION

Technological change in production refers to improvement in knowledge applied to the production process. Technological change improves the efficiency of conversion of input in to output ie., from the same amount of input more output can be produced or to produce a given amount of output lesser amount of inputs are required because of improvement in productivity.

Certain technologies are **yield increasing while some are factor saving**, where as some others are both yield increasing and factor saving. For example, high yielding varieties of crops respond to higher doses of fertilizer and give more yield than local varieties ie., the production function is shifted (Fig.2.5) upwards. It also saves land. Improved animal is an example for yield increasing technology.

Some technologies save scarce resources and a given amount of output can be produced with lesser amount of these resources. For example as compared to ordinary method of irrigation, drip irrigation saves about 50 per cent of irrigation water without reducing the yield. Improved methods of application save fertilizers.

Chapter - III Cost Principles

Costs are usually computed as a function of output. The cost function shows the relationship between costs and output.

Short run cost function: it is the one in which certain costs are fixed.

$C = f(Y) + K,$

Where

C- total cost,
Y- output,
K- fixed cost

Long run cost function is one in which all costs are variable.

$C = f(Y)$

Cost concepts

There are seven cost concepts.

i. **Total cost.** It is the total cost of producing a given level of output. It consists of fixed and variable costs.

ii. **Fixed costs:** Costs which **do not vary with the level of output** during a given production period is known as fixed costs. Since certain inputs are fixed during the production period, the costs associated with them do not vary. Total fixed cost (TFC) is the sum of the monetary values of fixed inputs. If F_1 and F_2 are fixed inputs, then TFC = F_1. PF_1+F_2. PF_2, where PF_1 and PF_2 ae the price / unit of F_1 and F_2, respectively. In agriculture, rent for land, land revenue, interest on fixed investments, depreciation are generally, considered as fixed costs since the value of land, buildings, machineries, implements, tools and animals do not change in the short run.

iii. **Variable cost:** Costs which **vary with the level of output** is known as variable cost. Variable cost in total (TVC) vary directly with the level of output, ie., increases when output increases and decreases when output decreases. Variable cost is also known as prime cost, direct cost or operating cost. Total variable cost is the sum of the monetary values of variable inputs. If X_1 and X_2 are variable inputs, then the total variable cost is X_1. Px_1 + X_2. Px_2, where Px1 and Px2 are price per unit of X_1 and X_2 respectively. Value of seed, manures, fertilizers, chemicals, irrigation, labour, fuel etc. are examples of variable costs. Total cost curves are presented in Figure 11.1

iv. **Average Fixed cost (AFC):** It refers to fixed cost per unit of output. It is obtained by dividing the total fixed cost by total amount of output.

AFC = TFC/Y

Since TFC is a constant the AFC decreases as output increases forming a rectangular hyperbola and never shows an upward movement since it is irrational to produce in the III region of the production function.

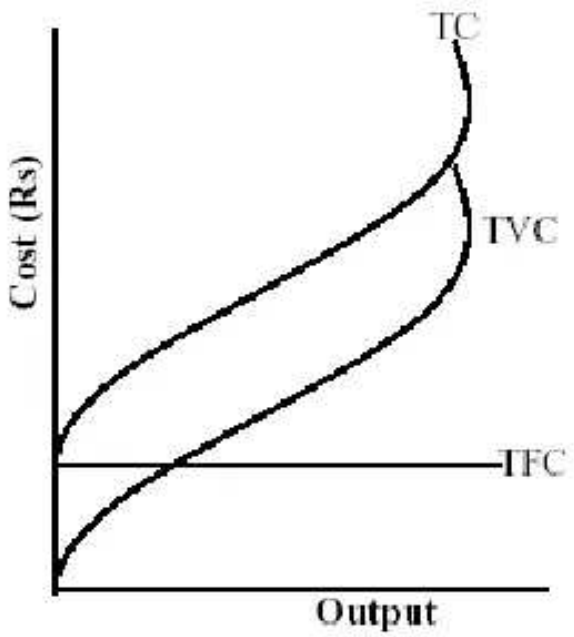


Fig 3.1 Total Cost Curves

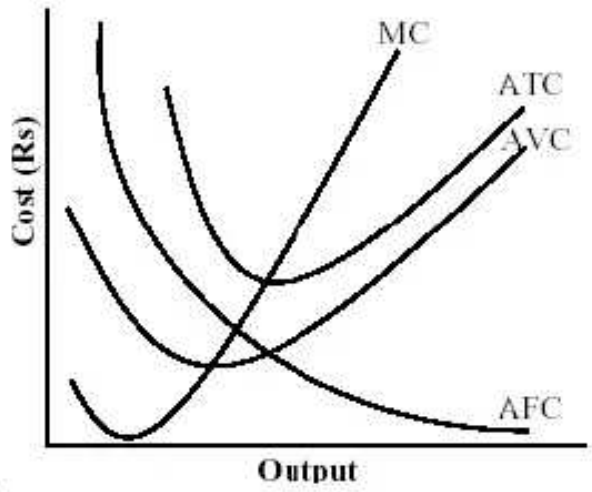


Fig 3.2.Average Cost Curves

v. **Average variable cost (AVC):** it is the variable cost per unit of output. It is computed by dividing the TVC by the corresponding level of output.

AVC = TVC/Y. AVC is inversely related to APP, when APP increases, AVC decreases, when APP decreases, AVC increases and when APP is at its maximum AVC is at its minimum.

vi. **Average cost (AC) or Average total cost (ATC):** It is the per unit cost of producing the output, consisting of average fixed and average variable costs. ATC is computed by adding average fixed cost and average variable cost or by dividing TC by the corresponding level of output.

$$AC = TC/Y \text{ or } TFC/Y + TVC/Y = AFC + AVC$$

In response to increase in output the average cost curve decreases, reaches its minimum and then goes upwards. **AC curve reaches its minimum at a higher level of output** than the output at which AVC curve reaches its minimum since the rate of fall in AFC is more as compared to the rate of increase in AVC. Once the rate of fall in AFC is lesser than the rate of increase in AVC, the AC curve starts rising.

vii. **Marginal cost (MC):** It is the cost of producing an additional unit of output. It refers to the change in TC in response to a unit change in output. It is the slope of TC curve. It is computed by dividing the change in total cost (Δ TC) by the corresponding change in output (Δ Y).

MC = Δ TC / Δ Y. MC can also be worked out by dividing the change in variable cost (Δ TVC) by the change in output (Δ Y) because the change in TC is equal to the change in TVC at a given level of Fixed Cost. MC is inversely related to MPP. When MPP increases MC

decreases, when MPP is maximum MC reaches its minimum and when MPP decreases MC increases.

Relationship between MC and Average Cost curves

Average and marginal cost curves are presented in Figure11.2 MC intersects AVC and AC curves from below. As long as the MC is below AVC and AC, AVC and AC decreases, when MC is equal to AVC and AC, AVC and AC reaches their minimum and when MC is above AVC and AC, AVC and AC increase.

Optimum level of output: Production of an additional unit of output is always profitable as long as MC < MR, because less is added to TC than is added to TR. **The profit is maximized when Marginal Revenue (MR) is equal to the Marginal Cost**, MC is rising and AVC rising or TR> TVC. Marginal revenue (MR) is the change in total revenue (TR) with respect to one unit change in output. It is the amount realized by selling an additional unit of output which is equal to price / unit of that output (Py). It is also the average revenue (AR).

Minimum loss principle

In the short run, since a producer does not have any control over the fixed cost he has to consider only the variable cost which can be altered. A producer has to continue production as long as the AR (Py) is greater than the AVC, even if AR is less than ATC, to minimize the loss in the short run. The loss would be higher if production is not carried out in the short run if TC >TR >TVC. In the long run, when all costs become variable, TR>TC or AR > AC to continue the production.

Example:

Suppose a farmer has incurred a cost of Rs.5000 to raise one ha of rice till harvesting stage. Because of severe pest attack, he expects a grain yield of only 10 quintals and a straw yield of 3 tonnes. The expected price is Rs.300/q of paddy and Rs.200/tonne of straw. The cost of harvesting and threshing would be Rs.2000/ha. Now the farmer has to decide whether to harvest or not to harvest the crop. The minimum loss principle guides the farmer in taking an appropriate decision.

Whether he harvests the crop or not, the cost already incurred (Rs.5000) up to harvesting stage can not be altered. The only cost under his control is the cost of harvesting (Rs.2000). Let us consider the economic consequence of the two alternative decisions.

Illustration of Minimum Loss Principle

Sl.No.	Cost/return	Decision I (Not harvesting)	Decision II (harvesting)
1	Total FC	5000	5000
2	Total VC	0	2000
3	Total cost	5000	7000
4	Total Revenue	0	3600
5	**Profit/loss**	**-5000(loss)**	**-3400(loss)**

In the given example, the TR is Rs.3600 which is >TVC but < TC. If the crop is not harvested the loss would be Rs.5000, if it is harvested the loss would be reduced to Rs.3400. Hence the rational decision is harvesting the crop to minimize the loss.

ECONOMIES OF SIZE

All inputs are variable in the long run. Production Planning in the long run consists of evaluating all production possibilities the farmer could take up. **All durable inputs put together is known as plant**. In farming, durable inputs such as land, buildings, machineries, and animals constitute a plant. The size of the plant decides the maximum production capacity of the farm. An increase in one or more durable inputs increases the plant size and consequently the production capacity. To make the analysis simple let us consider two inputs viz., X_1, available labour and X_2, the plant size. For each plant size (output level) there will be a corresponding level of variable input that minimizes the cost of producing a given output level. The average cost of production at different level of output (Plant size) decreases up to certain level and beyond that it starts increasing. Economies of size is realized as long as the long run average cost declines in response to increases in plant size. **The optimum plant size (output) is one which results in minimum long run average cost**. Diseconomies on size occur when it is rising. Increase in plant size improves efficiency due to specialization of labour, mechanization, purchase of inputs at discount, etc. But beyond certain level the long run average cost rises due to difficulties in management and control.

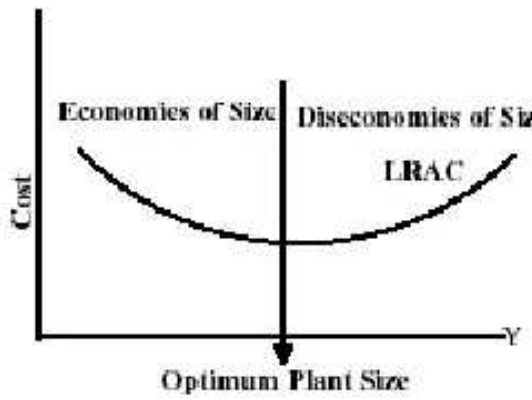


Fig 3.3 Economies of size

Economies of size

In farming as the size of a farm increases, cost per unit of production decreases, increased efficiency resulting from large size. (Eg.). the cost of production per kg of paddy in case of a 10 ha farm will be lesser than that of a per kg of Paddy produced from a 5 ha farm. This is because a 10 ha farm can effectively utilize labour and get other inputs at cheaper cost comparatively than that of a 5 ha farm.

