Course No. – ECON 365

Course title-

Farm Management, Production and Resource Economics

Credit - 2 (1+1)

Name. ....

Registration no. ....

Teaching Schedule

a) Theory

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Lecture no. 1
Farm Management – Meaning – Definitions – Scope – Objectives Relationship with other sciences

FARM MANAGEMENT

Meaning

- Farm Management comprises of two words i.e. Farm and Management.
  Farm means a piece of land where crops and livestock enterprises are taken up under common management and has specific boundaries.
- Farm is a socio economic unit which not only provides income to a farmer but also a source of happiness to him and his family.
- It is also a decision making unit where the farmer has many alternatives for his resources in the production of crops and livestock enterprises and their disposal.
- Hence, the farms are the micro units of vital importance which represents centre of dynamic decision making in regard to guiding the farm resources in the production process.
- The welfare of a nation depends upon happenings in the organisation in each farm unit.
- It is clear that agricultural production of a country is the sum of the contributions of the individual farm units and the development of agriculture means the development of millions of individual farms.
- Management is the art of getting work done out of others working in a group.
- Management is the process of designing and maintaining an environment in which individuals working together in groups accomplish selected aims.
- Management is the key ingredient.
- The manager makes or breaks a business.
- Management takes on a new dimension and importance in agriculture which is mechanised, uses many technological innovations, and operates with large amounts of borrowed capital.
- The prosperity of any country depends upon the prosperity of farmers, which in turn depends upon the rational allocation of resources among various uses and adoption improved technology.
- Human race depends more on farm products for their existence than anything else since food, clothing – the prime necessaries are products of farming industry.
- Even for industrial prosperity, farming industry forms the basic infrastructure.
- Thus the study farm management has got prime importance in any economy particularly on agrarian economy.

DEFINITIONS OF FARM MANAGEMENT

1. The art of managing a Farm successfully, as measured by the test of profitableness is called farm management. (L.C. Gray)
2. Farm management is defined as the science of organisation and management of farm enterprises for the purpose of securing the maximum continuous profits. (G.F. Warren)
3. Farm management may be defined as the science that deals with the organization and operation of the farm in the context of efficiency and continuous profits. (Efferson)
4. Farm management is defined as the study of business phase of farming.

5. Farm management is a branch of agricultural economics which deals with wealth earning and wealth spending activities of a farmer, in relation to the and operation of the individual farm unit for securing the maximum possible net income. (Bradford and Johnson)

OBJECTIVES
- To study the production pattern with the existing resources like land, labour, capital and management on the farm.
- To work out costs and returns on individual enterprise and the farm as a whole.
- To obtain maximum profit and family satisfaction through optimum use of resources and judicious income distribution.
- To perform the strategic task of finding out the deviation of the resources from their optimum utilization.

SCOPE OF FARM MANAGEMENT
- Farm Management is generally considered to be MICROECONOMIC in its scope.
- It deals with the allocation of resources at the level of individual farm.
- The primary concern of the farm management is the farm as a unit.
- Farm Management deals with decisions that affect the profitability of farm business.
- Farm Management seeks to help the farmer in deciding the problems like what to produce, buy or sell, how to produce, buy or sell and how much to produce etc.
- It covers all aspects of farming which have bearing on the economic efficiency of farm.

RELATIONSHIP OF FARM MANAGEMENT WITH OTHER SCIENCES

- The Farm Management integrates and synthesises diverse piece of information from physical and biological sciences of agriculture.
- The physical and biological sciences like Agronomy, animal husbandry, soil science, horticulture, plant breeding, agricultural engineering provide input-output relationships in their respective areas in physical terms i.e. they define production possibilities within which various choices can be made.
- Such information is helpful to the farm management in dealing with the problems of production efficiency.
- Farm Management as a subject matter is the application of business principles an farming from the point view of an individual farmer.
- It is a specialised branch ofwider field of economics.
- The tools and techniques for farm management are supplied by general economic theory.
- The law of variable proportion, principle of factor substitution, principle of product substitution are all instances of tools of economic theory used in farm management analysis.
- Statistics is another science that has been used extensively by the agricultural economist.
- This science is helpful in providing methods and procedures by which data regarding specific farm problems can be collected, analysed and evaluated.
- Psychology provides information of human motivations and attitudes, attitude towards risks depends on the psychological aspects of decision maker.
- Sometimes philosophy and religion forbid the farmers to grow certain enterprises, though they are highly profitable.

- For example, is lam prohibits muslim farmer to take up piggery while Hinduism prohibits beef production.
- The various pieces of legislation and actions of government affect the production decisions of the farmer such as ceiling on land, support prices, food zones etc.
- The physical sciences specify what can be produced; economics specify how resources should be used, while sociology, psychology, political sciences etc. specify the limitations which are placed on choice, through laws, customs etc.

Lecture no. 2
Farm – Meaning – Definition – its types and characteristics –factors determining size of farms.

Definition-
‒A **farm** is an area of land that is devoted primarily agricultural processes with the primary objective of producing food and other crops.‖

Here are seven different types of farms:

1. Subsistence farm — This is a type of farm that produces only enough food to feed the family with little or no surplus for **sale, says Africa Development Promise**. This type of farm is not meant to provide income, but would ideally produce all needed food, year-round. This is becoming increasingly popular among Americans who wish to live ―off the grid.‖

2. Commercial farm — This is the opposite of a **subsistence farm, says Grade Stack**, and is meant to provide income, often the sole form of income, for the farm family. It can consist of growing crops, raising animals for meat, eggs and dairy, raising fish, or a combination of these.

3. Crop farm — These farms grow fruits, vegetables, or grain. Most large-scale industrial farms are monoculture farms, meaning they grow only one type of crop at a time. **The Union of Concerned Scientists** says this type of farm relies heavily on chemical inputs. Smaller farms tend to be more diversified.

4. Fish farm — Also called aquaculture, fish farming is booming. It involves raising large quantities of fish in large tanks. **According to Grist, although farmed fish** has a less-than-favorable reputation, well-managed fish farms are sustainable, clean, and can produce high-quality protein.

5. Dairy farm — This type of farm focuses on raising animals for milk. The milk can then be used to make other dairy products like yogurt and cheese. Most large dairy farms raise dairy cows, but some artisanal dairy farms may raise sheep or goats.

6. Poultry farm — Most poultry farms raise chickens and turkeys for meat consumption, but some raise chicken for eggs. About 18 percent of all poultry meat in the U.S. is exported, **says the United States Department of Agriculture (USDA)**. Large-scale farms are the norm, but consumer demand for locally-produced, pastured, and humanely raised poultry is growing.

7. Meat farms — These farms exist solely to raise animals for slaughter and consumption. They can be divided into other categories like pig farms and cattle farms.

➢ **Farm Characteristics**

- General as well as specific characteristics of farms and their operators shape overall levels of production and productivity, generating differential returns to farming endeavors.
- Such characteristics as farm size, use of conservation practices, irrigation and water availability, land tenure, as well as household demographics and assets, have all been shown to exert some influence over enterprise and technology choice, input use and market participation.
- In sub-Saharan Africa, the majority of farmers operate less than 2 hectares of cropland, and as such are defined as smallholders, although the definition differs across country and agro-ecological zone.
- Limited farm size is seen as one of the major factors hampering the transition from household-based subsistence farm economies to commercially-oriented production systems.
- Conservation practices, irrigation, and water availability have an important bearing on both long-term farm income and resource sustainability.
- Secure land tenure provides operators with a solid basis for investment, as land can often be used as collateral for loans.
- Besides farm characteristics, the socio-demographic traits of farmers - education level, knowledge of farming practices, access to agricultural assets, level of poverty, age and gender structure of the household - can greatly affect farm performance.
- Harvest Choice attempts to systematically compile and conform household data on many of these indicators, drawing on information from a wide variety of primary as well as secondary data souces.

The following are the main factors responsible:
1. Entrepreneurial Skill:
- The most important factor of comes is the skill, initiative and resourcefulness of the entrepreneur.
- Everything depends on his judgment and ability.
- An entrepreneur of outstanding ability will be able to procure as much finance as he may need, hire the requisite labor force and build up a huge business.
- But an entrepreneur of moderate ability will run business on a moderate scale and a man of limited entrepreneurial skill will be content with a small business

2. Managerial Ability:
- For running the routine part of the business, managers are appointed.
- If a firm is lucky enough to have a manager of great ability, the size of the firm will grow to considerable dimensions.
- On the other hand, a mediocre manager will have a small-sized firm to manage.

3. Availability of Finance:
- It is finance which oils the wheels of business machine.
- If ample funds are available, it will help the entrepreneur to make his business grow to a big size.
- This requires a proper development, of the banking system so that savings of the community can be effectively mobilized and utilized in the development of trade and industry.

4. Availability of Labour:
- Another factor on which the size of the firm depends is the availability of labour of requisite skill.

- After all, what can the entrepreneur even with large capital do, if the labour to man the business is not available? What is required is efficient and skilled labour.

5. Nature of Business:
- Much also depends on the nature of business.
- If the business obeys the law of increasing Returns, it will grow to a big size, otherwise, in the case of diminishing returns it will remain stunted, and in the case of constant returns it will remain stagnant.

6. Extent of the Market:
- The size of the firm also depends on the extent of the market.
- If the commodity in which the firm deals or which it-manufactures has a wide market, naturally the business will assume a large scale.
- But if the demand for the commodity is fitful or limited, the size of the firm will continue to be small.
- These are some of the factors on which the size of an average firm in a country depends.

Lecture no. 3
Economic principles applied to farm management – Principle of variable proportions – Determination of optimum input and optimum output.

ECONOMIC PRINCIPLES APPLIED TO FARM MANAGEMENT.
The outpouring of new technological information is making the farm problems increasingly challenging and providing attractive opportunities for maxi missing profits.
Hence, the application of economic principles to farming is essential for the successful management of the farm business.
Some of the economic principles that help in rational farm management decisions are:
1. Law of variable proportions or Law of diminishing returns: It solves the problems of how much to produce ? It guides in the determination of optimum input to use and optimum output to produce.. It explains the one of the basic production relationships viz., factor-product relationship
2. Cost Principle: It explains how losses can be minimized during the periods of price adversity.
3. Principle of factor substitution: It solves the problem of _how to produce?. It guides in the determination of least cost combinations of resources. It explains facot-factor relationship.
4. Principle of product substitution: It solves the problem of _what to produce?'. It guides in the determination of optimum combination of enterprises (products). It explains Product-product relationship.
5. Principle of equi-marginal returns: It guides in the allocation of resources under conditions of scarcity.
6. Time comparison principle: It guides in making investment decisions.
7. Principle of comparative advantage: It explains regional specialisation in the production of commodities.

LAW OF VARIABLE PROPORTIONSOR LAW OF DIMINISHING
RETURNS
OR

PRINCIPLE OF ADDED COSTS AND ADDED RETURNS

The law of diminishing returns is a basic natural law affecting many phases of management of a farm business. The factor product relationship or the amount of resources that should be used (optimum input) and consequently the amount of product that should be produced (optimum output) is directly related to the operation of law of diminishing returns. This law derives its name from the fact that as successive units of variable resource are used in combination with a collection of fixed resources, the resulting addition to the total product will become successively smaller.

Most Profitable level of production

   (a) How much input to use (Optimum input to use).

      The determination of optimum input to use.

An important use of information derived from a production function is in determining how much of the variable input to use. Given a goal of maximizing profit, the farmer must select from all possible input levels, the one which will result in the greatest profit.

To determine the optimum input to use, we apply two marginal concepts viz: Marginal Value Product and Marginal Factor Cost.

Marginal Value Product (MVP): It is the additional income received from using an additional unit of input. It is calculated by using the following equation.

Marginal Value Product = ? Total Value Product/? input level

MVP = ? Y. Py/? X

? Change

Y =Output

Py = Price/unit

Marginal Input Cost (MIC) or Marginal Factor Cost (MFC):

 It is defined as the additional cost associated with the use of an additional unit of input.

Marginal Factor Cost = ? Total Input Cost/? Input level

MFC or MIC = ? X Px/? X = ? X .Px / ? x = Px

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X input Quantity

Px Price per unit of input

MFC is constant and equal to the price per unit of input.

This conclusionholds provided the input price does not change with the quantity of input purchased.