There are **two types of economies a) internal economies and b) external economies**.

a) Internal Economies

Internal economies are those economies in production, those reductions in production costs, which accrue to the farm itself when it expands its output or enlarges its scale of production. This is due to use of methods which small farms do not find it worth while to employ.

Internal economies may be of the following types

(i) Technical Economies (ii) Managerial Economies (iii) Commercial Economies (iv) Financial Economies and (v) Risk bearing Economies.

i. Technical Economies

It refers to the size of factory or establishment. It arises from use of (i) Large size machineries (ii) Linking process- integration of two or more is more economical. Eg. dairy farm + fodder farm, Sugar factory + Sugarcane farm, paper making & pulp making.
(iii) Superior technique – Large establishments can have power driven machinery.
(iv) Increased specialization – Specialization and division of labour are highly advantageous.

ii. Managerial Economies

These economies arise from the creation of special departments or from functional specialization. There is a vertical division of labour starting from workers to manager.

In general concentrate on the jobs which bring more profits. In large farms manager collects new technologies. For managing routine works, a permanent labour is employed and to perform various operations workers are employed.

iii. Commercial Economies

These arise from purchase of materials and sale of goods. Large farms have better bargaining power. Credit institutions will give special attention. Selling cost will be less and the profit will be more.

iv. Financial Economies

Large farmers have better credit and can borrow on more favourable terms which lead to more investment and more income.

v. Risk Bearing Economies

Large farmers can spread risk and avoid risk/eliminate them by diversifying the output.

b) External Economies

External economies are those economies, which accrue to each member firm as a result of the expansion of the industry as a whole.

i. Economies of concentration

These arise due to availability of skilled labour, better transport and credit facilities. Every firm in the industry shared the common stock of knowledge and experience.

ii. Economies of Information

These economies refer to the benefits which all firms engaged in an industry derive from the publication of trade and technical journals and from central research institutions.

iii. Economies of Disintegration

When an industry grows it becomes possible to split up some of the processes which are taken over by specialist firms. Examples are spare parts manufacturing units/assembling units.

Diseconomies of size

It is opposite to Economies of Size. It is a proven fact as the size of farm expands, the unit cost comes down. However, expansion beyond certain point results in increased unit cost of production owing to managerial problem and other factors which is termed as "Diseconomies".

Increase in production (or) large scale production may lead to increase in cost due to following **reasons**.

i) Over-worked Management: A large – scale producer cannot pay full attention to every detail. Cost often rises due to the dishonesty of the employees or waste of materials by them. This is due to lack of supervision.

ii) Individual tastes: If the consumers are not satisfied because large scale production is meant for mass. This leads to loss of customers.

iii) No personal Element: Large scale firms are managed by paid employees. Due to lack of personal touch between the owner and employers there may be frequent misunderstanding. Which lead to strikes and lock- outs. This is harmful to the business.

iv) Possibility of depression: Large scale production leads to over production. Production is more than the demand. It is not easy to dispose a large quantity in a profitable manner.

v) Lack of adaptability

Large farms find difficulty in switch over from one enterprise to another enterprise. If there are more number of farms it leads to competition for labour, raw materials which in turn increases higher cost, wages and cost of operation and hence less profit. Sometimes, due to scarcity farms use inferior or less efficient factors which also lead to increase in cost.

RETURNS TO SCALE

In the short run, quantity of certain inputs are increased, keeping others at constant level to increase the output. But, in the long run, the output can be changed by changing the quantity of all inputs in same proportion or in different proportion. **The response or behavior of out put when all inputs are changed in the same proportion is known as returns to scale.**

In response to the proportionate change in all inputs, if the output also increases in the same proportion, the relationship is known as **constant returns to scale**. If the output increases at a higher rate than the rate of increase in inputs, the relationship is **increasing returns to scale** if the output increases at a lower rate as compared to the rate of increase in inputs, these are **diminishing returns to scale**. For example, in the production function, $Y = f(X_1, X_2, X_3)$, X_1, X_2,and X_3 are increased simultaneously by a factor, **k**. Then $Y= f(kX_1, kX_2, kX_3)$. Suppose **k** is **2** it means that X_1, X_2, and X_3 are increased by **2 times.**

Example: Assume that to produce 50 quintals of rice, 1 ha of land (X_1), 200 units of labour (X_2), and Rs.5000 of capital (x3) are required. If all the inputs are increased by 2 times, then X_1, X_2, and X_3 will be, 2 ha, 400 mandays and Rs.10000, respectively. Consequently, the output of rice will also increase. It may increase in proportion to the increase in inputs ie, by 2 times (100 qtls) or by more than two times (>100 qtls.) or by less than 2 times (>50 but <100).

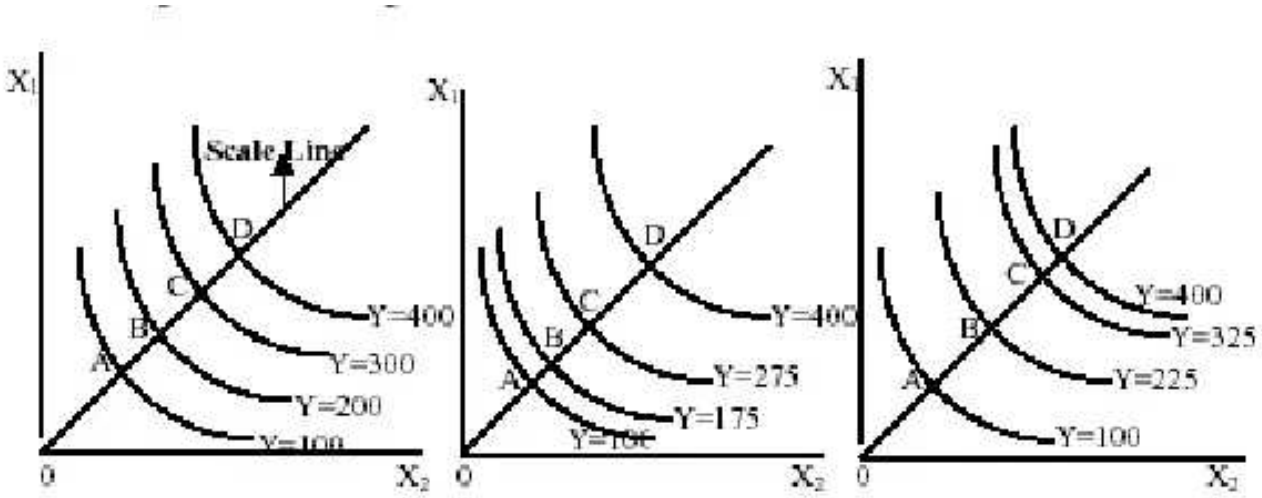


Fig 3.4 Constant returns to scale

Fig3.5 Decreasing returns to scale

Fig 3.6 Increasing returns to scale

AB=BC=CD	**AB<BC<CD**	**AB>BC>CD**
100	**75,100,125**	**125,100,75**

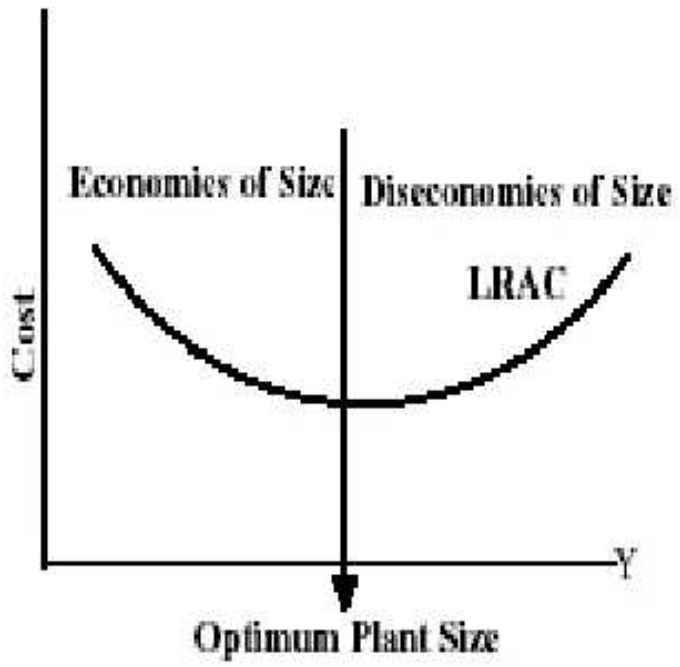


Fig 3.3 Economies of size

Chapter - IV Factor – Factor Relationship

There is more than one method of producing a commodity or performing a farm work. Generally, one or more factors can be substituted for another factor in producing a given amount of output. The principle of substitution applies to those situations in which choices much be made between input combinations. **This principle provides the guideline in choosing the least cost method of producing a given amount of output.**

The production function Y=f(C,L/A) shows that production (Y) depends on the variable inputs, capital (C) and labour (L) when area of land (A) is kept at fixed level.

Isoquant or Isoproduct curve

Isoquant is a curve showing all possible combinations of two inputs that results in equal output amount of (Figure 4.1).

Isoquant map

When number of isoquants are drawn on a graph it is known as isoquant map (Figure 4.2). Smooth convex isoquant assumes continuous substitutability between two inputs over a certain range beyond which the inputs cannot be substituted for each other. Isoquants nearer to the origin indicate lower level of output and away from the origin indicate higher level of output.

Characteristics of Isoquants

i) **Isoquants are negatively sloped** because increase in one input will decrease the other input to keep the output at constant level.

ii) **Convex to origin** Because of diminishing rate of substitution between inputs the isoquants are convex to origin.

iii) Two **isoquants never intersects** each other since a particular combination of two inputs will never results in two different level of output.