Decision Rules:

1. If MVP is greater than MIC, additional profit can be made by using more input.

2. If MVP is less than MIC, more profit can be made by using less input.

3. Profit maximizing or optimum input level is at the point where MVP=MFC

(? Y/? X) . Py = Px ? Y/? X = Px/ Py

Determination of optimum input level – Example

Input price: Rs.12 per unit, Output price: Rs.2 per unit

Input level	TPP	MPP	TVP (Rs)	MVP (Rs)	MIC (Rs)
X					
0	0	--	--	--	--
1	12	12	24	24	12
2	30	18	60	36	12

3	44	14	88	28	12
4	54	10	108	20	
5	62	8	124	16	12
6	68	6	136	12	12
7	72	4	144	8	12
8	74	2	148	4	12
9	72	-2	144	-4	12
10	68	-4	136	-8	12

The first few lines in the above table show that MVP to be greater than MIC. In other words, the additional income received from using additional unit of input exceeds the additional cost of that input. Therefore additional profit is being made. These relationships exist until the input level reaches 6 units. At this input level MVP=MFC. Using more than 6 units of input causes MVP to be less than MFC which causes profit to decline as more input is used. The profit maximizing input level is therefore, at the point where MVP=MIC. Note that the profit maximizing point is not at the input level which maximizes TVP. Profit is maximized at a lower input level.

(b) How much output to produce (Optimum output):
The determination of optimum output to produce. To answer this question, requires the introduction of two new marginal concepts.

Marginal Revenue (MR): It is defined as the additional income from selling additional unit of output. It is calculated from the following equation Marginal Revenue = Change in total revenue / Change in Total Physical Product

MR = ? TR / ? Y

MR=? Yy / ?Y

= Py

Y = output

Py = price per unit of output

Total Revenue is same as Total Value Product. MR is constant and equal to the price per unit of output.

Marginal Cost (MC): It is defined as the additional cost incurred from producing an additional unit of output. It is computed from the following equation.

Marginal Cost=Change in Total Cost / Change in Total Physical Product

MC=? X. P x/? Y

X= Quantity of input

Px= Price per unit of input.

Decision Rules:

1. If Marginal Revenue is greater than Marginal Cost, additional profit can be made by producing more output.

2. If Marginal Revenue is less than Marginal Cost, more profits can be made by producing less output.

3. The profit maximizing output level is at the point where MR=MC

? Y. Py/? Y=? X. Px/? Y

Py = ? X. Px/?Y

? Y. Py = ? X. Px

Determination of Optimum output to produce: **(An example)**

Input Price Rs.2 per unit output price Rs.2 per unit

Input level	TPP	MPP	TR (Rs)	MR (Rs)	MC (Rs)
X	0	0	--	--	--
1	12	12	24	2.00	1.00
2	30	18	60	2.00	0.67
3	44	14	88	2.00	0.86
4	54	10	108	2.00	1.20
5	62	8	124	2.00	1.50
6	68	6	136	2.00	2.00
7	72	4	144	2.00	3.00
8	72	2	148	2.00	6.00
9	72	-2	144	2.00	
10	68	-4	136	2.00	

In the above table, it is clear that MR is greater than MC up to the output level 62 units. At the output level of 68 units, the MR=MC. This is the optimum output to be produced. If we produce 72 units of output, additional revenue from additional output is less than the additional cost of producing output. Therefore profit decline.

Lecture. no. 4
Minimum loss principle (Cost Principle) - Principle of factor substitution

COST PRINCIPLE OR MINIMUM LOSS PRINCIPLE:
- This principle guides the producers in the minimization of losses.
- Costs are divided into fixed and variable costs.
- Variable costs are important in determining whether to produce or not .
- Fixed costs are important in making decisions on different practices and different amounts of production.
- In the short run, the gross returns or total revenue m ust cover the total variable costs (TVC).
- To state in a different way that selling price must cover the average variable cost (AVC) to continue production in the short run.
- In the long run, gross returns or total revenue must cover the total cost (TC).
- Alternatively stated, that the selling price must cover cost of production (ATC).
- In the short run MR = MC point may be at a level of output which may involve loss instead of profit. The situation of operating the farms when the price of product (MR) is less than average total cost (ATC) but greater than average variable cost (AVC) is common in agriculture.
- This explains why the farmers keep farming even when they run into losses.

   PRINCIPLE OF FACTOR SUBSTITUTION
- This economic principle explains one of the basic production relationships Viz, factor-factor relationship. It guides in the determination of least cost combination of resources.
- It helps in making a management decision of how to produce.
- Substitution of one input for another input occurs frequently in agricultural production.

- For example, one grain can be substituted for another or forage for grain in livestock ration, chemical fertilizers can be substitute d for organic manure, machinery for labour, herbicides for mechanical cultivation etc.
- The farmer must select that combination of inputs or practices which will produce a given amount of output for the least cost.
- In other words, the problem is to find the least cost combination of resources, as this will maximize profit from producing a given amount of output.
- The principle of factor substitution says that go on adding a resource so long as the cost of resource being added is less than the saving in cost from the resource being replaced.
- Thus if input X1 is being increased, and input X2 is being replaced, increase the use of X1 so long as.

Principle of product substitution - Law of Equi-marginal returns – Opportunity cost principle.

PRINCIPLE OF PRODUCT SUBSTITUTION

This principle explains the product-product relationship and helps in deciding the optimum combination of products. Also, this economic principle guides in makinga decision of what to produce.

It is economical to substitute one product for another product, if the decrease in returns from the product being replaced is less than the increase in returns from the product being added.

The principle of product substitution says that we should go on increasing the output of a product so long as decrease in the returns from the product being replaced is less than the increase in the returns from the product being added.

Decrease in returns	<	Increase in returns
Quantity of output reduced of replaced product ? price per unit of replaced product	<	Quantity of output increased of added product ? Price per unit of added product

i. e. $\dfrac{\text{Quatity of output reduced of replaced product}}{\text{Quantity of output increased of added product}}$ < $\dfrac{\text{Price per unit of added product}}{\text{price per unit of replaced product}}$

i.e. MRS < PR

Profit rules or Decision rules:

1. If MRS < PR, profits can be increased by producing more of added product.

MRS Y1, Y2 $= \dfrac{?Y2}{?\square 1}$ < $\dfrac{PY1}{\square \square 2}$ < increase Y1

MRS Y2, Y1 $= \dfrac{?\square 1}{?\square 2}$ < $\dfrac{\square \square 2}{\square \square 1}$ < increase Y2

2. MRS > PR, profits can be increased by producing more of replaced product.

$$MRSY1, Y2 = \frac{\Delta Y2}{\Delta Y1} \quad < \frac{PY1}{PY2} \quad > \text{increase } Y2$$

$$MRSY2, Y1 = \frac{\Delta Y1}{\Delta Y2} \quad < \frac{PY2}{PY1} \quad > \text{increase } Y1$$

3. Optimum combination of products is when MRS=PR

$$\frac{\Delta Y2}{\Delta Y1} = \frac{PY1}{PY2}$$

Or

$$\frac{\Delta Y1}{\Delta Y2} = \frac{PY2}{PY1}$$

Example : Selecting an optimum combination of enterprises
(PY1 = Rs. 280 per quintal; P Y2 = Rs. 400 per quintal)

Y1 (Quintals)	Y2 (Quintals)	ΔY1	ΔY2	MRS Y1, Y2	PR	Decrease in returns	Increase in returns
0	60	-	-	-	-	-	-
20	56	20	4	0.20	0.70	1600	5600
40	50	20	6	0.30	0.70	2400	5600
60	41	20	9	0.45	0.70	3600	5600
80	30	20	11	0.55	0.70	4400	5600
100	16	20	14	0.70	0.70	5600	5600
120	0	20	16	0.80	0.70	6400	5600

It can be seen from the above table that up to fifth combination MRS is less than PR. But at the sixth combination MRS is equal to PR. Therefore, the sixth combination which produces 100 quintals of corn Y1 and 16 quintals of wheat Y2 is the optimum or profit maximizing combination.

LAW OF EQUI-MARGINAL RETURNS
Most of the farmers have limited resources. They have limited land, limited capital, limited irrigation facilities. Even the labour which is considered to be surplus becomes scarce during peak sowing, weeding and harvesting periods. Under such resource limitations, farmers must decide how a limited amount of input should be allocated or divided among many possible uses or alternatives. For example farmer has to decide on the best allocation of fertilizer between different crops and feed between different types of livestock. In addition, limited capital must be allocated to the purchase of fertilizers, seeds, feed etc.

The equi-marginal principle provides guidelines for the rational allocation of scare resources. The principle says that returns from the limited resources will be maximum if each unit of the resource should be used where it brings greatest marginal returns.
Statement of the law
A limited input should be allocated among alternative uses in such a way that the marginal value products of the last unit are equal in all its uses.

Example

A farmer has Rs. 3000/- and wants to grow sugarcane, wheat and cotton. What amount of money be spent on each enterprise to get maximum profits.

Amount (Rs.)	Marginal value products from		
	Sugarcane (Rs.)	Wheat (Rs.)	Cotton (Rs.)
500	800 (1)	750 (2)	650 (6)
1000	700 (3)	650 (5)	560
1500	650 (4)	580	550
2000	640	540	510
2500	630	520	505
3000	605	510	500

The first Rs. 500 would be allocated to sugarcane as it has the highest MVP. The second dose of Rs. 500 would be allocated to wheat as its MVP is higher than that of cotton and sugarcane. In the same way, third would be used on sugarcane, the fourth, fifth and the sixth on sugarcane, wheat and cotton respectively. Each successive Rs of 500 is allocated to the crop which has highest marginal value product remaining after previous allocation.

The final allocation is Rs. 1500 on sugarcane, Rs 1000 on wheat and Rs. 500 on cotton.

OPPORTUNITY COST

It is an economic concept closely related to the equi-marginal principle.

Opportunity cost recognizes the fact that every input has an alternative use. Once an input is committed to a particular use, it is no longer available for any other alternative use and the income from the alternative must be foregone.

Definition : Opportunity cost is defined as the returns that are sacrificed from the next best alternative.

Opportunity cost is also known as **real cost or alternate cost**.

Lecture no.6
Principle of comparative advantage – Time comparison principle
PRINCIPLE OF COMPARATIVE ADVANTAGE

Certain crops can be grown in only limited areas because of specific soil and climatic requirements. However, even those crops and livestock enterprises which can be raised over a broad geographical area often have production concentrated in one region. Farmers in Punjab specialize in wheat production while farmers in Andhra Pradesh specialize in paddy production. These crops can be grown in each state.

Regional speciation in the production of agricultural commodities and other products can be explained by the principle of comparative advantage.

While crops and livestock products can be raised over a broad geographical area, the yields, production costs, profits may be different in each area. It is relative yields, costs, and profits which are important for the application of this principle.

Statement of the principle

Individuals or regions will tend to specialize in the production of those commodities for which their resources give them a relative or comparative advantage.

The following example illustrates the principle of comparative advantages.

Crop account per acre	Region A		Region B	
	Wheat	Groundnut	Wheat	Groundnut
Total Revenue (Rs.)	500	225	225	220
Total Cost (Rs.)	425	200	210	200
Net Returns (Rs.)	75	25	15	20
Returns per rupee	1.18	1.13	1.07	1.10

Region A has greater absolute advantage in growing both wheat and groundnut than Region B because the net incomes per acre are Rs. 75 and Rs. 25 respectively which are higher than the net incomes from wheat and groundnut in Region B. Farmers of Region A can make more profits by growing both the crops. But they want to make the greatest profits and this can be done by having the largest possible acreage under wheat alone as it is the question of relative advantage.
Similarly farmers of Region B have relative advantage in growing

TIME COMPARISON PRINCIPLE
Many farm decisions involve time. For example, a farmer has to decide between a cereal crop which would be harvested after about four months or an orchard which would start giving returns after three years. Further, a farmer has to decide whether to purchase new farm machinery with 10 years of life or a second hand one which may have only five years of life. Several other decisions involving time and initial capital investment could be judiciously taken by compounding or discounting.

Future value of a present sum:
The future value of money refers to the value of an investment at a specified date in the future. This concept assumes that investment will earn interest which is reinvested at the end of each time period to also earn interest. The procedure for determining the future value of present sum is called **compounding** .
The formula to find the future value of present sum in given below
$FV = P (1 + i) n$
where,
FV = Future value;
P = the present sum,
i = the interest rate,
n = the number of years.

Example:
Assume you have invested Rs. 100 in a savings account which earns 8% interest compounded annually and would like to know the future value of this investment after
3 years.

Year	Value at beginning of year (Rs.)	Rate of interest	Interest earne d (Rs.)	Value at the end of the year (Rs.)
1	100	8%	8.00	108.00
2	108	8%	8.64	116.64
3	116.64	8%	9.33	125.97

In the example, a present sum of Rs. 100 has a future value of Rs. 125.97 when invested at 8 per cent interest for 3 years. Interest is compounded when accumulated interest also earns future interest.

Present value of future sum:

Present value of future sum refers to the current value of sum of money to be received in the future. The procedure to find the present value of future sum is called **discounting** .

The discounting is done because sum to be received in the future is worth somewhat less now because of the time difference assuming positive interest rate.

The equation for finding the present value of future sum is

$$PV = \frac{P}{(1+i)n}$$

where,

PV = Present value

P = Future sum

i = rate of interest

n = number of years.

Example:

Find the present value of Rs. 1000/- to be received in 5 years using an interest rate of 8%.

$$PV = \frac{1000}{(1+0.08)^5} = 681$$

A payment of Rs. 1000 to be received in 5 years has a present value of Rs. 681 at 8% interest.

Lecture no.7
Types of farming – Specialization, Diversification, Mixed farming, Dry farming and Ranching – factors influencing types of farming

TYPES OF FARMING

The type of farming refers to the nature and degree of product or combination of products being produced and the methods and practices used for them.

Types -
1. Specialized Farming
2. Diversified Farming
3. Mixed Farming
4. Dry Farming
5. Ranching

I. SPECIALIZED FARMING:

When a farm is organized for the production of a single commodity and this commodity is the only source of income, the farm is said to be specialized. The major enterprise contributes more than 50% of the total farm income.

Examples are sugarcane farm, cotton farm, poultry farm, dairy farm, wheat farm etc.

Advantages:

1. Better use of land
2. Better marketing
3. Better management
4. Improved skill and efficiency
5. Economical to maintain costly machinery
6. Less requirement of labour

Disadvantages:
1. Greater risk
2. Soil fertility cannot be maintained
3. By products cannot be fully utilized
4. Income is received once or twice in a year
5. Knowledge about enterprises becomes limited.

II. DIVERSIFIED FARMING:

When a farm is organized to produce several products (commodities), each of which is itself a direct source of income, the farm business is said to be diversified. In diversified farming, no single enterprise contributes 50% of the total farms income.

Advantages:
1. Better utilization of productive resources.
2. Reduction of risk .
3. Regular and quicker returns.
4. Proper utilization of by products.

Disadvantages:
1. Supervision will become difficult.
2. Marketing problems.
3. Not economical to maintain costly machinery.

III. MIXED FARMING:

It is the type of farming under which crop production is combined with livestock raising. At least 10 per cent of gross income must be contributed by the livestock. This contribution in any case should not exceed 49%.

Advantages:
1. Maintenance of soil fertility
2. Proper use of by products
3. Facilitates intensive cultivation
4. Higher income
5. Milch cattle provide drought animals.
6. Employment of labour.

IV. RANCHING:

The practice of grazing animals on public lands is called **ranching.** Ranch land is not used for raising of crops. Ranching is followed in Australia, America and Tibet.

V. A. Dry farming: Cultivation of crops in regions with annual rainfall of less than 750 mm. Crop failure is most common due to prolonged dry spells during crop period.

B. Dry land farming : Cultivation of crops in regions with annual rainfall of more than 750mm. Moisture conservation practices are necessary for crop production.

C. Rain fed farming : Cultivation of crops in regions with an annual rain fall of more than 1150 mm.

FACTORS INFLUENCING TYPES OF FARMING:

A. Physical factors :
1. Climate
2. soils
3. topography

B. Economic factors:
1. Marketing cost
2. Relative profitability of enterprises
3. Availability of capital
4. Availability of labour
5. Land values
6. Cycles over and under production
7. Competition between enterprises
8. Personal likes and dislikes of farming.

Lecture no.8
Types of farm business organizations – Peasant farming, Cooperative farming, Capitalistic farming, Collective farming and State farming.

Types of Farme business organizations-(Systems of Farming)
The system of farming refers to the organizational set up under which farm is being run. It involves questions like who is the owner of land, whether resources are used jointly or individually and who makes managerial decisions.
Systems of farming, which are based on different organizational set up, may be **classified into five broad categories:**
1. Peasant farming
2. Co-operative farming
3. Capitalistic farming (Estate farming)
4. Collective farming
5. State farming

1. Peasant farming:
- This system of farming refers to the type of organization in which an individual cultivator is the owner, manager and organizer of the farm.
- He makes decision and plans for his farm depending upon his resources which are generally meager in comparison to other systems of farming.
- The biggest advantage of this system is that the farmers himself is the owner and therefore free to take all types of decisions.

- A general weakness of this system is that the resources with the individual are less. Another difficulty is because of the law of inheritance.
- An individual holding goes on reducing as all the members in the family have equal rights in that land.

2. Cooperative farming:
- Co-operative farming is a voluntary organization in which small farmers and landless labores increase their income by pooling land resources.
- According to planning commission, Co-operative farming necessarily implies pooling of land and joint management.
- The working group on co-operative farming defines a co-operative farming society as ―a voluntary association of cultivators for better utilization of resources including manpower and pooled land and in which majority of the members participate in farm operation with a view to increasing agricultural production, employment and income.‖
- **Co-operative farming society makes one of the following four forms**
  I. Co-operative better farming
  II. C-operative Joint farming
  III. Co-operative tenant farming
  IV. Co-operative collective farming
  Co-operative better farming:
- These societies are based on individual ownership and individual operation. Farmers who have small holdings and limited resources join to form a society for some specific purpose eg: use of machinery, sale of product.
- They are organized with a view to introduce improved methods of agriculture.
- Each farmer pays for the services which he receives from the society.
- The earnings of the member from piece of land, after deducting the expenses, his profit.

  Co-operative Joint farming:
- Under this type, the right of individual ownership is recognized and respected but the small owners pool their land for the purpose of joint cultivation.
- The ownership is individual but the operations are collective.
- The management is democratic and is elected by the members of the society.
- Each member working on the farm receives daily wages for his daily work and profit is distributed according to his share in land.

  Co-operative tenant farming:
- Such societies are usually organized by landless farmers.
- In this system usually land belongs to the society.
- The land is divided into plots which are leased out for cultivation to individual members.
- The society arranges for agricultural requirements e g: credit, seeds, manures, marketing of the produce etc.
- Each member is responsible to the society for the payments of rent on his plot.
- He is at liberty to dispose of his produce in such a manner as he likes.
  Co-operative collective farming:
- Both ownership and operations under this system are collective.
- Members do not have any right on land and they can‗t take farming decisions independently but are guided by a supreme general body.

- It undertakes joint cultivation for which all members pool their resources.
- Profit is distributed according to the labour and capitals invested by the members.

3. Capitalist or Estate farming:

- In what is known as capitalistic or estate or corporate farming, land is held in large areas by private capitalists, corporations or syndicates.
- Capital is supplied by one or a few persons or by many, in which case it runs like a joint stock company.
- In such farms, the unit of organization is large and the work is carried on with hired labor; latest technical know how is used and extensive use of machines are made and hence they are efficient.
- Examples of this type of farming are frequently found in USA, Australia, Canada and few in India too.
- Such types of farms have been organized in the states of Bombay, Madras and Mysore for the plantation of coffee, tea and rubber and sugarcane.
- The advantages of such farming are good supervision, strong organizational set up, sufficient resources etc.
- Their weaknesses are that it creates socio-economic imbalances and the actual cultivator is not the owner of the farm.

4. Collective farming:

- The name, collective farming implies the collective management of land where in large number of families or villagers residing in the same village pool the ir resources eg: land, livestock, and machinery.
- A general body having the highest power is formed which manages the farms.
- The resources do not belong to any family or farmer but to the society or collective.
- Collective farming has come into much promin nec and has been adopted by some countries notably by the Russia and China.
- The worst thing with this system is that the individual has no voice.
- Farming is done generally on large scale and thereby is mostly mechanized.
- This system is not prevalent in our country.

5. State farming:

- State farming as the name indicates is managed by the government.
- Here land is owned by the state. The operation and management is done by government officials.
- The state performs the function of risk bearing and decision making, which cultivation is carried on with help of hired labour.
- All the labourers are hired on daily or monthly basis and they have no right in deciding the farm policy.
- Such farms are not very paying because of lack of incentive.
- There is no dearth of resources at such farms but s sometimes it so happens that they are not available in time and utilized fully.

System of farming	Type of ownership	Types of Operation ship
I Co-operative farming		
a Coop. better farming	Individual	Individual
b Coop. joint farming	Individual	Collective
c Coop. tenant farming	Collective	Individual
d Coop.collective farming	Collective	Collective
II Collective farming	Society/state	Society/state
III Capitalistic farming	Individual	Individual
IV State farming	State	Paid Management
V Peasant farming	Individual	Individual

Lecture no. 9
Meaning and concept of cost –types of costs – cost concepts – farm income measures – Gross income, farm business income, family labour income, net farm income & farm investment income.

Meaning and concept of cost
In general terms, **cost** refers to an amount to be paid or given up for acquiring any resource or service. In economics,
Cost can be defined as a monetary valuation of efforts, material, resources, time and utilities consumed, risks incurred, and opportunity forgone in the production of a good or service.

Concept of Costs
In order to understand the general concept of costs, it is important to know the following types of costs:

1. Accounting costs and Economic costs
2. Outlay costs and Opportunity costs
3. Direct/Traceable costs and Indirect/Untraceable costs
4. Incremental costs and Sunk costs
5. Private costs and Social costs
6. Fixed costs and Variable costs

Types Of Cost
A) On the basis of Treatment
1. Accounting costs
Accounting costs are those for which the entrepreneur pays direct cash for procuring resources for production. These include costs of the price paid for raw materials and machines, wages paid to workers, electricity charges, the cost incurred in hiring or purchasing a building or plot, etc. Accounting costs are treated as expenses. Chartered accountants record them in financial statements.
2. Economic costs
There are certain costs that accounting costs disregard. These include money which the entrepreneur forgoes but would have earned had he invested his time, efforts and investments in

other ventures. For example, the entrepreneur would have earned an income had he sold his services to others instead of working on his own business.

Similarly, potential returns on the capital he employed in his business instead of giving it to others, the output generated by his resources which he could have used for others' benefits, etc. are other examples of economic costs.

Economic costs help the entrepreneur calculate supernormal profits, i.e. profits he would earn above the normal profits by investing in ventures other than his.

B) On the basis of Nature of Expenses

1. Outlay costs

The actual expenses incurred by the entrepreneur in employing inputs are called outlay costs. These include costs on payment of wages, rent, electricity or fuel charges, raw materials, etc. We have to treat them are general expenses for the business.

2. Opportunity costs

Opportunity costs are incomes from the next best alternative that is foregone when the entrepreneur makes certain choices.

For example, the entrepreneur could have earned a salary had he worked for others instead of spending time on his own business. These costs calculate the missed opportunity and calculate income that we can earn by following some other policy.

C) On the basis of Traceability

1. Direct costs

Direct costs are related to a specific process or product. They are also called traceable costs as we can directly trace them to a particular activity, product or process.

They can vary with changes in the activity or product. Examples of direct costs include manufacturing costs relating to production, customer acquisition costs pertaining to sales, etc.

2. Indirect costs

Indirect costs, or untraceable costs, are those which do not directly relate to a specific activity or component of the business. For example, an increase in charges of electricity or taxes payable on income. Although we cannot trace indirect costs, they are important because they affect overall profitability.

D) On the basis of Purpose

1. Incremental costs

These costs are incurred when the business makes a policy decision. For example, change of product line, acquisition of new customers, upgrade of machinery to increase output are incremental costs.

2. Sunk costs

Suck costs are costs which the entrepreneur has already incurred and he cannot recover them again now. These include money spent on advertising, conducting research, and acquiring machinery.

E) On the basis of Payers

1. Private costs

These costs are incurred by the business in furtherance of its own objectives. Entrepreneurs spend them for their own private and business interests. For example, costs of manufacturing, production, sale, advertising, etc.