Marginal Rate of Technical Substitution (MRTS)

I t refers to the number of units of an input that must be reduced for one unit increase in another input to maintain the given level of output.

$$MRTS = \frac{\text{Units of replaced input}}{\text{Units of added input.}}$$

Consider two inputs capital (C) and labour (L) for producing an output and the isoquant is written as

C = f(L,Y)

L = f(C,Y)

$$MRTS_{c,l} = \frac{\Delta L}{\Delta C} = \frac{MPP_c}{MPP_l}$$

Types of Isoquants

1. Linear Isoquant - The rate of substitution depends on MPP of L (X_1) land C (X_2). If MRTS is constant – isoquant is linear (Fig 4.3) the two inputs C and L are **perfect substitutes.**

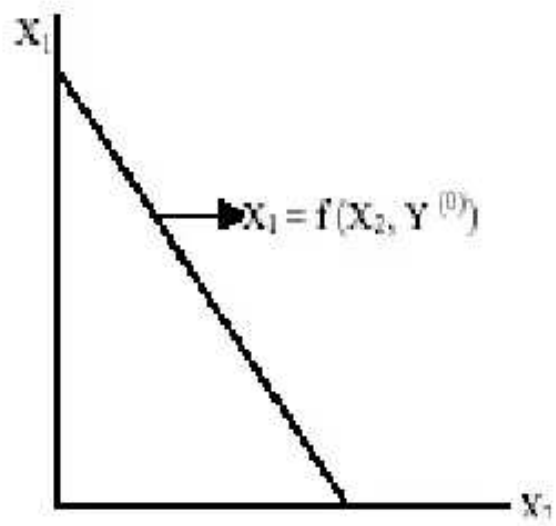


Fig 4.3 Linear Isoquant

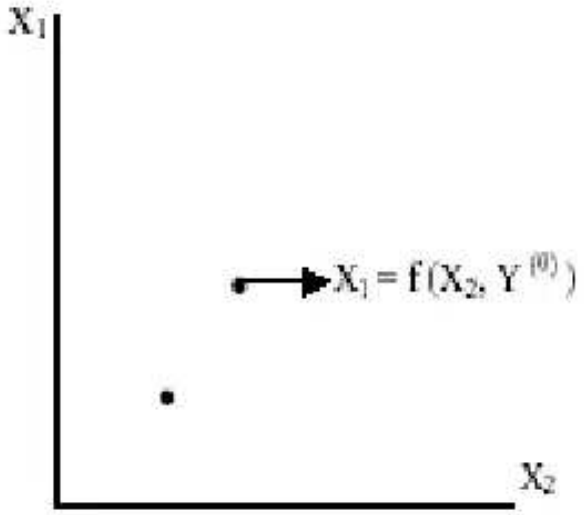


Fig 4.6 Input output Isoquant

2.Convex isoquant. If MRTS declines isoquant is convex (figure 4.4) Inputs, C and L are imperfect substitutes.

3. Kinked Isoquant - When there is **limited substitutability** between C and L the isoquant is a kinked one (Figure 4.5) That is, there are only limited number of process for producing a commodity. Each process is represented by a straight line passes through the origin. Substitution between C and L is possible only at the kinks.

4. Input – output isoquant - When the inputs C and L are complementary and **cannot be substituted**, the isoquant is known as input – output isoquant (Fig 4.6). There is only one method of (only one combination of inputs) producing a commodity. For example, increasing L. Keeping C at C1 level will not increase the output.

Isoclines: These are lines pass through points of equal MRTS in the isoquant map, ie. A particular isocline passes through all isoquants on points where they have the **same slope**.

Ridge line: An isocline passes through points of **zero MRTS on the isoquant map** is known as ridge line. Also known as boundary lines, it demarcates the boundaries beyond which substitution between inputs is not possible.

Expansion Path

It is a line or curve connecting **least cost combinations of inputs** for all output levels. It is also called as isocline since it passes through all the isoquants where they have same slope.

Isoclines, ridgelines, and expansion path are presented in figure 4.7.

Elasticity of factor substitution (Es)- Es is defined as the percentage change in one input (L) divided by the percentage change in the other input C.

$$Es = \frac{\Delta L}{L} \times 100 \Big/ \frac{\Delta C}{C} \times 100$$

$$= \frac{\Delta L}{\Delta C} \times \frac{C}{L}$$

Budget line: (Isocost line)

It shows all possible combinations of two inputs that cost the same amount.

TVC = Pl.L+Pc.C Where Pl- price of L, Pc – price of C

The slope of the isocost line is Pc/Pl. Disproportionate change in input price will change the slope of isocost line. Suppose the price/ unit of labour is Rs.10/- and price/unit of capital is Rs.5. and a farmer has Rs.100 at his disposal. If the entire amount is spent on one input, either he can hire 10 units of labour (100/10) or purchase 20 units (100/5) of capital. If he reduces the capital by 1 unit he can hire ½ unit of more labour, since the price / unit of labour is two times of the price of capital i.e.. **Pc/Pl = 5/10, which is the slope of the budget line**. It indicates at what rate labour is exchanged/unit of capital for the given prices of capital and labour. The slope of the budge line is negative since increase in one input reduces the other for a given amount of budget.

Optimum combination of two inputs (C & L)

When different combinations of two inputs are available for producing a given amount of output, a farmer has to select the optimum combination among the various combinations. The optimum combination is one which results in least cost (minimum cost) for producing a given amount of output. The least cost principle says that a producer can add more and more units of one input (capital) to replace another input (labour) as long as the value of the replaced input ($-\Delta L.Pl$) is greater than the value of the added input ($\Delta C.Pc. > \Delta L.Pl$). **The optimum or Least Cost Combination(LCC) is obtained when $\Delta C.Pc. = \Delta L.Pl$. i.e. MRTScl = inverse price ratio between C & L.**

$$\text{i.e.} = \frac{\Delta L}{\Delta C} = -\frac{Pc}{Pl}$$

If these ratios are cross multiplied, then the relationship will be $\Delta C.Pc = -\Delta L.Pl$. Hence, as long as MRTS is greater than the price ratio, labour can be replaced by adding more capital. The least cost combination is obtained when MRTS cl is equal to the inverse price ratio –

Pc/Pl. Graphically, it is the point at which the **budget line is tangent to the isoquant**,(Fig 4.4) when the budget line is tangent to the isoquant, the slope of the isoquant (MRTS) i.e. $\Delta L/\Delta C$ is equal to the slope of the budget line (Pc/Pl).

The least cost combination can also be found out by computing the total cost for each combination and selecting the particular combination which results in minimum cost.

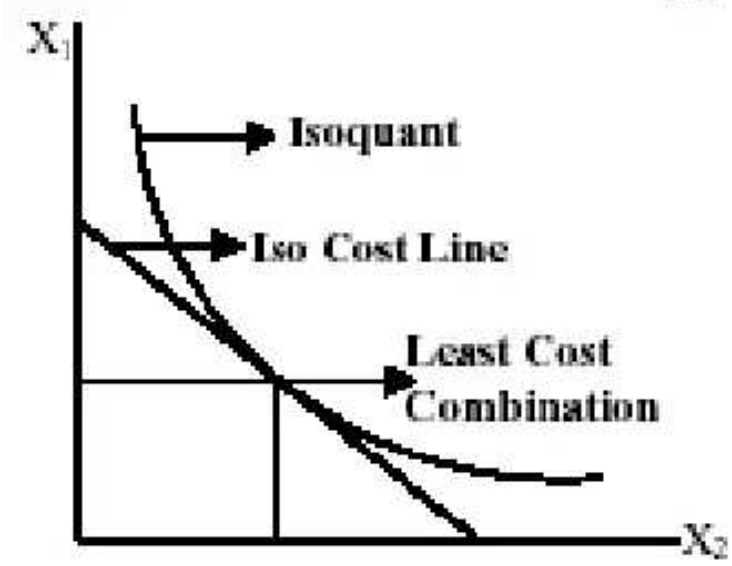


Fig 4.8 Least cost combination of Factors

Chapter – V Product – Product Relationship

The question under product- product relationship is what combination of enterprise should be produced from a given level of resources? Or how much of the scarce resource should be applied to each enterprise? Generally, farmers do not have enough resources to maximize the income from each and every enterprise by equating the price of an input to the MVP of that input (MVP = MIC) and hence the enterprise can be considered independently. The degree of interdependence among enterprises depends on the technical and economic relationships.

Relationship between products (enterprises)

1. Joint Products

Joint products result from the same production process. Production of one without the other is not possible. Examples are cotton lint and cotton seed, paddy and straw etc. Graphically quantities of Y_1 and Y_2 that can be produced at different level of resources are given in Fig. 5.1. A, B and C are the combinations of products. For production decisions, joint products can be treated as one product.

2. Complementary products

Two products are complementary if an increase in one product causes an increase in the other product (Fig 5.2) eg., rice followed by pulses in wet land.

3. Supplementary products

Two products are supplementary if the amount of one can be increased without increasing or decreasing the amount of other product. Supplementary relationship involves the use of surplus resources that would otherwise be wasted (Fig.5.3) eg. Enterprise that uses the family labour during lean season.

4. Competitive products

Two products are competitive when the output of one product can be increased only by reducing the output of the other product. The products are competitive because they require the same limited resource at the same time eg., rice and sugarcane in wet lands.

Competitive products may substitute at constant, increasing and decreasing rates. These are presented in Figure 5.4, 5.5 and 5.6.

Production Possibility Curve (PPC) / Iso resource curve

PPC represents all possible combinations of two products, that can be produced with a given amount of a resource. Since each output combination uses the same amount of a resource it is known as iso resource curve.

Marginal Rate of Product Substitution (MRPS)

It is the rate of change in one product as a result of one unit change in other product. MRPS is the slope of the production possibility curve.

$$MRPS = \frac{\text{Amount of replaced product}}{\text{Amount of added product}}$$

If Y_1 and Y_2 are competitive product (ie. One has to be reduced to increase the other) than

$$MRPS_{y2y1} = \frac{-\Delta Y1}{\Delta Y2}$$

If $MRPS_{y2y1,} < 0$, Y1 and Y2 are competitive
If $MRPS_{y2y1} < 0$, Y1 and Y2 are complementary
If $MRPS_{y2y1} = 0$, Y1 and Y2 are supplementary

Isoclines: These are the lines pass through the points of equal MRPS on production possibility curve map.

Ridge line: An isocline passes through the point of zero MRPS on the isoquant map. It is the boundary line demarcates the boundaries beyond which substitution between products is not possible (fig.5.7).

Iso revenue line or price line

It indicates all possible combinations of two products that yield the same revenue (fig 5.8). The price ratio of the two products is the slope of the price line. Disproportionate change in the price of product change the slope of price line.

$TR = Y_1 . P_{Y1} + Y_2 . P_{Y2}$

Optimum combination of two products i.e. The particular combination that maximizes the revenue is obtained when MRPSy2y1 is equal to the inverse price ratio ie, when $-\Delta Y_1 / \Delta Y_2 = P_{y2}/P_{y1}$ or when the slope of production possibility curve is equal to the slope of iso revenue line (Fig.5.9)

It is always profitable to substitute one product (Y_2) for another (Y_1) as long as the revenue added ($\Delta Y_2 . P_{Y2}$) is greater than revenue sacrificed ($-\Delta Y_1 P_{y1}$).

Expansion path: A special isocline that passes through the points of maximum revenue combination of two products for different levels of a resource (fig 5.10)

The Principle of Equi marginal returns

The equi marginal return principle is useful in determining how to allocate the limited resource among two or more alternatives.

Farmers, generally do not have enough resources to increase the output from each activity to the point where MVP = MIC. If that is possible the factor product analysis would be adequate to answer to combination of enterprises question.

When resources are limited , distribute them among different production activities beginning with the one giving the highest return and continue distributing the inputs to the

next highest activity until the input is exhausted. But resources will not be used beyond the point of maximum profit for any individual production activity.

Equi -marginal return principle states that the most profitable return from a scarce or limited resource is obtained when the value (MVP) added by the last unit of the resource is same in all its alternative uses.