2. Social costs

As the name suggests, it is the society that bears social costs for private interests and expenses of the business. These include social resources for which the firm does not incur expenses, like atmosphere, water resources and environmental pollution.

F) On the basis of Variability

1. Fixed costs

Fixed costs are those which do not change with the volume of output. The business incurs them regardless of their level of production. Examples of these include payment of rent, taxes, interest on a loan, etc.

2. Variable costs

These costs will vary depending upon the output that the business generates. Less production will cost fewer expenses, and vice versa, the business will pay more when its production is greater. Expenses on the purchase of raw material and payment of wages are examples of variable costs.

Lecture no. 10
 Farm business analysis – meaning and concept of farm income and profitability – technical and economic efficiency measures.

Farm Business Analysis

Efficient managers want to be able to determine the position of a business at any point of time. They also want a basis for evaluating where the business is going on. This helps their control of the business operations overtime. Thus, the objectives of farm business at a particular point of time are:

a. To evaluate the performance of the business at a particular point of time;
b. To identify the weakness of the business;
c. To remove the hurdles and improve the business; and
d. To prepare financial documents like balance sheet and income statement so as to acquire credit, design farm policies and prepare tax statement.

i) Steps or Stages of Farm Business Analysis

a) Proper recording of accounts and activities.

b) Analysis of the data.

c) Interpretation of the results.

a. Recording of data: A systematic recording of information on financial aspects of the farm is essential for farm business analysis and for this purpose, a sound knowledge on book keeping and accounting is essential.

b. Analysis of data: The data collected would be useful to construct balance sheet and income statement. Financial ratio analysis would also increase the farm efficiency.

c. Interpretation of the results: The financial analysis would indicate the performance of the business and suggest measures for improvement. The interpretation of results would be more useful to understand the performance of the business.

ii) Advantages of Farm Business Analysis

a) They are the means to increase the farm income.
b) They are the basis for diagnosis or planning.
c) They show the way to improve the managerial ability of farmer.
d) They are useful for credit acquisition and management.
e) They provide database for conducting research in agriculture economics.

f) They form the basis for designing government policies – land policy, price policy, national farm policies, etc.

Farm Profitability -

Farm profitability can be measuring using earnings before interest, taxes, and amortization (EBITA), net **farm** income, operating **profit** margin ratio, rate of return on **farm** assets, and rate of return on **farm** equity.

Farm Income

Farm income refers to profits and losses incurred through the operation of a **farm**. A **farm income** statement (sometimes called a **farm profit** and loss statement) is a summary of **income** and expenses that occurred during a specified accounting period.

Efficiency: it means absence of waste or using the economy's resources as effectively as possible to satisfy people's needs and desir es.

Technical Efficiency: It refers to the amount of output with given amounts of factors of production. In other words, technical efficiency is the ratio of output to input (Average physical product).
Technical efficiency = Y/X, Where Y= Total output and X= Quantity of input

Economic Efficiency: It is a ratio of value of output to value of input. Economic efficiency = Y.Py / X.Px

Lecture no. 11
Farm records and accounts – importance – types of farm records needed to maintain on farm.
Definition-
Farm records-
"A **farm record** is a document (in most cases a book) that is used to keep account of different activities, events, materials etc. regarding the **farm** operations‖.
Farm accounts –
"**Farm Accounts** are statements of money paid out or received for goods and services used in **farming** business‖.
Importance of farm records and accounts
1. Farm records help a farmer to keep stock and manage each aspect of the farm properly.
2. They are important for planning and budgeting. They provides a farmer with enough information needed for proper planning and budgeting at every point in time.
3. They help farmers know the progress and contributions of each aspect of the farm to its overall success.
4. They are important for proper farm management.
5. They can be very helpful when a farmer needs to access financial aids from banks or other financial institutions.

Types of farm records and their uses
1. **Daily farm records**

These are the records of all important daily activities and events that happen on the farm. These records help the farmer keep track of past farming activities and plan for future activities.

2. **Records of farm implements and equipment**
   This is used to keep an inventory of all the equipment on the farm and their quantity. It can also contain the date of purchase of the equipment and sometimes their description.

3. **Record of agricultural inputs**
   This record is used to keep track of all agricultural inputs such as fertilizers, seeds, etc. The record often also contains the amount of that was bought, the amount that has been used, and what is left.

4. **Records of livestock and livestock products**
   Farmers keep different records of livestock for each type of livestock on the farm. Also, for livestock that have products e.g. eggs from chickens, the farmer keeps a record that accounts for the number of eggs laid every day. If a farmer has cows for milk production, he keeps record of the amount of liters of milk produced per day.

5. **Records of animal feeds**
   This record is used for keeping an inventory of the types of animal feed and the quantity purchased, used, and also quantity in stock on a daily basis.

6. **Production records**
   Production records are used to document everything that is produced on the farm. These records are prepared every week. And then summed up at the end of the month and also at the end of the year. Thus, there is a weekly record, a monthly record, and an annual record of everything produced on the farm. They help the farmer to keep track of how well the farm is doing.

7. **Records for farm us**
   Used for recording the date the land was prepared for farming, the number of plots or hectares used in planting, the plants planted on the farm and where they are planted.

8. **Farm expenditure records**
   Farm expenditure records are used to keep a record of all expenditures. 9. Workers records. This type is used to keep the record of staffs, their salaries, and payment. It is also known as labour record.

9. **Vehicle records**
   It is used to keep a record of all vehicles used on the farm, petrol and oil used, and also any repairs and servicing and the dates of the repair or servicing. 11. Sales record Sale records are used to keep a record of all sales made from farm produce. Since the importance of farm records in proper farm management have been highlighted here, farmers are encouraged to start keeping them at the beginning of every farming season or cycle. An organised farm record, good management and success go hand in hand.

Lecture no. 12
Farm inventory – methods of valuation– net selling price, cost less depreciation, market price, cost method, replacement cost less depreciation and income capitalization methods.

   <u>**Farm Inventory**</u>:
   Farm inventory includes a complete listing of all that a farm owns and owes at a particular date, generally at the beginning and the end of each agricultural year. It includes not only the listing of physical assets but also assigning values of all such assets, liabilities and debts as well. There are two steps involved in taking a farm inventory.

Valuation of Inventories

This Standard should be applied in accounting for all inventories except the following :

(a) work in progress in the construction business, including directly related service contracts

(b) work in progress of service business (consulting, banking etc)

(c) shares, debentures and other financial instruments held as stock in trade

(d) Inventories like livestock, agricultural and forest products, mineral oils etc These inventories are valued at net realizable value

II. Net Realisable Value (NRV):

―Net realizable value is the estimated selling price in the ordinary course of business less the estimated costs of completion and the estimated costs necessary to make the sale‖

Valuation of Inventories

Inventories should be valued at lower of cost and net realizable value. Following are the steps for valuation of inventories:

A. Determine the cost of inventories
B. Determine the net realizable value of inventories
C. On Comparison between the cost and net realizable value, the lower of the two is considered as the value of inventory. A comparison can be made the item by item or by the group of items.

Let's discuss the important items of Inventory valuation in detail:

A. Cost of Inventories

The cost of inventories includes the following
i) Purchase cost
ii) Conversion cost
iii) Other costs which are incurred in bringing the inventories to their present location and condition.

B. Cost of Purchase

While determining the purchase cost, the following should be considered:
i) Purchase cost of the inventory includes duties and taxes (except those which are subsequently recoverable from the taxing authorities)
ii) Freight inwards
iii) Other expenditure which is directly attributable to the purchase
iv) Trade discounts, rebates, duty drawbacks and other similar items are deducted in determining the costs of purchase

C. Cost of Conversion

Cost of conversion includes all cost incurred during the production process to complete the raw materials into finished goods.
Cost of conversion also includes a systematic allocation of fixed and variable overheads incurred by the enterprise during the production process.
Following are the categories of conversion cost:

I. Direct Cost

All the cost directly related to the unit of production such as direct labor

II. Fixed Overhead Cost

Fixed overheads are those indirect costs which are incurred by the enterprise irrespective of production volume. These are the cost that remains relatively constant regardless of the volume of production, such as depreciation, building maintenance cost, administration cost etc.

The allocation of fixed production overheads is based on the normal capacity of the production facilities. In case of low production or idle plant allocation of these fixed overheads are not increased consequently.

III. Variable Overhead Cost

Variable overheads are those indirect costs of production that vary directly with the volume of production. These are the cost that will be incurred based on the actual production volume such as packing materials and indirect labor.

D. Other Cost

All the other cost which are incurred in bringing the inventories to the current location and condition. For (eg) design cost which is incurred for the specific customer order.

If there are by-products during the production of main products, their cost has to be separately identified. If they are not separately identifiable, then allocation can be made on the relative sale value of the main product and the by-product.

Some of the cost which should not be included are:

a. Cost of any abnormal waste materials cost

b. Selling and distribution cost unless those costs are necessary for the production process

c. A normal loss which occurs during the production process is apportioned over the remaining no of units and abnormal loss is treated as an expense

Net Selling Price

Product means the total sales revenue for such Product (including any amounts for rental or leasing of such product), excluding charges for returns, rebates, credits, post-sale adjustments, including adjustments for doubtful accounts, outbound prepaid or allowed transportation charges, sales

Cost Less Depreciation.

Actual price paid for property when acquired, **minus depreciation**. Original **cost less depreciation** is used to compute actual cash value, which is often the insurable interest in a property.

Market Price

It is the current **price** at which an asset or service can be bought or sold. The economic theory contends that the **market price** converges at a point where the forces of supply and demand meet

Cost Method

It is a type of accounting used for investments. ... A financial or economic investment is any asset or instrument purchased with the intention of selling said asset for a higher price at a future point in time

Replacement Cost Less Depreciation

Under this method, actual cash **value** is the **replace cost less depreciation**. This rule was to determine the actual cash **value** of the property in the property insurance. it takes into consideration the inflation and **depreciation** of the property over time.

Income Capitalization

It is a valuation **method** that appraisers and real estate investors use to estimate the value of **income**-producing real estate. It is based on the expectation of future benefits. This **method** of valuation relates value to the market rent that a property can be expected to earn and to the resale value.

Lecture no. 13
Balance sheet or Net worth statement – Assets, liabilities and net worth – ratio measures

A **net worth statement** is simply a personal **balance sheet**. It shows where you stand financially. It provides a summary of your **assets** minus your liabilities. In other words, your personal **net worth** is calculated by listing all that you own, and then subtracting all that you owe to get a **net** number.

Categorizing Balance Sheet Items

Balance sheet information is organized into two columns: assets and liabilities.The column on the left describes the farm business's assets and the column on the right describes the farm business's liabilities.

Assets are items owned by the farm business that have value. They include the items that the farm uses to produce the products they sell. Assets include, but are not limited to, cash, grain and feed inventories, prepaid expenses, market livestock, breeding livestock, machinery and equipment, buildings, and farmland.

Liabilities are debts owed to others including commercial lenders, vendors, and private individuals. Debt may be used to finance asset purchases or cover cash shortfalls in the farm business. Balance sheet liabilities include outstanding financial obligations for farm operating expenses such as feed, seed, and fuel. Other liabilities may also include loans for market or breeding livestock, machinery, equipment, land, buildings, and improvements.

Total assets and liabilities on the balance sheet are used to determine the owner's equity, or net worth, of the farm business. Net worth represents the value of the business owned and free of debt. Net worth or owner's equity is a simple calculation:

Total Assets – Total Liabilities = Net Worth
Terms of Assets and Liabilities
<u>Current Assets</u>
Current assets are cash or items that can be easily converted to cash in one year or less. Common current assets include cash, savings, prepaid expenses, growing crops, harvested crop inventories, market livestock, accounts receivable, seed, feed, fertilizer, and other supplies on hand.
<u>Intermediate Assets</u>
Intermediate assets have an assumed useful life of one to 10 years. Common intermediate assets are breeding livestock, machinery and equipment, titled vehicles, and not-readily- marketable bonds and securities.
<u>Long-Term Assets</u>
Long-term, or fixed, assets are typically permanent items with an assumed useful life of more than 10 years and include farmland, improvements such as tile and fence, buildings, farmsteads, capital retains, investments, and other similar items.

Current Liabilities

Current liabilities are obligations that are due and payable in the next 12 months. Common current liabilities include accounts payable (bills), credit card balances, operating lines of credit, accrued interest, and the principal due on intermediate and long-term loans in the next 12 months.