$MVPy_1 = MVP\ y_2 \ldots\ldots\ldots = MVP\ yn$

Capital Rs.	**Total returns (TVP) Rs.**			**MVP (Rs.)**		
	Crop	**Live stock**	**Poultry**	**Crop**	**Live stock**	**Poultry**
1000	1300	1400	1500	1300	1400	1500
2000	2600	2600	2750	1300	1200	1250
3000	3800	3700	3850	1200	1100	1100
4000	5000	4600	4850	1200	900	1000
5000	6100	5400	5750	1100	800	900

	Poultry	**Crop**	**Livestock**
Total return	6100	5400	5750
Net profit	1100	400	750
Average return	1.21	1.08	1.15

This principle states that resources should be used where they bring not the greater average returns but the greatest marginal return.

Average return is highest if the whole amount is spent on crops. But MVP should be considered for the allocation of capital among the enterprises. If capital is allocated considering the MVP of each activity as shown below the total return will be Rs.6750 and the net profit will be Rs. 1750.

S.No.	**Capital unit**	**Activity**	**MVP**
1	1000	Poultry	1500
2	1000	Live stock	1400
3	1000	Crop	1300
4	1000	Crop	1300
5	1000	Poultry	1250
	Total return		6750
	Net profit		**1750**

Average return in Rs. = 6750 / 5000 = 1.35.

OPPORTUNITY COST PRINCIPLE

The farm resources are always limited and there are more than one alternative to use these resources. When resources are used in the production of one activity some alternative activity is always foregone. The opportunity cost of using the resource in one activity / product is the return that could be obtained by using it in another activity. For example with

the limited availability of land, a farmer can choose either cholam or maize in a particular season. If cholam is chosen, the opportunity cost of using land in cholam is the income that would have been earned from maize if the land is allocated for maize.

	Cholam	Maize
Net income / ha	Rs.1500	Rs.1800

The opportunity cost of growing cholam is Rs.1800/- in terms of maize.

In simple way opportunity cost is defined as the return foregone from the next best alternative.

Resources that are scarce or limit production has a positive opportunity cost. Resources that are not scarce and do not limit production due to their availability or lack of alternative employment opportunities will have zero opportunity cost.

The opportunity cost principle is used in valuing scarce resources. It is employed to impute value for family labour, farm produced inputs such as seeds, manures etc.

SPECIALISATION AND DIVERSIFICAION PRINCIPLE

Diversification of Enterprises

Diversification is a very important, useful and popular method to safeguard against risk and uncertainty in agriculture. Here we refer to diversification of products as a means of stabilizing incomes rather than profit maximization. It is related to reaping gains of complementary and supplementary relation between products.

Under a risky environment, a farmer may not specialize in a single enterprise over a period of time even if the price is high for that enterprise. Instead he may choose several enterprises in some proportion over time so as to distribute the risk factor. It is a good method to prevent large losses.

Diversification can be accomplished either after increasing the existing stock of resources or just by holding the level of resources constant.

Specialisation of Enterprises

If the climate and soil is suitable for a particular crop and price is high, farmers may produce that crop Eg. Growing sugarcane (or) Banana.

Specialization may also be done due to higher yield for that crop in that farm. But specialization is associated with risk. If there is any out break of disease (or) pest the entire crop will be affected.

Chapter - VI Management of Important Resources

Management of Resources is important since the resources are scarce and involve cost. It includes mobilization and allocation among different alternatives.

Mobilization of Resources

Farm resources can be mobilized in the following ways: (i) Own (ii) Lease (iii) Custom Hire of Resources and (iv) buying.

Alternative to owning land & machinery, leasing and custom hiring is in practice.

Lease

A lease is a formal agreement whereby the machine owner grants control and use of the machine to the user for a specified period of time for an agreed amount of payment.

Short term leasing covers days or months while long term leasing may cover one or more years.

Leasing land: A lease is a legal contract where by the landowner or land lord gives the tenant the possession and use of an asset such as land for a period of time in return for a specified payment. The payment may be cash, a share of the production, or a combination of the two. Oral leases are legal in many countries. But it is not recommended. This may lead to disputes if the memories fail. A lease should be written and contain the following information: Description of the land, Land owner and tenant period, term of the lease, rent amount, time of payment, rights and signatures.

Livestock share: It is like crop share. Mostly share are 50:50 for owner and tenant / leaser.
Labour share: This is in practice for crop & livestock enterprises. Actually the labourers put their services in cultivation of land and they get their share as per the agreement made.

Labour – Hiring

Human labour can be hired on daily basis or on monthly basis or for years. Accordingly wages are paid.

Water

Water is an important resource in farming. It is supplied through canals if source of water is reservoir/ tanks. Farmers own wells. Some farmers purchase water from neighbours. Pricing of water is done by seller farmer.

Land Management

Land has a wider meaning in economics. Land stands for all natural resources which yield an income. It represents those natural resources which are useful and scarce. From economics point of view, the concern is more profitable use of these resources through optimal utilization.

Land use efficiency measures

a. Yield per hectare

If refers to the productivity of individual crops. It is the ratio of total production to the number of hectares. It is presented in terms of kg/ha (or)qtl/ha.

$$\text{Yield per hectare} = \frac{\text{Total production}}{\text{Number of hectares}}$$

b) Production efficiency

The production efficiency with respect to any particular crop enterprise can be expressed in terms of percentage as compared with the average yield of the locality

$$\text{Production efficiency of a crop in a farm} = \frac{\text{Particular crop yield per ha in a farm}}{\text{---}} \times 100$$

$$\text{Production efficiency of farm (A)} = \frac{\text{Average yield of the locality}}{\text{Average yield of the locality}} = \frac{80 \text{ quintals}}{60 \text{ quintals}} = \frac{80 \times 100}{60} = 133.33\%$$

Example: Paddy yield per hectare of farm (A) = 80 quintals
Average yield of the locality = 60 quintals

Higher the percentage, the higher the efficiency of that crop production in the farm. If the value is more than 100 it indicates the efficiency of crop production in the farm.

c) Crop yield Index

It is a measure of comparison of the yields of all crops in a farm, with the average yields of those crops in the locality. The relationship is expressed in percentage terms. This is a convenient measure, because it combines all the yields into a single figure. If the crop yield index is more than 100, one could include that efficiency is more.

Example

Crop (1)	Yield in the Locality (2)	Yield in the Farm (3)	Hectares of crop on farm (4)	Production efficiency Crop yield of farm (A) as a % of (5)=3/2	% multiplied by hectares (6)=(5x4)
Cotton	24.70	37.05	2	150	300
Paddy	37.05	49.40	8	133	1064
Maize	49.40	24.70	4	50	200
Total			14		1564

$$\text{Crop Yield Index (\%)} = \frac{\text{Total percentage}}{\text{Total area}} = \frac{1564}{14} = 111.71$$

d) Cropping intensity

It measures the extent of the use of land for cropping purposes during a given year. It is expressed as percentage.

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net cropped area}} \times 100$$

Where, Net cropped area = Total cultivated area:
Gross cropped area = Net cropped area + area sown more than once.

Example: $\frac{\text{Gross cropped area}}{\text{Net cropped area}} \equiv \frac{8 \text{ ha}}{4 \text{ ha}}$

Cropping intensity = 8/4 x100 =200%

- If only one crop is raised in a year, cropping intensity will be 100%.
- If the land area is not cultivated fully, cropping intensity will be less than 100%
- By introducing new technologies (Short duration varieties), we trying to improve cropping intensity.

The cropping intensity is 200 per cent which indicates the better utilization of land. It depends on the water available for cultivation purpose. In dry lands it is only 100 %.

Labour Management

Labour

Any work whether manual or mental which is undertaken for a monetary consideration is called labour.

Classification of farm labour

Farm labour is classified into: 1) Unpaid labour; (2) Paid labour (hired). Unpaid labour is further classified into a) Farmer's own labour, (b) Family labour. Paid labour is further classified into:

1. Permanent or attached labour
2. Casual – hired labour or seasonal labour.

Farm Manager's labour, farm family's labour and permanent hired labour are fixed resources due to general lack of mobility.

Farm Manager's labour

Indian farmer is a manager. Manager's labour is of course the best type of available labour due to his personal interest. Family labour is the main source of labour on Indian farms.

Permanent hired labour

It is hired on cash, kind or crop share basis for a fixed period i.e. six months or one year.

Casual labour

It is hired from time to time and according to the demand for agricultural operations. The wages are paid on daily basis or on the basis of work done.

Skilled labour

Specilalised labour and trained labours for specific jobs is known as skilled labour eg. tractor driver.

Unskilled labour

It is ordinary labour employed for manual work, which does not need any training of specialized nature.

Labour efficiency

Labour efficiency in agriculture refers to the amount of productive work accomplished per man on the farm per unit of time.

Labour efficiency measures

1) Marginal analysis in a specific situation, 2) Conventional measures and (3) labour efficiency index.

1. Marginal productivity analysis

Marginal productivity is the output produced by an additional unit of labour input. Average productivity of labour is the output per unit of labour.

2. Conventional measures

A) Hectares of crops per man

It indicates the number of days of productive work done by a worker on the farm in crop production. Man equivalent is defined by converting woman labour day and child labour day into men labour day. (i. e) 2 men labour days = 3 women labour days and 1 man labour day or manday = 2 children labour days.

$$\text{a. Hectares of crops per man} = \frac{\text{Total area in hectares}}{\text{Man equivalents}}$$

$$\text{b. Out – turn per worker} = \frac{\text{Output}}{\text{Number of earners/workers}}$$

$$\text{c. Return per worker} = \frac{\text{Value of output minus cost of input factors excluding human labour}}{\text{Total number of workers}}$$

3. Labour efficiency index

In areas where labour efficiency standards have been set on the basis of the amount of labour to be performed on crops and livestock, the labour efficiency can be worked out. Suppose the labour required for a given farm is calculated at 500 days of work on crops and 250 days on livestock. The normal labour cost for such a combination is Rs.25,000 but the actual labour cost is Rs.30,000.

The efficiency index is calculated as

$$= \frac{25000}{30{,}000} \times 100 = 83.33$$

(ie) the efficiency is below normal (100)

Expressed as percentage of normal cost

$$= \frac{30000}{25000} \times 100 = 120$$

(ie) the cost is above normal (100) and hence the efficiency is less

Water Management

Available water has to be utilized in an efficient manner. Crops have to be chosen based on water availability. Method of irrigation and types of channels used for irrigation would also influence the water use efficiency.

Measures of water use efficiency

There are two types of measures viz., **1. Physical and 2) Monetary**

i. **Physical measures**: It is the rate of yield to water use a) Quantity of output/ha.cm of water used b) Quantity of output/irrigation

ii. **Monetary measures** : It is the ratio of gross return / profit to water used. Following are the measures. a) Gross return/ ha cm. b). Profit / ha. cm c) Gross return / irrigation d) Profit per irrigation.

$$\text{Water use efficiency} = \frac{\text{Output}}{\text{Quantity of water used}}$$

Example

In 'Farm A' paddy yield per ha was 6000 kgs and the water used was 150 ha cm. Water use efficiency = 6000/150 = 40 kgs / ha cm. In 'Farm B' paddy yield per ha was 5000 kgs and the water used was 100 ha cm.