Intermediate Liabilities

Intermediate liabilities are debts that are scheduled to be paid back between 13 months to 10 years, and are usually associated with the intermediate farm assets found on the left side of the balance sheet. Common intermediate liabilities are the principal remaining on machinery and equipment loans or breeding livestock purchases.

Long-Term Liabilities

Long-term, or fixed, liabilities are debts with terms greater than 10 years. Long-term liabilities typically include farmland or building mortgages. Loans are classified as intermediate or long-term liabilities based on the original length of the loan. For instance, when there are eight years left to pay on a 20-year mortgage, it continues to be listed as a long-term liability on the balance sheet.

Keys to Completing the Balance Sheet

To develop a high-quality year-end balance sheet:

- Complete the balance sheet on the same date each year, usually as of December 31st.
- Inventory all assets, using standard weight and measure units (e.g., pounds, head, tons, bushels, bales, etc.)
- Utilize current market prices for crop and livestock inventories.
- Value growing crops at the cost of inputs.
- Include government payments, insurance indemnities, and other income yet to be received as accounts receivable.
- Apply conservative breeding livestock values, avoiding large year-to-year changes.
- Separate farm and personal assets and liabilities. Either create separate balance sheets, or itemize personal assets and liabilities as separate schedules on the balance sheet

Balance Sheet Ratios Measures

Are the financial metrics that determine relationships between different aspects of a company's financial position i.e. liquidity vs. solvency. They include only **balance sheet** items i.e. components of assets, liabilities and shareholders equity in their calculation.

Lecture no. 14
 Income statement or profit and loss statement – Receipts, expenses and net income – ratio measures.

P&L is short for profit and loss statement.
- A business **profit and loss statement** shows you how much money your business earned and lost within a period of time. There is no difference between **income statement** and **profit and loss**.

- The **income statement** is also known as **statement** of **income** or **statement** of operations
  Receipts are the amount of cash a business takes in during any one accounting period.

Receipts

Receipts are cash sales, as well as money received on a customer's account.
Cash **receipts** are shown on the cash flow **statement**, which is helpful in showing how much money is available for the business to pay its **financial** obligations.

Expenses

Expenses consist of cash outflows or other using-up of assets or incurrence of liabilities. Elements of **expenses** include: Cost of Goods Sold (COGS): the direct costs attributable to goods produced and sold by a business. It includes items such as material costs and direct labor.

Income statements

Income statements show the process of determining **net income**. Total revenues, cost of goods sold, gross **income**, expenses, taxes, and **net income** are all line items on the **income statement**. **Net income** is the final line of the **statement**, which is why it is also called the bottom line

Lecture no. 16
Farm planning – Meaning – Need for farm planning – types of farm plans – simple farm plan and whole farm plan – Characteristics of a good farm plan – basic steps in farm planning.

FARM PLANNING
- A successful farm business is not a result of chance factor.
- Good weather and good prices help but a profitable and growing business is the product of good planning.
- With recent technological developments in agriculture, farming has become more complex business and requires careful planning for successful organization.

NEED FOR FARM PLANNING
- A **farm plan** is a programme of total farm activity of a farmer drawn up in advance.
- A farm plan should show the enterprises to be taken up on the farm; the practices to be followed in their production ,use of labour , investments to be made and similar other details
- Farm planning enables the farmer to achieve his objectives (Profit maximization or cost minimization) in a more organized manner.
- It also helps in the analysis of existing resources and their allocation for achieving higher resource use efficiency, farm income and farm family welfare.
- Farm planning is an approach which introduces desirable changes in farm organization and operation and makes a farm viable unit.

TYPE OF FARM PLANS
1. Simple Farm Planning
2. Whole farm planning (Complete Farm Plan)

   1. **Simple farm planning:**

✓ It is adopted either for a part of the land or for one enterprise or to substitute one resource to another.
✓ This is very simple and easy to implement.
✓ The process of change should always begin with these simple plans.

2.   Whole farm planning (Complete):
✓ This is the planning for the whole farm.
✓ This planning is adopted when major changes are contemplated in the existing organization of farm business.

Characteristics of Good farm plan
1. It is should be written.
2. It should be flexible.
3. It should provide for efficient use of resources.
4. Farm plan should have balanced combination of enterprises.
   Such combination in turn ensures,
a. Production of food, cash and fodder crops.
b. Maintain soil fertility.
c. Increase in income.
d. Improve distribution of and use of labour, power and water requirement throughout the year.
5. Avoid excessive risks.
6. Utilize farmer's knowledge and experience and take account of his likes and dislikes.
7. Provide for efficient marketing.
8. Provision for borrowing, using and repayment of credit.
9. Provide for the use of latest technology.

BASIC STEPS IN FARM PLANNING
I. RESOURCE INVENTORY:
The development of whole plan is directly dependent upon an accurate inventory of available resources. The resources provide the means for production and profit. The type and quality of resources available determine the inclusion of enterprise in whole farm plan.
1) **Land:** Land resource should receive top priority when completing the resource inventory. It is one of the fixed resources. The following are some of the important items to be included in land inventory
a) Total number of acres available
b) Soil types (slope, texture, depth)
c) Soil fertility levels.
d) Water supply or potential for developing an irrigation system.
e) Drainage problems and possible corrective measures.
f) Existing soil conservation practices
g) Existing and potential pest and weed problems which might affect enterprise selection and crop yields.
h) Climatic factors including annual rainfall, growing seasons etc.

2) **Buildings:** Listing of all farm buildings along with their size, capacity and potential uses. Livestock enterprises and crop storage may be severely limited in both number and size of the build ings available.

3) **Labour**: Labour should be analyzed for both quantity and quality. Quantity can be measured in man days of labour available from the farm operator (farmer), family members and hired labour. Labour quality is more difficult to measure, but any special s kills, training and experience should be noted.

4) **Machinery**: it is also a fixed resource. The number, size and capacity of the available machinery should be included in the inventory.

5) **Capital**: The farmer's own capital and estimate of amount which can be borrowed represent the capital available for developing whole farm plan.

6) **Management:** The assessment of the management resources should include not only overall management ability but also special skills, training, strengths, weaknesses of manager. Good management is reflected in higher yields and more efficient use of resources.

II. Identifying enterprises: Based on resource inventory, certain crop and livestock enterprises will be feasible alternatives. Care should be taken to include all possible enterprises to avoid missing enterprise with profit potential. Custom and tradition should not be allowed to restrict the list of potential enterprises.

III. Estimation of coefficients :
Each enterprise should be defined on small unit such one acre or hectare for crops and one head for livestock. The resource requirements per unit of each enterprise or the technical coefficients must be estimated. The technical coefficients become very important in determining the maximum size of enterprise and the final enterprise combination.

IV. Estimating gross margins :
A gross margin is estimated for a single unit of each enterprise. Gross margin is the difference between total income and tota variable costs. Calculation of gross margin requires the farmer's best estimate of yields for each enterprise and expected prices for the output. The calculation of total variable cost requires a list of each variable input needed, the amount required and the price of each input.

V. Developing the whole farm plan:
All information necessary to organize a whole farm plan is now ready for use. The systematic procedure to whole farm planning is identifying the most limiting resource and selecting those enterprises with greatest gross margin per unit of resource.

$$\textbf{Returns per unit of resource} = \frac{\square\square\square\square\square\ \square\square\square\square\square}{\square\square\square\square\ \square\square\ \square\square\square\square\square\square\square\square\ \square\square\square\square\square\square\square}$$

Land will generally be a limiting resource and it provides a good starting point. At some point in the planning procedure, a resource other than land may become more limiting and emphasis shifts to identifying enterprises with greatest return or gross margin per unit of this resource.

Lecture no. 17
Farm budgeting – Meaning – types of farm budgets – Enterprise budgeting – Partial budgeting and whole farm budgeting.

FARM BUDGETING

- Budgeting can be used to select the most profitable plan from among a number of alternatives and to test the profitability of any proposed change in plan.
- It involves testing a new plan before implementing it, to be sure that it will improve profit.
- Farm budgeting is a method of estimating expected income, expenses and profit for a farm business.

Types of farm budgets
1. Enterprise budgeting
2. Partial budgeting
3. Whole farm budgeting.

1. Enterprise budget
- An enterprise is defined as a single crop or livestock commodity being produced on the farm.
- An enterprise budget is an estimate of all income and expenses associated with a specific enterprise and estimate of its profitability.
- Enterprise budget can be developed for each actual and potential enterprise in a farm plan such as paddy enterprise, wheat enterprise or a cow enterprise.
- Each is developed on the basis of small common unit such as one acre or one hectare for crops or one head for livestock.
- This permits easier comparison of the profit for alternative and competing enterprises.
- Enterprise budget can be organized and presented in three sections income, variable costs and fixed costs.
- The first step in developing an enterprise is to estimate the total production and expected output price.
- The estimated yield should be an average yield expected under normal weather conditions given the soil type and input levels to be used.
- The output price should be the manager's best estimate of the average price expected during the next year or next several years.
- Variable costs are estimated by knowing the quantities of inputs to be used (such as seed, fertilizer, labour, manures) and their prices.
- The fixed costs in a crop enterprise budget are depreciation on machinery, equipment, implements, livestock, farm building etc., rental value of land, land revenue, interest on fixed capital.
- Example: Enterprise budget for paddy production (one hectare).

I) INCOME

48 quintals @ Rs. 600 per quintal	28,80

II) VARIABLE COSTS

1. Human labour	9,000
a) Owned	3,000
b) Hired	6,000
2. Bullock labour	300
a) Owned	100
b) Hired	200
3. Tractor power	4,000
a) Owned	1,000

b) Hired	3,000
4. Seeds	1,200
5. F.Y.M.	1,800
6. Green leaf manures	700
7. Fertilizers	3,000
8. Plant protection chemicals	500
9. Irrigation charges	500
10. Interest on working capital	1,700
Total variable costs	22,700

III) FIXED COSTS

1. Land revenue	12
2. Depreciation	900
3. Rent on owned land	3,500
4. Interest on fixed capital	450
Total fixed costs	4,862
Total costs	27,562
Gross Margin (T. R. - T.V.C.)	6,100
Profit (T.R.-T.C.)	1,238

2. Partial budget

- ✓ It is used to calculate the expected change in profit for a proposed change in
- ✓ the farm business.
- ✓ Partial budget is best adopted to anlysing relatively small change in the whole farm plan.
- ✓ Changes in the farm plan or organization adopted to analysis by use of **partial budget are of three types.**

1. Enterprise substitution: This includes a complete or partial substitution of one enterprise for another. For example substitution of sunflower for groundnut.

2. Input substitution : Example : Machinery for labour, changing livestock rations, owning a machine instead of hiring, increasing or decreasing fertilizers or chemicals.

3. Size or scale of operation: This includes changing in total size of the farm business or in the size of the single enterprise, buying or renting of additional land , expanding or decreasing an enterprise.

Partial budget format

Proposed change

……………………………………………………………………………

Additional cost (Rs.)	Additional income (Rs.)
Reduced income (Rs.)	Reduced costs (Rs.)
A. Total of additional costs and reduced income_____	B. Total of additional income and reduced Costs_____

Net cha nge in profit (B -A)

a. Additional costs

A proposed change may cause additional costs because of a new or expanded enterprise requiring the purchase of additional inputs.

b. Reduced income

Income may be reduced if the proposed cha nge would eliminate an enterprise, reduce the size of an enterprise or cause a reduction in yield.

c. Additional income

A proposed change may cause an increase in total farm income if a new enterprise is being added, if an enterprise is being expanded or if the change will cause yield levels to increase.

d. Reduced costs

Costs may be reduced if the change results in elimination of an enterprise, or reduction in size of an enterprise or some change in technology which decreases the need for variable resources.

Partial budgeting is intermediate in scope between enterprise budgeting and whole farm planning. A partial budget contains only those income and expense items which will change if the proposed modification in the farm plan is implemented. Only the changes in income are included and not total values. The final result is an estimate of the increase or decrease in profit.

3. Complete Budget or Whole farm budget

It is statement of expected income, expenses, and profit of the firm as a whole.

4. Cash flow budget

It is summary of cash inflows and outflows for a business over a given time period. Its primary purpose is to estimate the future borrowing needs and loan repayment capacity of the farm business.

Lecture no. 18
Linear programming – Meaning – Assumptions – Advantages and limitations

LINEAR PROGRAMMING
- ✓ Linear programming was developed by George B Dantzing (1947) during second world war. It has been widely used to find the optimum resource allocation and enterprise combination.
- ✓ The word linear is used to describe the relationship among two or more variables which are directly proportional.
- ✓ For example , doubling (or tripling) the production of a product will exactly double (or triple) the profit and the required resources, then it is linear relationship.
- ✓ Programming implies planning of activities in a manner that achieves some optimal result with restricted resources.

Definition of L.P.

Linear programming is defined as the optimization (Minimization or maximization) of a linear function subject to specific linear inequalities or equalities.

$$\text{Max } z \sum_{j=1}^{n} c_j x_j$$

St

$$\sum_{j=1}^{n} a_{ij} < b_i \quad i = 1 \text{ to } m$$

$$x_j = 0$$

c_j = Net income from jth activity
x_j = Level of jth activity
a_{ij} = Amount of ith resource required for jth activity
b_i = Amount of ith resource available.

Assumptions of Linear Programming
1. Linearity: It describes the relationship among two or more variables which are directly proportional.
2. Additivity: Total input required is the sum of the resources used by each activity. Total product is sum of the production from each activity.
3. Divisibility: Resources can be used in fractional amounts. Similarly, the output can be produced in fractions.
4. Finiteness of activities and resource restrictions: There is limit to the number of activities and resource constraints.
5. Non negativity: Resources and activities cannot take negative values. That means the level of activities or resources cannot be less than zero.
6. Single value expectations: Resource supplies, input-output coefficients and prices are known with certainty.

Advantages of L.P
1. Allocation problems are solved.
2. Provides possible and practical solutions.
3. Improves the quality of decisions.
4. Highlights the constraints in the production.
5. Helps in optimum use of resources.
6. Provides information on marginal value products (shadow prices).

Limitations
1. Linearity
2. Considers only one objective for optimization.
3. Does not consider the effect of time and uncertainty
4. No guarantee of integer solutions
5. Single valued expectations.

Complete budgeting	Partial budgeting
1. It is adopted when drastic changes in the existing organization are contemplated	1. Adopted when minor changes are introduced on the farm.
2. All the available alternatives are considered	2. Considers few or only two alternatives
3. It is a method of estimating expected	3. It is used to calculate expected change

| income, expenses and profit for the farm as a whole | in profit for a proposed minor modification |

Farm budgeting	Linear programming
1. Method of estimating expected income, expenses and profit for the farm business	1. Optimization of linear function subject to linear inequalities or equalities.
2. Non mathematical tool	2. Mathematical programming mode ls
3. It is a trial and error method	3. It offers a mechanical process of calculations in the selection of products
4. Computation become tedious and Cumbersome.	4. Computations are easy.

Lecture no. 19
Risk and uncertainty in agriculture – nature and sources of risks – Production and technical risks – Price or marketing risk – Financial risk – methods of reducing risk.

RISK AND UNCERTAINTY
Farmers must make decisions on crops to be planted, seeding rates, fertilizer levels and other input levels early in the cropping season. The crop yield obtained as a result of these decisions will not be known with certainty for several months or even several years in the case of perennial crops. Changes in weather, prices and other factors between the time the decision is made and the final outcome is known can make previously good decision very bad.

Because of time lag in agricultural production and our inability to predict the future accurately, there are varying amounts of risk and uncertainty in all farm management decisions. If everything was known with certainty, decision would be relatively easy. However, in the real world more successful manager are the ones with the ability to make the best possible decisions, and courage to make them when surrounded by risk and uncertainty.

Definition of risk and uncertainty

Risk is a situation where all possible outcomes are known for a given management decision and the probability associated with each possible outcome is also known.
Risk refers to variability or outcomes which are measurable in an empirical or quantitative manner. Risk is insurable.

Uncertainty exists when one or both of two situations exist for a management decision. Either all possible outcomes are unknown, the probability of the outcomes is unknown or nether the outcomes nor the probabilities are known. Uncertainty refers to future events where the parameters of probability distribution (mean yield or price, the variance, range or dispersion and the skew and kurtosis) cannot be determined empirically. Uncertainty is not insurable.

Nature and Sources of risk and uncertainty
The most common sources of risk are.
1. Production risk:

- Crop and livestock yields are not with certainty before harvest or final sale weather, diseases, insects, weeds are examples of factors which can't be accurately predicted and cause yield variability.
- Even if the same quantity and quality of inputs are used every year, these and other factors will cause yield variations which cannot be predicted at the time most input decision must be made.
- The yield variations are examples of production risk.
- Input prices have tended to be less variable than output prices but still represent another source of production risk.
- The cost of production per unit of output depends on both costs and yield.
- Therefore , cost of production is highly variable as both input prices and yield vary.

2. Technological risk:
- Another source of production risk is new technology.
- Will the new technology perform as expected?
- Will it actually reduce costs and increase yields?
- These questions must be answered before adopting new technology.

3. Price or marketing risk:
- Variability of output prices is another source of risk.
- Commodity prices vary from year to year and may have substantial seasonal variation within a year.
- Commodity prices change for number of reasons which are beyond the control of individual farmer.

4. Financial risk:
- Financial risk is incurred when money is borrowed to finance the operation of farm business.
- There is some chance that future income will not be sufficient to repay the debt. Changes may take place in the interest rates, scale of finance, and ability of the business to generate income.

METHODS OF REDUCING RISK AND UNCERTAINTY
The various methods which can be used to reduce risk are discussed hereunder.
1. Diversification: Production of two or more commodities on the farm may reduce income variability if all prices and yields are not low or high at the same time.
2. Stable enterprises: Irrigation will provide more stable crop yields than dry land farming. Production risk can be reduced by careful selection of the enterprises with low yield variability. This is particularly important in areas of low rainfall and unstable climate.
3. Crop and livestock insurance: For phenomena, which can be insured, possible magnitude of loss is lessened through converting the chance of large loss into certain cost.
4. Flexibility: Diversification is mainly a method of preventing large losses. Flexibility is a method of preventing the sacrifice of large gains. Flexibility allows for changing plans as time passes, additional information is obtained and ability to predict the future improves.
5. Spreading sales: Instead of selling the entire crop output at one time, farmers prefer to sell part of the output at several times during the year. Spreading sales avoids selling all the crop output at the lowest price of the year but also prevents selling at the highest price.

6. Hedging: It is a technical procedure that involves trading in a commodity futures contracts through a commodity broker.

7. Contract sales: Producers of some specialty crops like gherkins, vegetables often sign a contract with a buyer or processor before planting season. A contract of this type removes the price risk at planting time.

8. Minimum support price: The government purchases the farm commodity from the farmers if the market price falls below the support price.

9. Net worth: It is the net worth of the business that provides the solvency, liquidity and much of the available credit.

Lecture no. 20
Agricultural Production Economics – Definition – Nature – Scope and subject matter of Agricultural Production Economics – Objectives of Production Economics – Basic Production Problems.

AGRICULTURAL PRODUCTION ECONOMICS

Definition: *Agricultural Production Economics is an applied field of science wherein the principles of choice are applied to the use of capital, labour, land and management resources in the farming industry.*

NATURE AND SCOPE OF AGRICULTURAL PRODUCTION ECONOMICS

Agricultural production economics is a field of specialization within the subject of agric- ultural economics. It is concerned with the choice of production patterns and resource use in order to maximize the objective function of farmers, their families, the society or the nation within a framework of limited resources.

Production economics is concerned with two broad categories of decisions in the production process.

1. How to organize resources in order to maximize the production of a single commodity? i.e. Choice making among various alternative ways of using resources.

2. What combination of different commodities to produce?

SUBJECT MATTER OF AGRICULTURAL PRODUCTION ECONOMICS

With a view to optimizing the use of farm resources on an individual farm level and to rationalize the use of resources from a national angle, production economics involves analysis of relationships and principles of rational decisions.

Production Economics is concerned with productivity i.e use and incomes from productive inputs (land, labour, capital and management). As a study of resource productivity, it deals with

a) Resource use efficiency

b) Resource combination

c) Resource allocation

d) Resource management

e) Resource administration

The subject matter of Production Economics includes such topics as methods or techniques of production, combination of enterprises, size of the farm, return to scale, leasing, production

possibilities, farming efficiency, soil conservation, use of credit and capital, risks and uncertainty which effect decision making.

Any agricultural problem that falls under the scope of resource allocation and marginal productivity analysis is the subject matter of the production economics.

The production economist is therefore, concerned with any phenomena which have a bearing on economic efficiency in the use of agricultural resources.

OBJECTIVES OF AGRICULTURAL PRODUCTION ECONOMICS
The main objectives of Agricultural production economics are:

1. To determine and define the conditions which provide for optimum use of resources.
2. To determine the extent to which the existing use of resources deviates from the optimum use.
3. To analyze the factors or forces which are responsible for the existing production pattern and resource use.
4. To explain means and methods for changing existing use of resources to the optimum level.

BASIC PRODUCTION PROBLEMS
1. WHAT TO PRODUCE?
This problem involves selecting the combination of crops and livestock enterprises to be produced. Should the business produce only crops, only livestock or some combination? Which crop or rotations? Which livestock? The farmer must select from among many alternatives that combination which will maximize profits.

2. HOW TO PRODUCE?
Many agricultural products can be produced in a number of ways. Crops can be produced with more capital and less labour (capital intensive technology) or more labour and less capital (labour intensive technology). A manager must select the appropriate combination of inputs which will minimize the cost of producing a given quantity of some commodity.

3. HOW MUCH TO PRODUCE?
The level of production and profit will be determined by the input levels selected. A manager is faced with the problems of how much fertilizer and irrigation water to use, seed rates, feeding levels, labour and machinery use etc.

4. WHEN TO BUY AND SELL?
The seasonality of supply conditions in factor and product market results in variations in the prices. The manager must consider these things in determining when to sell or buy.

5. WHERE TO BUY AND SELL?
Farmers generally purchase a number of inputs for a production. Attempt is always to purchase at the least cost. The producer must decide whether to sell in the village market or in the regulated market or other alternative market.

Lecture no. 21
Law of returns - Law of increasing returns – Law of constant returns – Law of decreasing returns

LAWS OF RETURNS
Production is the result of cooperative working of various factors of production viz . land, labour, capital and management. The laws of returns operate on account of variability in the proportion in which the various factors can be combined for the purpose of production.

In the production of a commodity where one input is varied, keeping all inputs fixed, the nature of relationship between single variable input and output can be either of the one or a combination of the following:

1. Law of increasing returns
2. Law of constant returns
3. Law of decreasing returns

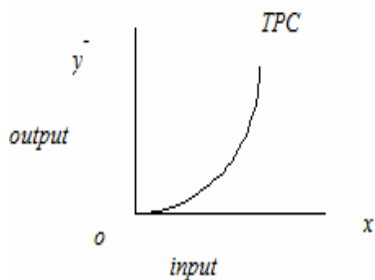## LAW OF INCREASING RETURNS (Increasing Marginal Productivity)

Each successive unit of variable input when applied to the fixed factor adds more and more to the total product than the previous unit . The marginal physical product is increasing and hence known as law of increasing returns.

Increasing returns means lower costs per unit of output. Thus the law of increasing returns signifies that cost per unit of additional product falls as more and more output is produced.

Hence law of increasing returns also called law of decreasing costs.

Input(X)	Output(Y)	? X	? Y	? Y/?X=MPP
1	2	1	2	2/1=2
2	6	1	4	4/1=4
3	12	1	6	6/1=6
4	20	1	8	8/1=8
5	30	1	10	10/1=10

As shown in the above table, the first unit of variable input adds 2 units, while the second add 4 units to the total output, the third add 6 units and so on

When production function is graphed with output on vertical axis and input on horizontal axis, the resulting curve is convex to the origin.

Algebraically increasing returns is expressed as
? 1Y/? 1X < ? 2Y/? 2X < ....< ? nY/? nX

LAW OF CONSTANT RETURNS (Constant Marginal Productivity)

Each additional unit of variable input when applied to the fixed factors produces an equal amount of additional product. The amount of product (TPP) increases by the same magnitude for each additional unit of input. The marginal physical product remains the same for each additional unit of input and hence it is called law of constant marginal productivity.