Water use efficiency = 5000/100 = 50 kgs/ha cm. It indicates that in farm B water use efficiency is more than in farm A.

Chapter - VII Time Comparison Principle

Farm management is a dynamic one and a farmer often has to take decisions over varying horizons of time. The two aspects of such decision where time plays a major role in decision making are

i. Differences in costs and returns due to time and

ii. Risk and uncertainty.

First we consider the difference in cost and returns, a farmer is faced with several decision over time. For example he has to decide.

i. Whether to invest in annual crops or perennial crops.

ii. Whether to invest surplus funds in a bank or machines.

iii. Whether to buy a new machine or second hand machine.

The above questions can be answered if we know the amount available with the farmer and the future. An amount available after one year is not equal to the same amount today ie. Rs.100 received after 1 year is not equal to 100 rupees received today. Hence when costs and returns are distributed over to different periods, they should be reduced to present values for meaningful comparison. The process of finding the present value of future sum is known as discounting.

$$Po = \frac{Pt}{(1+r)^1}$$

Po = present value, Pt – Future sum at time t
r = rate of interest
t= time period

Comparison of Two costs over time

Like returns, two or more costs can also be compared over time by discounting them to their present value:

The objective of farm-firm is to maximize profit continuously over a planning horizon. Major investment decisions are complicated by time element. Planning horizon varies with individual farmers.

For the entire planning horizon three basic variations can be introduced

1. Varying the amount of one input and output simultaneously
2. substituting one input for another, and
3. substituting one output for another

Under the above variations, the following are the conditions for profit maximization.
In addition to the set of conditions given in the table the present value of the stream of profits over the planning horizon must be positive. It may be noted that all the conditions of profit maximization of the static case hold here.

	Necessary condition	Sufficient conditions
1	MP of any factor with respect to every product must be equal to the ratio of their unit discounted prices $= \frac{\Delta y}{\Delta x} = \frac{Px}{Py}$	There must be a diminishing marginal product of a factor with respect to a product. (MPP – diminishing)
2	The rate of technical substitution between any two inputs must be equal to the ratio of their per unit discounted prices $= \frac{\Delta X_1}{\Delta X_2} = \frac{Px_2}{Px_1}$	The rate of technical substitution between inputs must be diminishing (MRTS – diminishing)
3	The rate of product transformation (RPT) for every pair of products must be equal to the ratio of their per unit discounted prices $= \frac{\Delta Y_1}{\Delta Y_2} = \frac{Py_2}{Py_1}$	The rate of product transformation (RPT) between two products must be increasing.

Absolute advantage

It exists if one area /region produce a commodity at a lesser cost than another because of differences in natural, human and economic factors. The following table shows the per ha yield of rice and wheat in two regions. If both the regions produce both the crops, the total production would be 22 tonnes.

	Region I	Region II	Total
Rice / ha in tonnes	6	4	10
Wheat / ha in tonnes	5	7	12
Total	11	11	22

If region I specializes in rice and region II in wheat then, the total production would be 26 tonnes (12 tonnes of rice in region I and 14 tonnes of wheat in region II) as compared to 22 tonnes produced when there was no specilalisation. Region I is more efficient in using land in producing rice and has an absolute advantage in rice production, while region II has an absolute advantage in producing wheat.

Principle of comparative advantage

Different areas will tend to produce those products for which they have the greater comparative advantage, and not just absolute advantage. This leads to the different system of farming existing in a particular area.

The principle of comparative advantage explains the relative advantage of producing different commodities in different regions because of differences in opportunity cost even if one region has absolute advantage in producing all commodities.

	Region I	Region II	Total
Rice / ha in tones	6**(1.33)**	4(1.75)	10
Wheat / ha in tones	8 (0.75)	7 **(0.57)**	15
Total	14	11	25

(figures within brackets indicate the opportunity cost of one crop in terms of other).

Region I is more efficient in the production of rice and wheat. But the opportunity cost of growing rice is ie., units of wheat that has to be sacrificed for producing one unit of rice is lowest is Region I (8/6 = 1.33) as compared to 1.75 (7/4 = 1.75) in Region II. Similarly the opportunity cost of growing wheat in terms of rice is lower (0.57) in region II. Hence, rice should be produced in Region I and Wheat in Region II. The basis for international trade is the comparative advantage enjoyed by different countries for different commodities.

Example :2

Land availability is 2 ha in Region I & II

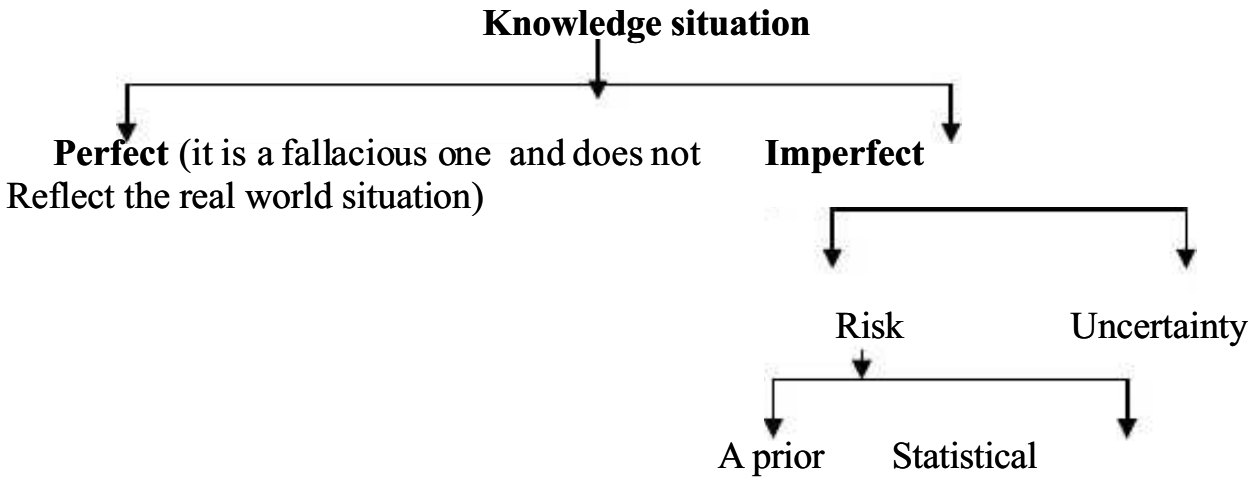
	Region I	Region II	
Rice	12	--	
	■	14	
	12	14	=26

The total production will be 26 tonnes. This is the maximum production level. If we allocate the land in other ways, the output will be lesser.

Chapter - VIII Risk and Uncertainty

Agriculture depends on climatic factors like rainfall, sunlight, humidity, etc., and always not easy to predict. Knowledge on various aspects that affects the crop and how to overcome these situations would enable the decision maker to manage the farm in an efficient manner.

Frank knight classified the knowledge situation as follows



A situation is said to be risky, if the occurrence of future events can be predicted by the specified level of probability. Risk represents less imperfection in knowledge that does uncertainty. A priori risk means based on advance information about the occurrence of an event can be predicted.

A priori – risk prevails when sufficient information is available about the occurrence of an event. Eg. tossing a coin. Contrary to this, a statistical risk can only be predicted on the basis of occurrence of several observations in the past. Mortality tables of insurance companies provide good examples of statistical risk. Because of the quantification of imperfect knowledge under a risk situation, the event can be insured.

Uncertainty

It is a situation in which the occurrence of future event can not be predicted with certain probability level.

Decision. If the future is so uncertain, farmers will not commit any of his resources to a production plan such a decision itself is a farmer's reaction to the imperfect knowledge situation.

It is very difficult to (classify) or differentiate above two situation – risk and uncertain – hence in most of the literatures it is used interchangeably.

Types of risk & uncertainties: It can be classified into the following five categories.

1. Economic uncertainties:

In general, farmers face fluctuations in prices of input & output. These type of uncertainties are reduced markedly in many countries by announcing the price prior to the

sowing season. Mostly these uncertainties are due to changes in demand and supply and national and international policies which are beyond the approach of an individual farmer.

2. Physical and Biological uncertainties:

Flood or drought, hailstorms, frost, pests and diseases may affect the yields – quantity and quality of output.

3. Technological uncertainties:

Technological progress may make the existing technologies obsolete and inefficient. For example availability of new efficient machineries may result in the reduction of the value of existing machines and non availability of spare parts. Introduction of new varieties may create market problems.

4. Institutional uncertainties

Institutions like government, bank etc. may also cause uncertainties for an individual farmer. Change in institutional policies on prices, import and export, input supply, marketing, credit and subsidy may have an impact on cost and returns.

5. Personal uncertainties

Unexpected events in the family such as death, major illness may affect the execution of the farm plans.

Safeguards against risk & uncertainty

Farmers adopt various measures to manage risk and uncertainty in farming.

1. Selection of Enterprises with low variability.

In practice, data on yield and price of various enterprises over a period of time may be used to find the range, variability and coefficient of variation. Based on this choose the enterprises with low variability. Eg. Rice under irrigated conditions compared to vegetables.

2. Discounting Returns

Planning based on single value expectation of yield, income or prices may be misleading. Hence we have to deduct a safety margin from the expected prices, yields or income to incorporate risk.

In terms of profit maximization

$$MPP = \frac{Px}{Py}$$

Discounting means that Py is decreased by some proportion, Px is increased and MPP would assume higher value ie. Lower production. Thus the profit maximizing level X is lower now.

3. Insurance

It is a well accepted method to safeguard against risk and uncertainty. So far, crop and livestock insurance cover is given to the farmers who availed crop loans. At present Government is seriously thinking of extending this cover to all the farmers. And also, in our

country insurance cover is not given for dry land crops. Hence, it has only a very limited role in environment around the farmers.
Advantages of insurance. 1) stabilize farm income 2) improve credit worthiness 3) incentive to adopt new technology and 4) reduce government obligation to provide relief.

4. Forward contracts

Forward contracts are made to reduce the uncertainty in input supply, price fluctuations etc. forward contact may either be in money or kind (eg) employment of permanent labour on the farm for a period of one or two years based on some agreement. Fixed rent in kind or cash is a good example of forward contract. Contracts in kind reduce income variability where contracts in money do exactly the opposite. Sale of crops such as banana and mango to pre harvest contractors, tie up arrangement with sugar mills to sell sugarcane are few examples of contract sales to safe guard against price risk.