Regardless of the scale of production, the cost of additional unit of product remains the same and hence it is also called law of constant costs.

Linear production function or constant returns is not a common relationship in agriculture.

Input(X)	Output(Y)	? X	? Y	? Y/?X=MPP
1	10	1	10	10/1=10
2	20	1	10	10/1=10
3	30	1	10	10/1=10
4	40	1	10	10/1=10
5	50	1	10	10/1=10

As shown in the table, each unit of input adds 10 units. The shape of the total product curve is linear. Linear production indicates constant returns.
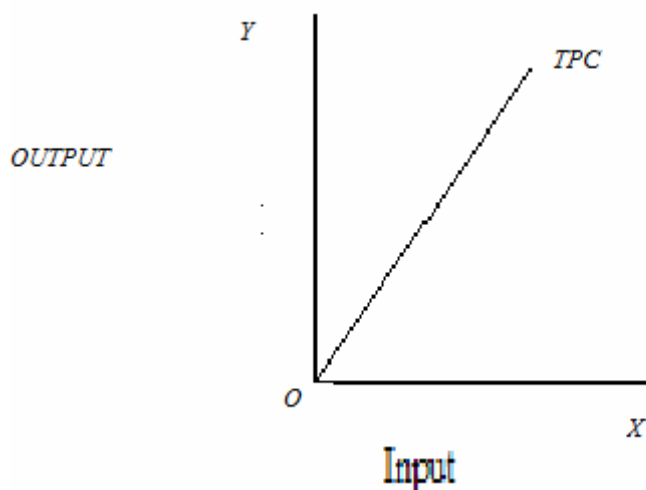
Algebraically constant returns is expressed as
? 1Y/? 1X = ? 2Y/? 2X = ...= ? nY/? nX

LAW OF DECREASING RETURNS (Decreasing Marginal Productivity)
Each additional unit of variable input when applied to the fixed factors adds less and less to the total product than the previous unit.
The marginal physical product is declining , hence the name law of decreasing returns.

Input X	Input Y	? X	? Y	? Y/?X=MPP
1	25	1	25	25/1=25
2	45	1	20	20/1=20
3	60	1	15	15/1=15
4	70	1	10	10/1=10
5	75	1	5	5/1=5

As shown in the table, the first unit of input adds 25 units, the second adds 20 units and the third adds 15 units and so on.

The production function which exhibits diminishing returns is concave to the origin. Law of diminishing returns is very common in agriculture.
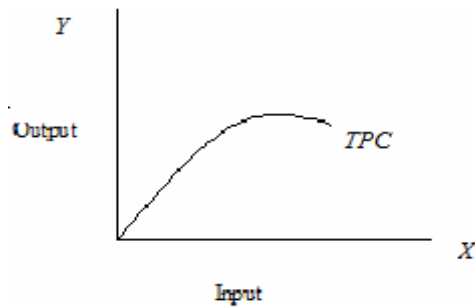
The cost of each additional unit of output increases as we produce more and more output and hence it is called Law of increasing costs.

Algebraically, it can be expressed as

? 1Y/? 1X > ? 2Y/? 2X > ....> ? nY/? nX

Lecture no. 22
Factor- product relationship – production function and its types – Elasticity of production - Three stages of production function

BASIC PRODUCTION RELATIONSHIPS
Production of farm commodities involves numerous relationships between resources and products. Some of these relationships are simple, others are complex. Knowledge of these relationships is essential as they provide the tools by means of which the problems of production or resource use can be analyzed.

Major production relationships are:
1. Factor -Product relationship
2. Factor -Factor relationship
3. Product-Product relationship

FACTOR-PRODUCT RELATIONSHIP
1. It deals with the production efficiency of resources.
2. The rate at which the factors are transformed in to products is the study of this relationship.
3. Optimization of production is the goal of this relationship.
4. This relationship is known as input-output relationship by farm management specialists and fertilizer responsive curve by agronomists.
5. Factor -Product relationship guides the producer in making the decision _how much to produce?'
6. This relationship helps the producer in the determination of optimum input to use and optimum output to produce.
7. Price ratio is the choice indicator.
8. This relationship is explained by the law of diminishing returns.
9. Algebraically, this relationship can be expressed as

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

Elasticity of Production (Ep):

It is a measure of responsiveness of output to changes in input. The elasticity of production refers to the proportionate change in output as compared to proportionate change in input.

Ep = Percentage change in output/Percentage change in input.

Ep = ((change in output / initial output)*100) / ((change in input / initial input)*100)

i.e., $((? Y/Y)*100)/((? X/X)*100)$

$= (? Y/Y) / (? X/X) = (? Y/Y)*(X/? X) = (? Y/? X) * (X/Y)$

By rearranging we have,

$(? Y/?X) * (X/Y) = (?Y/? X)/(Y/X) = MPP/APP$

The elasticity of production is the ratio of Marginal Physical Product to Average Physical Product.

Ep = 1 ,Constant Returns. Ep is one at MPP = APP (At the end of I stage)

Ep > 1 , Increasing Returns (I Stage of Production)

Ep < 1 , Diminishing returns (II Stage of Production)

Ep = 0 , When MPP is zero or TPP is Maximum (At the end of II stage)

Ep < 0, Negative Returns (III Stage of Production)

THREE STAGES OF PRODUCTION FUNCTION

The production function showing total, average and marginal product can be divided into three regions, stages or zones in such a manner that one can locate the zone of production function in which the production decisions are rational.

First Stage or I Region or Zone 1:

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

- This zone ends at the point where MPP=APP or where APP is Maximum.

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

Third Stage or III Region or Zone III:
- This zone starts from where the technical efficiency of fixed resource is maximum (TPP is Max).
- Average Physical Product is declining but remains positive.
- Marginal Physical Product becomes negative.
- The Total Physical Product declines at faster rate since MPP is negative.
- Elasticity of production is less than zero (Ep < 0)
- In this zone variable resource is in excess capacity.
- The technical efficiency of variable resource is decreasing as reflected by declining APP.
- The technical efficiency of fixed resource is also decreasing as indicated by declining TPP.
- Marginal Value Product is less than Marginal Factor Cost (MVP < MFC)
- Marginal Revenue is less than Marginal Cost (MR < MC)
- This zone is irrational or supra-optimal zone.
- Producer should never operate in this zone even if the resources are available at free of cost.

Lecture no. 23
Factor-factor relationship – Isoquant and their characteristics – MRTS – Types of factor substitution.

Factor-Factor Relationship
1. This relationship deals with the resource combination and resource substitution.
2. Cost minimization is the goal of factor -factor relationship.

3. Under factor-factor relationship, output is kept constant, input is varied in quantity.
4. This relationship guides the producer in deciding _How to produce'.
5. This relationship is explained by the principle of factor substitution or principle of substitution between inputs.
6. Factor-Factor relationship is concerned with the determination of least cost combination of resources.
7. The choice indicators are substitution ratio and price ratio.
8. Algebraically, it is expressed as

$$Y = f(X_1 \ X_2 \ / \ X_3 \ X_4 \ ….. \ X_n)$$

In the production, inputs are substitutable. Capital can be substituted for labour and vice versa, grain can be substituted for fodder and vice versa. The producer has to choose that input or inputs, practice or practices which produce a given output with minimum cost. The producer aims at cost minimization i.e., choice of inputs and their combinations.

Isoquants:

The relationship between two factors and output can't be presented with two dimensional graph. This involves three variables and can be presented in three dimensional diagram giving a production surface.

An isoquant is a convenient method for compressing three dimensional picture of production into two dimensions.

Definition :

"An isoquant represents all possible combinations of two resources (X1 and X2) physically capable of producing the same quantity of output".

Isoquants are also known as isoproduct curves or equal product curves or product indifference curves.
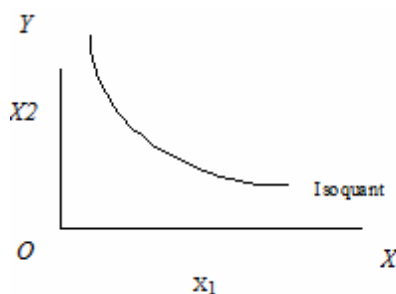
Isoquant Map or Iso product Contour
If number of isoquants are drawn on one graph, it is known as isoquant map. Isoquant map indicates the shape of production surface which in turn indicates the output response to the inputs.
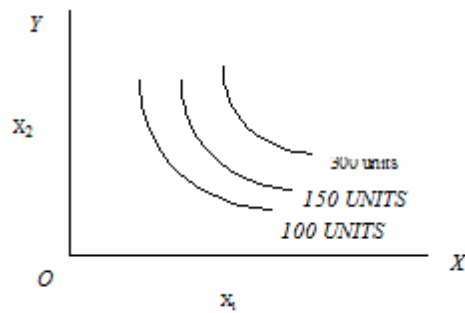
Characteristics of Isoquants
1. Slope downwards from left to right or negatively sloped.
2. Convex to the origin.
3. Nonintersecting
4. Isoquants lying above and to the right of another represents higher level of output.
5. The slope of isoquant denotes the marginal rate of technical substitution (MRTS).

Marginal Rate of Technical Substitution (MRTS)
It refers to the amount by which one resource is reduced as another resource is increased by one unit.

Or

The rate of exchange between some units of X1 and X2 which are equally preferred.

$$MRTSX1X2 = ? X2/? X1$$

$$MRTSX2X1 = ? X1/ ? X2$$

Marginal Rate of Technical Substitution = $\dfrac{\text{प्रतिस्थापन की जाने वाली उत्पादन संसाधन}}{\text{प्रयोजन की जाने की जाने संसाधन}}$

The slope of Isoquant indicates MRTS.

Substitutes: A range of input combinations which will produce a given level of output. When one factor is reduced in quantity, a second factor must always be increased MRTS is always less than zero.

Perfect Substitutes: When two resources are completely interchangeable, they are called perfect substitutes.
The isoquants for perfect substitutes is negatively sloped straight lines.
The MRTS is constant.
Ex: Family labour and hired labour, Farm produced and purchased seed etc,

Complements: Two resources which are used together are called complements.
In the case of complements reduction in one factor can not be replaced by an increase in another factor.
MRTS is zero .

Perfect Complements: Two resources which are used together in fixed proportion are called perfect complements. It means that only one exact combination of inputs will produce a particular level of output. The isoquant in this case is of a right angle.
Ex: Tractor and driver, Pair of bullocks and labourer

Types of factor substitution
The shape of isoquant and production surface will depend up on the manner in which

the variable inputs are combined to produce a particular level of output. There can be three such categories of input combinations. They are:

1. Fixed Proportion combination of inputs

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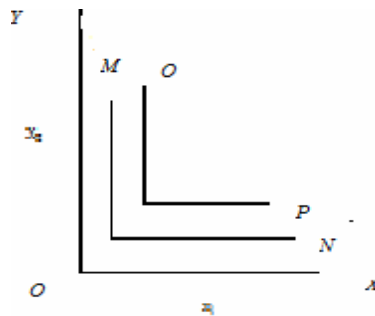
2. Constant rate of Substitution:

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

X1	X2	?X1	?X2	MRTS$_{X1X2}$ = ? X$_2$/? X$_1$
O	50	-	-	-
5	40	5	10	10/5=2
10	30	5	10	10/5=2
15	20	5	10	10/5=2
20	10	5	10	10/5=2
25	0	5	10	10/5=2

The above table shows that the six combinations of resources X2 and X2 can be used in producing a given level of output. As X1 input is increased from 0 to 5 units ,10 units of X2 are replaced. Similarly addition of another 5 units of X1 replaces another 10 units. The MRS of X1 for X2 is 2. That means if we want to obtain one unit of X1, we have to forego 2 units of X2. Ex:, family labour and hired labour,

When inputs substitute at constant rate, it is economical to use only one resource, and which one to use depends up on relative prices.

Algebraically, constant rate of factor substitution is expressed as

$\Delta_1 X_2 / \Delta_1 X_1 = \Delta_2 X_2 / \Delta_2 X_1 = \ldots\ldots = \Delta_n X_2 / \Delta_n X_1$
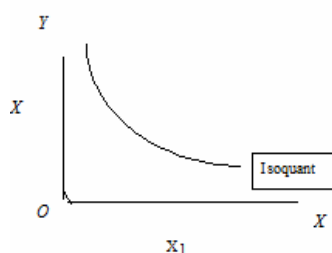
3. Decreasing Rate of substitution:

Every subsequent increase in the use of one factor replaces less and less of other factor. In other words, each one unit increase in one factor requires smaller and smaller sacrifice in another factor.