5. Flexibility

This refers to the convenience with which the organization of production on a farm can be changed. It helps in obtaining advantages of economic & technological changes. There are three types.

a. **Time flexibility:** Time flexibility may be introduced by proper selection of products. Eg. Short lived structure is more flexible. Annual / seasonal crop is more flexible than perennial corps.
b. **Cost flexibility:** When time flexibility is of limited use, cost flexibility becomes important. Though hiring a machine is costly than owning. The farmer may hire it in order to have cost flexibility Eg. Hiring a tractor / sprayer / polisher.
c. **Product flexibility**: It refers to the ease with which a farmer divert farm resources from enterprise to other. Changing the enterprises in response to price signals. Eg. rice to sugarcane. Resources may be diverted to the most profitable enterprise. Eg. machines, farm structures etc. which can be switched readily from one product to another.

6. Liquidity and Asset Management

More liquid assets are cash on hand and deposits in the bank. Slightly less liquid assets are seeds, fertilizers. Least liquid assets are land and machineries. Here the motive is transactional not speculative. Cash can be converted to any form within short period. Hence one has to keep some amount to meet contingencies in farming. In general farmers have cash for cultivation purposes.

7. Diversification

It is meant for stabilization of farm income. Though specialization has certain advantages it may lead to income fluctuations due to variation in yield and prices. Diversification is one of the methods of safeguarding against income variability by having few or more enterprises. Example – growing different crops, crop and livestock enterprises etc. it is useful and popular method to safeguard against risk & uncertainty. This is useful if there is variation in yields of commodities.

8. Maintaining resources in reserve

If a resource will not be available at the right time, then one can stock the resource. It depends on the fund available with the farmers and the cost of stocking.

9. Adjustment to uncertain availability of Inputs

If the best input is not available i) use the second best and (ii) use of less quantity. If the required quantity is not available, use the level of input at which the marginal return is equal for all crops. This is always less than the profit maximizing level.

Risk & uncertainty in Farming

Farmers normally face the following three types of uncertainties.

1. product – price uncertainty 2) yield variability and 3) uncertain availability of inputs.

1. Product – Price Uncertainty

Since the production depends on price of a commodity uncertainty in price will have impact on returns from an enterprise. It has to be accounted in deciding the level and combination of enterprises. Normally farmers face the following four situations.

1. High return enterprise with low price variability
2. Low return enterprise with high price variability
3. Low return enterprise with low price variability
4. Low return enterprise with high price variability.

If we consider (1) and (4), we select (1). If the situation is (2) and (3), then the farmer has to make a rational decision by following the rule.

Value of taking risk (P) = Cost of risk (R)

$$= \frac{\Delta P}{\Delta R} = \frac{Pr}{Pp}$$

P- return / profit

R – Risk

Pp is the weight attached to a unit of return

Pr is the cost involved per unit of risk

Farmers take risk based on their mental attitude and also they assign weights for risk accordingly.

In general, as return increases the risk also increases. This can be represented by graph.

2. Yield uncertainty

It is due to changes in technologies. When a farmer is using old technology which is inefficient compared to new technology, then he has to face variability.

There are four enterprise alternatives are available to the farmers.

1. Low yield variability and high risk enterprise
2. Low yield variability and Low risk enterprise
3. High yield variability and High risk enterprise
4. High yield variability and Low risk enterprise

Of (1) and (4) obviously (4) will be chosen. For (2) and (3), rational decision have to be made following the rule.

$\Delta Y.Py > \Delta V.Pv$

ΔY – change in yield, Py – Price of output, Pv - cost the farmer put on the yield variability, ΔV – change in yield variability, $\Delta V.Pv$ – cost of taking risk in yield, $\Delta Y.Py$- return from taking risk.

3. Uncertain availability of inputs

Some inputs availability may be uncertain for some farmers. Eg Fertilizer, Hybrid seed. This can be tackled by

1. Adjustments in changing the level of enterprises.
2. Adjustment in the planting dates
3. Adjustment in application rates of inputs, especially on the growing crops.

CHAPTER IX Farm Planning and Budgeting

Economic planning involves allocation of limited resources among alternative opportunities in order to satisfy the objectives. Any planning process contain three essential components.

1. An objective

Production economics assumes maximization of profit as the goal. Farmers may have other goals also. These goals are achieved not by abandoning the profit maximizing principle, but by including personal or managerial constraints.

2. Resources and constraints

The resource available to the farmer act as a frame work with in which he must plan his system of farming. The resources available to the farmer distinguish the feasible from the infeasible enterprises. The fixed resources place a limit on the maximum level of production from individual enterprises. The quantity and quality of fixed resources also influence the level of variable resources used. Resource constraints can be divided in to major categories such as land, labour, capital, personal, institutional and husbandry constraints. The first three represents material resources and the last three represents non material resources.

a) Land

It is a complex resource influencing farming through its location, through natural factors associated with it such as soil type, fertility, topography, drainage, water etc. It is common to find more than one category of land at the same farm. The land can be divided into homogenous plots considering the soil characteristics.

b) Labour

In the case of crop production labour constraints operate through peak periods.

c) Capital

Both fixed and working capital may act as constraints. Buildings, machineries are fixed capital. Liquid capital is required to pay for variable inputs, to service the fixed capital, paying taxes, insurance premium and for family expenses.

d) Personal and family constraints

Constraints such as attitude towards risk, (willingness to accept risk), requirements of the family such as grains, fruits, vegetables, milk etc., farmers subjective preference for an enterprise, act as constraints in achieving the goals.

e) Institutional constraints

These arise from factors operating outside the farm and are concerned with the policies of the Government, marketing and credit institutions.

(i.e)Govt: the procurement of food grains by govt.,the price is higher.
Marketing: Commission charges, late payment, product market availability
Credit: Loan amount, interest rate, procedures

f) Husbandry constraints

These are concerned with preserving the long term fertility and condition of soil, controlling the diseases so that sustainability can be maintained. For example, allocating some area for green manure / legumes, keeping land fallow.

3. Enterprises

This represents alternative ways of using the resources to attain the objectives. The following information about the enterprises are necessary for planning.

1. Requirements of fixed inputs – land, buildings, machine
2. Requirements of variable inputs
3. Financial returns.

The maximum size of an enterprise depends on the amount of fixed resource required / unit of the enterprise and the total amount of the fixed resource available.

$$\text{Max. size of enterprise} = \frac{\text{Total fixed resource}}{\text{Fixed resource per unit of enterprise}}$$

Farm Plan

A farm plan is a programme for the organization and operation of a farm. It is a blue print of a set of proposed actions to be taken for a given period to achieve a specified goal(s). Farm planning and budgeting are the physical and financial components of farm decisions. Planning is the process of preparing plans ie, it is the process of allocating scarce resources among competing alternatives to achieve a goal (s). Farm planning is a continuous process since farmers operate the business in a dynamic environment. In response to changes in resource availability, technologies, input and output prices, Government policies and institutions farmers have to alter existing plans or prepare new plans.

Budgeting

Budgeting is a method used to analyse the probable effect of the farm plan on costs and returns of the farm business. When coupled with cash flow analysis, budgeting gives a good indication of profitability and cash flow feasibility. It is better described as an aid to rather than a method of farm planning. Planning without estimating expenditure and income is not of much use. So farm planning and budgeting go side by side.

In the short run, farm plans do not alter farm structure and used to optimize the resource use with given resources and environment. In the long run farm plans alter the farm structure such that the constraints are relaxed or removed and farm growth is generated.

The primary purpose of farm planning and budgeting is to improve the organization and operation of the farm. It is useful in (1) Diagnosing farm business problems (ii) improving the economic efficiency of farm business (iii) planning for the resource requirements.

Today, farmers live in a dynamic world. Technological, economic and institutional changes made farming system in many regions of the world obsolete and there are maladjustments in the organization and operation of farms. To determine the changes or adjustments which are needed, farm management research workers rely on the technique of

farm planning and budgeting. There are three types of farm budgeting viz., (i) partial budgeting (ii) enterprise budgeting and (iii)complete budgeting.

(I) Partial budgeting

It is commonly used to estimate the costs and returns of making relatively small changes in the existing farm organization. It does not consider the farm as a whole and estimates the cost and returns for a part of the farm business. There are three main types of change.

1. Factor substitution

Here the term factor is used in the widest sense. Often a change in production techniques is involved i.e., substitution between inputs. Examples are using power sprayer instead of hand sprayer, using tractor instead of bullocks for ploughing, foliar application of nitrogen instead of soil application, using complex fertilizer instead of straight fertilizers, chemical weeding instead of hand weeding, combine harvester instead of human labour.

2. Product substitution

Here one enterprise is substituted for other. Examples are replacing local variety of a crop with High Yielding varieties. Replacing a crop with another crop.

(i.e) Cholam Vs Maize

3. Adding a new enterprise without substitution

A new enterprise is added without replacing the existing enterprises. Examples are: adding a few milch animal or birds, a green manure crop in fallow lands.

Four questions are considered in partial budgeting, two of which relate to financial losses from the contemplated changes (debit) and other two relate to the consequential financial gain (credit). Only those changes in costs and returns as a result of contemplated change are considered. Both fixed and variable costs relate to the change have to be considered. Using these values partial budget has to be prepared and the format given

Partial Budget Format

Debit	**Amount**	**Credit**	**Amount**
1) Increased (added) cost		1. Increased (added) return	
2) Reduced revenue		2. Reduced cost	
----------		----------	
Total			
----------		----------	

If the credit is greater than debit the proposed change can be effected.

(II) Enterprise Budget

Enterprise budget is a convenient means of summarizing enterprise cost and return projections for use in many management decisions such as selecting a process to produce a crop / livestock, developing leasing arrangements / choosing appropriate investment / preparing whole farm plan. Hence it is necessary for farmers to frequently estimate costs and returns for future periods of time. **A projection of average cost and return for an**

enterprise is commonly referred to as enterprise budget or a gross margin calculation. An enterprise account is a summary of costs and returns for some historic period such as the past year or an average of several years. It is obtained from the records of the business. An enterprise budget is a projection of costs and returns for some future period, such as the coming year. While enterprise accounts may be useful in preparing enterprise budget, they seldom provide all of the data needed. Even the operator who expects to produce the same enterprise using the identical system of production may expect different input prices, product prices, and for production levels in the future than prevailed in the past. The change in prices may suggest a different combination of variable inputs and timing of production to improve profitability.

(III) WHOLE FARM PLANNING AND BUDGETING

Complete budgeting relates to the entire farm business and all costs and receipts have to be estimated.

Steps in whole farm planning and budgeting

1. Setting of goals

The identification of family and business goals is very important. Family goals are influenced by family values (religious belief, social value system etc) and family circumstances (age, health, skill, education level etc.) Business goals are influenced by business values (high profitability, growth, liquidity etc) and business circumstances (existing social, economical, technological and institutional conditions).

The family goals that coincide or do not conflict with business goals are the relevant family business goals which can be used in planning.

2. Inventory of Resource availability

Inventory of resources such a land, labour, capital (building, machinery, liquid capital etc) will help to assess the resource limitation and production capabilities of the farm. The possibilities of renting, hiring and borrowing of resources may also be considered.

3. Identification and selection of alternatives to be analysed

In forward planning, analysing alternatives is of great importance. Lack of information and knowledge limit the alternatives one might consider.It is based on land, soil and water.

4. Selection of input information to be used in the analysis process

Once the alternatives have been selected the next step is to specify the input – output relationships. It is concerned with the quantity, the quality of inputs needed to achieve a certain level of output. It is important to consider the fundamental economic concepts in deciding the input and output levels.

5. Selection of prices to be used in the analysis process

Once the input relationships have been established, price must be considered to evaluate the economic consequences of the proposed alternative or adjustment. Product prices may be some what more difficult to estimate that input prices because of wide fluctuations.

6. Analysis of various alternatives

In this final step of forward planning each of the alternatives under consideration is analyzed. Analysis involves selecting the appropriate analysis technique and evaluating the positive and negative aspects of each alternative. Partial and whole farm budgeting can be used to analyze the alternatives.

7. Comparing the alternative plans

The alternative plans are compared and the best one is chosen considering sustainable and long development of the farm.

Important reasons for making farm plans

1. It enables the farmer to achieve his objectives in relation to his farm and family in a more organized manner. The process of farm planning may also encourage him to develop and gather new ideas about farm practices with a view to achieve the stated objectives.
2. Farm planning enables a careful examination of the existing resources and their best allocation for achieving higher resource use efficiency, farm income and farm family welfare. Thus it helps maximizing efficiency and family satisfaction and minimizing the wastes.
3. A good farm plan serves as a basis for a judicious combining of the existing and new alternative enterprises. It is a continuous process wherein relatively more profitable new enterprises keep on replacing the old and less profitable ones over time.
4. Supply needs of input can be identified reasonably ahead of time and adequate arrangements made for their procurement.
5. The expected incomes can be estimated well ahead of time. It helps the farmers to initiative steps for procuring the required credit. Also, investment opportunities can be planned depending upon the surplus of expected incomes at some future point of time.
6. A good farm plan helps to prevent many of the stresses and strains in the business of farming through orderly planning.
7. A properly thought of farm plan may provide cash incomes at points of time when they may be most needed at the farm.
8. Above, all, a farm plan acts as useful money saving device. It is always cheaper to commit mistakes on a paper than in the business.

Characteristics of a good farm plan

1. The most important characteristic of good plan is that it should be written. All the minor details about the organisation and operation of farm business should be clearly outlined.
2. It should be forward looking. An element of flexibility in a farm plan proves useful in introducing suitable changes in response to variations in the environment around the farm, farmer and farm family from time to time. Rigidity is contrary to the very concept of planning.
3. A farm plan should be such that it ensures maximum resource use efficiency at the farm. It is particularly important in view of the scarcity of resources and the possibilities of their alternative uses.

4. It should provide for the attainment of both business and farming goals. Such a combination in turn ensures.
    i. Production of food, cash and fodder crops consistent with the objectives of the farmer.
    ii. Prevention of unnecessary stresses and strains in the use of farm resources like land, labour, power and machinery throughout the year.
    iii. Proper crop rotations so as to maintain and improve soil fertility.
    iv. A more or less regular flow of income over time rather than only at one or two points of time in a year.
    v. Stabilization of the farm incomes over time; and
    vi. Taking care of the likes and dislikes of the farmer, e.g. it may be essential to include / exclude certain enterprises which may be relatively more / less profitable.
    vii. Conservation of vital resources such as soil and water to make farming sustainable in the long run.
5. Risk and uncertainties can be accounted for in good farm plan. Thus it should help the farmer to avoid the chances of large losses due to risk and uncertainties or complete ruin during bad times through wise planning.
6. A good farm plan is one which optimizes the use of the existing body of knowledge, training and experience with the farmer. It ensures minimization of under utilization of the personal resources and ability of the farmer.
7. It should provide periodical details about the inflow and outflow of funds. Thus it helps in timely procurement and repayment of farm credit.
8. An ideal farm plan also gives due consideration to the marketing arrangements for farm inputs and farm products.

CHAPTER - X Farm Financial Management

Financial management is needed for all farms, irrespective of their scale and nature of crops and enterprises. In fact, the success towards attaining farm's goals heavily depends upon how good is financial plan.

Financial management is concerned with the efficient use of an important economic resources, namely capital funds.

Financial management is concerned with

- Estimation of financial need.
- Acquisition of funds from appropriate sources.
- Allocation of funds among short term and long term assets and
- Ensuring their efficient use.

Goals of financial management

- ✓ To maintain liquidity to meet current activities.
- ✓ To maximize profit
- ✓ To maximize wealth
- ✓ To maximize earning per unit of capital invested/used
- ✓ To achieve social responsibility and
- ✓ To achieve efficiency.

Financial management includes

(a) Working capital management (b) capital budgeting.

Working capital management It refers the efficient use of funds available for day to day operations of an enterprise. It also represents the excess of current assets over current liabilities including short term loans.

Capital budgeting refers to the long term planning involving proposed capital outlays and planning.

Tools of Financial Management

- Cost of capital
- Financial leverage (Trading on equity)
- Capital budgeting
- Ratio analysis
- Funds flow analysis

Financial Statements : There are three important financial statements. They are

i) Balance sheet ii) Income statement iii)Cash flow statement or Fund flow statement.

Balance sheet

It shows the financial status of a business at a given point of time. It provides a snapshot and may be regarded as a static picture. It is a systematic listing of all assets and liabilities of the business. Its purpose is to reveal liquidity, solvency and wealth of the business of that particular movement.

Balance sheet of a farmer as on 31st March 2004

Sl. No.	Assets	Value in Rs.	S. No.	Liabilities	Value in Rs.
I	**Current assets**		**I**	**Current liabilities**	
1.	Paddy grains	25000	1.	Wages for Farm labour to be paid	500
2.	Seeds and fertilizers	1500	2.	Interest to be paid	500
3.	Cash on hand	500	3.	Tax payable	1000
4.	Savings in the bank	1000	4.	Crop loan	1000
5.	Poultry birds	2500	5.	Instalment for term loans	
6.	Farm yard manure	800		**Sub Total**	4000
	Sub Total	**31300**			**7000**
II	**Intermediate assets**		**II**	**Intermediate liabilities**	
1.	Milch animal	4200	1.	Loan for animal (medium term loan outstanding)	5000
2.	Share in co-operative bank	2000			
3.	Farm implements	800			
	Sub Total	**7000**		**Sub Total**	**5000**
III	**Long term assets**		**III**	**Long term liabilities**	
1.	Land	150000	1.	Long term loan	137000
2.	Building	25000			
3.	Tractor	125000			
	Sub Total	**300000**		**Sub Total**	**137000**
	Total	***338300***		**Total**	***149000***
				Net worth	***189300***

Income Statement

It is also called profit and loss account. It is the accounting report which summaries the revenues, expenses and difference between them (or net income) for an accounting period. Technically, the income statement is an adjunct to the balance sheet because it provides details relating to the net income, which represents the change in owners' equity between two successive balance sheets plus dividends. Yet in practice it is often considered to be more important than the balance sheet itself, because the details of revenues and expenses provided in the income statement shed considerable light on the performance of the business.

Income statement of a farm for the year 2003-2004

Sl. No.	Source of income	Amount in Rs.	Sl. No.	Expenses	Amount in Rs.
I	**Cash farm Income**		**I**	**Variable Cash Expenses**	
	By sale of				
1.	Paddy	8000	1.	Cost of feed	1500
2.	Banana	5000	2.	Cost of seed	2000
3.	Tomato	3000	3.	Cost of diesel	500
4.	Milk	5000	4.	Cost of labour	2000
5.	Poultry bird	500	5.	Cost of fertilizers	1000
	Sub total	***21500***		***Sub total***	***7000***
II	**Net capital gain income**	1000	**II**	**Fixed cost**	300
III	**Total farm income**	22500	**III**	**Repayment of Loan**	2000
IV	**Off farm income**	1000	**IV**	**Total cash expenses**	9300
V	**Non farm income**	2500	**V**	**Non cash adjustment**	600
	Total income	***26000***	**VI**	***Total farm expenses***	***9900***
			VII	**Capital investment**	
			1.	Implement	300
			VIII	**Family expenditure**	**7000**
			IX	**Total expenses**	**17200**

Fund Flow Statement

It shows the sources of funds and allocation of funds during the period. It is also referred as the statement of changes in financial position or statement of sources and uses of funds, it draws on the information contained in the basic financial statements. Fund flow analysis provides an insight into the movement of funds and helps in understanding the changes in the structure of assets, liabilities, and owners' equity.

Financial Ratio Analysis

A ratio is defined as an arithmetic relationship between two figures. The study of relationship between various items or groups of items in the financial statements is known as financial ratio analysis.

Financial ratios have been classified into

a)Liquidity ratios b) Solvency ratios c)Efficiency or Turn over ratios and d) Profitability ratios

Liquidity Ratios

i) Liquidity refers to the ability of the firm to meet its obligations in the short run, usually period of one year. Liquidity ratios are generally based on the relationship between current assets (the sources for meeting short term obligations) and current liabilities. The important liquidity ratios are i)Current ratio ii)Acid test ratio and iii)The bank finance to working capital gap ratio

Cash Flow Statement of a Farm for the year 2003-2004 **(in Rs.)**

Sl. No.	Particulars	July-September	October-December	January-March	April – June
I	**Beginning cash balance**	1000	2500	8000	8000
II	**Cash in flow**				
1.	Sale of crop products	-	5000	-	3000
2.	Sale of milk	3000	3000	3000	3000
3.	Sale of poultry	-	-	500	-
4.	Loan received	3000	-	-	-
	Sub total	***6000***	***8000***	***3500***	***6000***
III	**Cash outflow**				
1.	Cultivation expenses	1500	1000	2000	500
2.	Maintenance of livestock	1500	1500	1500	1500
3.	Insurance	--	--	--	200
4.	Tax	--	--	--	300
5.	Repayment of loan	--	--	--	2000
6.	Purchase of calf	1000	--	--	--
7.	Purchase of implement	500	--	--	--
	Sub total	***4500***	***2500***	***3500***	***4500***
IV	**Ending Cash Balance**	2500	8000	8000	9500

Current Ratio

Current ratio is a very popular financial ratio, measures the ability of the firm to meet its current liabilities. Current assets get converted into cash in the operational cycle of the firm and provide the funds needed to pay current liabilities. Normally higher the current ratio, the greater the short term solvency. A firm with a high proportion of current assets in the form of cash and accounts receivable is more liquid than one with a high proportion of current assets in the form of inventories, even though both have the same current ratio.

Current ratio = Current assets / current liabilities

Acid Test Ratio

Acid test ratio is called quick ratio, is a fairly stringent measure of liquidity. It is based on those current assets which are highly liquid. Inventories are excluded from the numerator of this ratio because they are deemed to be least liquid component of the current assets. Quick assets are defined as current assets excluding inventories.

Acid Test Ratio = Quick assets / current liabilities.

Solvency

It is defined as what the owner would have left after all assets were converted to cash and debts are cleared. It is a measure of financial security and firm's ability to meet long run claims of the firm/corporation. The important ratios are leverage ratios and net capital ratio.

Leverage Ratio

Leverage ratios measure the use of debt finance, which represents borrowed funds. Leverage ratios help in assessing the risk arising from the use of debt capital. Common leverage ratios are: 1) Debt – equity ratio, 2) Debt-assets ratio 3) Interest coverage ratio and 4) Cash flow coverage ratio.

1) Debt-Equity Ratio = Debt / Equity

Where

Debt = all liabilities (short term as well as long term)

Equity = net worth plus preferred capital

In general, the lower the debt-equity ratio, the higher of protection enjoyed by the creditors.

2) Debt-Assets Ratio = Debt / Assets

Where,

Debt = All liabilities (short term as well as long term)

Assets = Total of assets in the balance sheet.

Lower the ratio higher the leverage

3) Interest Coverage Ratio

It gives the idea about the ability of a firm to pay interest. A high interest coverage ratio means that the firm can easily meet its interest burden even if earning before interest and taxes suffer a considerable decline.

Interest coverage ratio = Earnings before interest and taxes / Debt interest

4) Cash Flow Coverage Ratio

This ratio measures debt servicing ability adequately because it considers both the interest and the principal repayment obligation.

Cash flow coverage ratio = Earnings before interest and taxes + Depreciation / Debt interest + Repayment of loan / 1- Tax rate

Net Capital Ratio (NCR) = Total assets / Total liabilities

Higher the ratio, the firm or corporation is having sufficient assets to pay all liabilities.

Turnover Ratios

It is also called activity ratios or asset management ratios, measure how efficiently the assets are employed by the firm. The significance of turn over ratios are given in the Table. 4

Table 4: Turnover Ratios/ Efficiency ratios

Sl. No.	Ratio	Formula	Inference
1	Inventory Turnover Ratio	Net Sales / Inventory	It measures the efficiency of inventory management higher the ratio more efficient and vice versa.
2	Average collection period	Receivables / Average sales / day	It shows the efficiency of receivables management normally average collection period should not exceed one and half times credit period.
3	Receivables turnover ratio	Net sales / receivables	Higher the ratio shorter the collection period
4	Fixed asset turnover ratio	Net sales / fixed assets.	Higher the ratio higher the degree of efficiency in the use of fixed assets.
5	Total assets turnover ratio	Net sales / Total assets	This ratio measures the efficiency of assets employed. Higher the ratio higher the degree of efficiency in the use of assets.

Profitability Ratios

Profitability reflects the final result of business operations. The important ratios and their significance are given in the Table 5.

Tables 5. Profitability Ratios

Sl. No.	Ratio	Formula	Inference
1	Gross profit margin ratio	Gross profit / Net sales	This ratio indicates the margin left after meeting manufacturing costs. It measures the efficiency of production as well as pricing.
2	Net profit margin	Net profit / Net sales	This ratio shows the earnings left for stockholders as a percentage of the net sales. It measures the overall efficiency of production, administration, selling, financing, pricing and tax management
3	Net income to total assets ratio	Net income / Total assets	This Measures how efficiently capital is employed
4	Return on investment	Earnings before interest and taxes / total assets	It is a measure of business performance which is not affected by interest charges and tax payments.
5	Return of equity	Equity earnings / Net worth.	It is a measure of the profitability of equity investment which represents the ownership capital

Capital Budgeting

Capital budgeting refers to the long term planning involving the proposed capital outlays and planning.

Capital budgeting is the firm's process of decision making for the acquisition and investment of capital, involving various step like the estimated financial outlay, formal plan for purchase of fixed assets, estimation of expected cash flow etc.

Need for Capital Budgeting

It has long-term consequences. Capital investment decisions have considerable impact on what a firm can do in the future.

It is difficult to reverse capital investment decisions because the market for used capital investments is ill-organized and / or most of the capital equipment bought by a firm is tailored to meet its specific requirements.

Capital investment decision involves substantial outlay.

Capital Budgeting Process

It is a complex process which may be divided into following phases;

ii) Identification of potential investment opportunities
iii) Assembling of proposed investments
iv) Decision making
v) Preparation of capital budget and appropriations
vi) Implementation and
vii) Performance review

Use of Capital Budgeting

1. It determines the capital projects on which work can be started during the budget period, after taking into account their urgency and the expected rate of return on each project.
2. It determines the expenditure that would have to be, incurred on capital projects approved by the management with sources.
3. It restricts the capital expenditure on projects within authorized limits.
4. It enables the investment proposals to be taken up as a single package.

Defining Costs and Benefits

Capital expenditures generally involve current and near future costs which are expected to yield a flow of benefits in the future. In evaluating a capital expenditure proposal two broad phases are involved.

Defining the stream of costs and benefits associated with the investment. Appraising the investment to determine whether it is worthwhile or not.

Important Appraisal Criteria are

i)Payback period
ii)Average rate of return
iii)Net present value
iv) Benefit cost ratio
v)Internal rate of return

Pay Back Period

Pay back period is the length of time required to recover the initial cash outlay on the project. According to payback criterion the shorter the payback period, the more desirable the project.

Example.

Sl. No.	**Investment (Rs.)**	**Benefits (Rs.)**
1	5,00,00.00	1,00,000.00
2	--	1,50,000.00
3	--	2,50,000.00
4	--	50,000.00

In this case payback period is 3 years.

Advantages

1. It is simple, both in concept and application.
2. It is rough and ready method for dealing with risk.
3. Since it emphasis earlier cash inflows, it will be a sensible criterion when the firm pressed with problems of liquidity.

Limitations

1. It fails to consider the time value money.
2. It ignores cash flow beyond the payback period.
3. It is a measure of a project's capital recovery, not its profitability
4. It does not indicate the liquidity position of the firm as a whole which is more important.

Average Rate of Return

It is also called the accounting rate of return. It computes income before taxes and depreciation and after taxes and depreciation.

Average rate of Return = Average earnings / Average investment Higher the average rate of return, the better the project.

Advantages

1. It is simple to calculate.
2. It is based on accounting information which is readily available and familiar to businessmen.
3. It considers benefits over the entire life of the project.

Limitations

1. It does not take into account the time value of money.
2. The average rate of return measure is internally a little inconsistent.

Discounted Techniques

Time value of money is considered in these techniques.

1) Net Present Value

The net present value of a project is equal to the sum of the present value of all net cash flows associated with the project.

$$NPV = \sum_{t=0}^{n} CF_t /(1+k)^t$$

where,

NPV = Net present value. CF_t = Net cash flow occurring at the end of year 't'

(t = o-n). K = Cost of capital used as the discount rate.

Decision Rule

Accept the project if the net present value is positive and reject the project if it is negative.

Merits of NPV

It takes into account the time value of money.
It considers the cash flow stream entirely.
The net present value represents the contribution to the wealth of farm/profit.

2) Benefit Cost Ratio

It relates the present value of benefits to the initial investment.

$$BCR = \frac{\sum_{t=0}^{n} B_t (1+i)^t}{\sum_{t=0}^{n} C_t /(1+i)^t}$$

Where,

B_t = Benefits in the year t. C_t =Costs in the year t.
i = interest rate or discount rate N = number of years or life period of the project.

Selection criteria: BCR> 1, then accept the project.
< 1, then reject the project.

3) Internal Rate of Return (IRR)

It is defined as the rate of discount which makes the present worth of benefits and costs equal or the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal to zero.

It is the maximum return that a project can yield for the resources. It is the measure of earning capacity of the project.

$$IRR = \sum_{t=0}^{n} B_t - C_t /(1+i)^t = 0$$

Where,

B_t = Benefits in the year t. C_t = Costs in the year t.
i = Interest rate. n = Number of years or life period of the project.

Advantages

1. It takes into account the time value of money.
2. It considers the cash flow stream entirely.
3. It makes sense to businessmen.

Table 1. Model Balance Sheet – ABC Agro Firm Ltd., As on 31.12.2001

Sl. No.	Particulars	Rs. in lakhs
	Owners equity & Liability	
1.	Share capital	
i.	Equity	120.00
ii.	Preference	50.00
2	Reserves & surplus	215.00
3	Long term debt	
i.	Debentures	25.00
ii.	Term loan	25.00
4	Current liabilities & provisions	
i.	Loans and advances	131.00
ii.	Creditors	330.00
iii.	Provisions	69.00
	Total	**965.00**

Assets

Sl.No.	Particulars	Rs. In lakhs
1	Fixed assets	229.00
2	Long term investments	35.00
3	Current assets	
i.	Cash & bank	73.00
ii.	Marketable securities	6.00
iii.	Debtors	189.00
iv.	Inventories	355.00
v.	Pre-paid expenses	5.00
vi.	Miscellaneous current assets.	58.00
4	Other assets	15.00
	Total	**965.00**

Table. 3 Fund Flow Statement (cash basis for the year ended December 31, 2001 for ABL Agro Ltd.,

Sl.No.	Particulars	Rs. In lakhs
	Sources of cash	
1	Operations	
i.	Net income	55.00
ii.	Depreciation	25.00
2	Issue of share capital	5.00
3	Long term borrowings	5.00
4	Sale of non – current assets	2.00
5	Increase in current liabilities	
i.	Creditors	11.00
ii.	Provisions	6.00
6	Decrease in current assets, other than costs	
i.	Inventories	17.00
ii.	Miscellaneous current assets	4.00

Total cash generated		**130.00**
	Use of cash	
1	Payment of dividends	17.00
2	Purchase of non-current assets	
i.	Fixed assets	41.00
ii.	Longterm investments	20.00
iii.	Intangible investments	4.00
3	Repayment of longterm liabilities	2.00
4	Decrease in current liabilities	
i.	Loans	12.00
ii.	Advance	2.00
5	Increase in current assets, other than cash	29.00
Total cash need1		**27.00**
	Net change in cash position	

Table 2. Income Statement of ABC Agro Firm Ltd. For the year 2001

Sl.No.	Particulars	Rs. In lakhs
1	Net sales	904.00
2	Cost of goods sold	
i.	Stocks	366.00
ii.	Wages and salaries	188.00
iii.	Other manufacturing expenses	160.00
3	Gross profit	190.00
4	Operating expenses	
i.	Selling, administration & general	71.00
ii.	Depreciation	25.00
5	Operating Profit	94.00
6	Non –operating surplus or deficit	49.00
7	Earnings before payment of interest	143.00
8	Interest	
i.	Bank borrowings	29.00
ii.	Debentures	4.00
9	Profit before tax	110.00
10	Tax	58.00
11	Profit after tax	52.00
12	Dividend	
i.	Equity	14.00
ii.	Preference	3.00
13	Retained earnings	35.00

Farm management is an integral part of agricultural production economics. Farm management is an intra farm science whereas agricultural production economics is an inter farm or inter region science. The distinction sometimes