Ex: Capital and labour, concentrates and green fodder, organic and inorganic fertilizers etc.

X1	X2	?X1	?X2	MRTS$_{X1X2}$ = ? X$_2$/? X$_1$
1	18	--	--	--
2	13	1	5	5/1=5
3	9	1	4	4/1=4
4	6	1	3	3/1=3
5	4	1	2	2/1=2

The MRS of X1 for X2 becomes smaller and smaller as X1 replaces X2.

Isoquants are convex to the origin when inputs substitute at decreasing rate.

Algebraically, decreasing rate of substitution is expressed as

? 1X2/? 1X1 > ? 2X2/? 2X1 > ……. > ? nX2/? nX1

Decreasing rate of factor subs titution is more common in agricultural production.

Lecture no. 24
Iso-cost lines – Characteristics – Methods of determining Least cost Combination of resources – Expansion path – Isoclines – Ridge lines
Iso-cost Line (price line, budget line, iso outlay line, factor cost line)

Isocost line defines all possible combinations of two resources (X1 and X2) which can be purchased with a given outlay of funds.
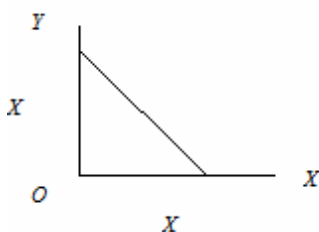
Characteristics of Iso-cost line:

1. As the total outlay increases, the isocost line moves farther away from the origin.
2. Isocost line is a straight line because input prices do not change with the quantity purchased.
3. The slope of isocost line indicates the ratio of factor prices.

Least Cost Combination of inputs

There are innumerable possible combinations of factors which can be used to produce a particular level of output. The problem is to find out a combination of inputs which should cost the least, a cost minimization problem. There are three methods to find out the least cost combination of inputs. They are:

1. Simple Arithmetical calculations:

One possible way to determine the least cost combination is to compute the cost of all possible combinations of inputs and then select one combination with minimum cost.
This method is suitable where only a few combinations produce a particular level of output.

X1	X2	X1@Rs.3	X2@rs.2	Total cost
10	3	30	6	36
7	4	21	8	29
5	6	15	12	27
3	8	9	16	25
2	12	6	24	30

The above table shows five combinations of inputs which can produce a given level of output. The price per unit of X1 is Rs.3/ - and of X2 is Rs.2/-. The total cost of each combination of inputs is computed. Out of five combination, 3 units of X1 and 8 units of X2 is the least cost combination of inputs i.e., Rs.25/-

2. Algebraic method:

a) Compute Marginal Rate of technical substitution
MRS = Number of units of replaced resource / Number of units of added resource
MRS X1X2= ? X2/?X1
MRSX2X1 = ? X1/?X2
b) Compute Price Ratio (PR)
PR=Price per unit of added resource/Price per unit of replaced resource
PR=PX1/PX2 if MRSX1X2
Or
PR= PX2/ PX1 if MRSX2X1

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c) Workout least cost combination by equating MRS and PR
i.e., ?X2/?X1= P X1/PX2 MRSX1X2
? X1/?X2= PX2/ PX1 MRSX2X1
The same can be expressed as
? X2. PX2= PX1.?X1
Or
? X1.PX1 =? X2. PX2
The least cost combination is obtained when Marginal Rate of substitution is equal to Price Ratio.

3. Graphical Method:

Since the slope of isoquant indicates MRTS and the slope of isocost line indicates factor price ratio, minimum cost for given output will be indicated by the tangency of these isoclines. For this purpose, isocost line and isoquant are drawn on the same graph for different levels of production. The least cost combination will be at the point where isocost line is tangent to the isoquant i.e., slope of isoquant=slope of isocost line i.e., MRS=PR
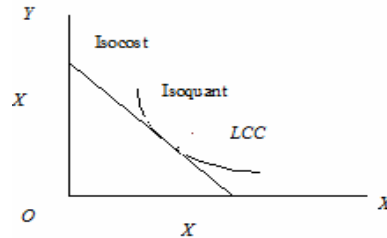
Expansion Path : Of many isoclines, the isocline which is considered to be the most appropriate over a production period is known as expansion path or scale line. At any particular time, only one expansion path is possible

Iso-cline

There can be number of possible output levels as shown in the figure and the least cost combination can be found out for these various output levels. A line or curve connecting the least cost combination of inputs for all output levels is called isocline.
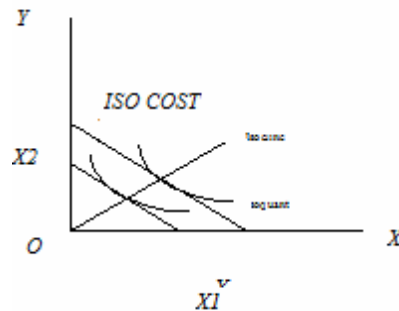
The isocline passes through all the isoquants at points where they have the same slope. Isoclines can be drawn at different sets of price ratio. All isoclines of course converge at the point of maximum output. Though all the points on isoclines represent least cost combination, only one point represents the maximum profit output.

Ridge lines or Border or Boundary lines

Ridge lines represent the points of maximum output from each input, given a fixed amount of another input. Also they represent limits of substitution. Ridge lines reflect the limits of economic relevance, the boundaries beyond which isoquant map ceases to have economic meaning. The portions of isoquants which lie between the lines are suited for economic production (Where MPP of both inputs are positive but decreasing and isoquants are negatively sloped). Portions of is oquants outside the ridge lines are not suitable for production in economic terms (outside the ridge lines, MPP of both factors are negative and methods of production are inefficient).
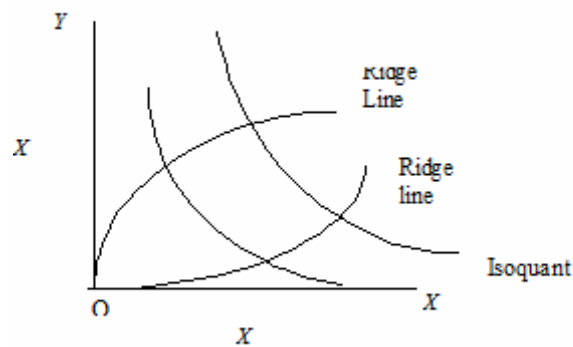
Lecture no. 25
Product-product relationship – Production possibility curve – Marginal rate of product substitution – Types of enterprise relationships – Joint products – Complementary – Supplementary – Competitive and Antagonistic products.

Product-Product Relationship
* Product-Product relationship deals wit h resource allocation among competing enterprises.
* The goal of Product-Product relationship is profit maximization.
* Under Product-Product relationship, inputs are kept constant while products (outputs) are varied.
* This relationship guides the producer in deciding ‗What to produce'
* This relationship is explained by the principle of product substitution and law of equi marginal returns.
* This relationship is concerned with the determination of optimum combination of products (enterprises).
* The choice indicators are substitution ratio and price ratio.
* Algebraically it is expressed as
    Y1=f (Y2 Y3, ……. Yn)

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

Marginal rate of product substitution

The term marginal rate of product substitution has the same meaning under the product-product relationship as under the factor-factor relationship.

Marginal rate of the product substitution refers to the absolute change in one product associated with a change of one unit in competing product.

The quantity of one product to be sacrificed so as to gain another product by one unit is called MRPS.

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

$MRPS_{Y1Y2} = \Delta Y2 / \Delta Y1$

$MRPS_{Y2Y1} = \Delta Y1 / \Delta Y2$

Types of Product-Product Relationships or Enterprise Relationship

Farm commodities bear several physical relationships to one another. These basic product relationships can be

1) **Joint Products:** These are produced through single production process. As a rule the two are combined products. Production of one (main product) without the other (by-product) is not possible. The level of production of one decides the level of production of another. All farm commodities are mostly joint products.
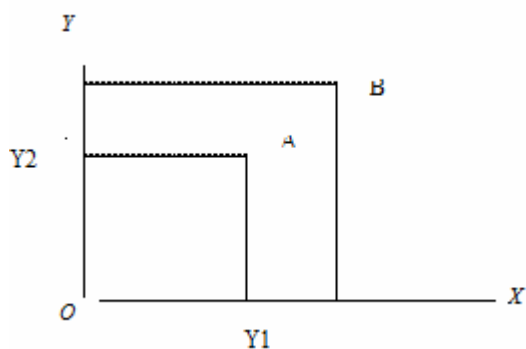
Ex: Wheat and Straw, paddy and straw, groundnut and hulms , cotton seed and lint, cattle and manure, butter and buttermilk, beef and hides, mutton and wool etc.

Graphically the quantities of Y1 and Y2 that can be produced at different levels of resources will be shown as points AB in the figure.

2) **Complementary enterprises:** Complementarity between two enterprises exists when with a change in the level of production of one, the other also changes in the same direction. That is when increase in output of one product, with resources held constant, also results in an increase in the output of the other product. The two enterprises do not compete for resources but contribute to the mutual production by providing an element of production required by each other. The marginal rate of product substitution is positive (> 0). Ex: Cereals and pulses, crops and livestock enterprises.
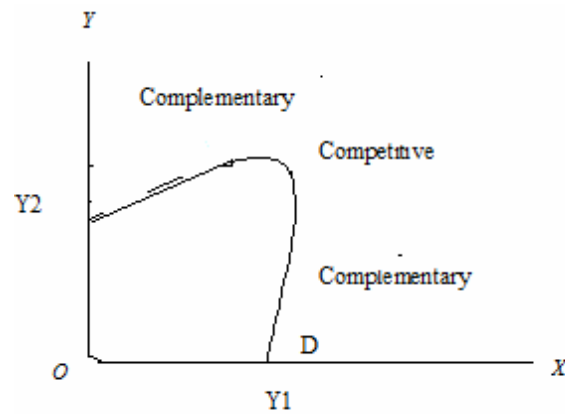
As shown in the figure, range of complementarities is from point A to point B when production of Y1 expands beyond zero level. On the other end of the curve, the products again are complementary as production of Y2 expands beyond zero. This means Y1 must be produced up to B and Y2 up to point C , up to these points increase in one product increases the production of other.

All complementary relationships should be taken advantage by producing both products up to the point where the products become competitive.

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

For example- small poultry or dairy or piggery enterprise is supplementary on the farm.

All supplementary relationships should be taken advantage by producing both products up to the point where the products become competitive.

Production of Y1 can be increased without affecting the production of Y2 in the range AB.

From C to D, production of Y2 ca n be increased without affecting the production of Y1.

4) Competitive enterprises: This relationship exists when increase or decrease in the production of one product affect the production of other product inversely. That is when increase in output of one product , with resources held constant, results in the decrease of output of other product.Competitive enterprises compete for the same resources. Two enterprises are competitive in the use of given resources if output of one can be increased only through sacrifice in the production of another. The marginal rate of product substitution is negative (<0)
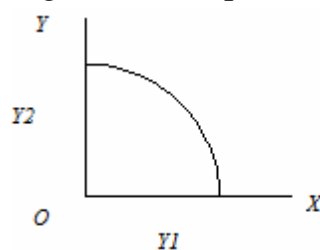
5) Antagonistic products: Two products may be detrimental to each other because of disease or similar factors. When this is true ,only one of the products should be produced. **Eg**: Aqua culture and paddy cultivation.

Lecture no. 26
Iso-revenue line and characteristics – Methods of determining optimum combination of products – Expansion path – Ridge lines

IsoRevenue Line
It represents all possible combination of two products which would yield an equal (same) revenue or income.

Characteristics:
1) Isorevenue line is a straight line because product prices do not change with quantity sold.
2) As the total revenue increases, the isorevenue line moves away from the origin since the total revenue determines the distance of it from the origin.
3) The slope indicates ratio of product (output) prices. As long as product prices remaining constant, the isorevenue line show ing different total revenues are parallel.
But change in either price will change the slope.

Determination of optimum combination of products:
1) Algebraic Method:
There are three steps to determine the optimum product combination through algebraic method.
      a) Compute Marginal Rate of Product Substitution
        MRPS =Number of units of replaced products/Number of units of added product
   MRPSY1Y2 = ? Y2/? Y1
   MRPSY2Y1 = ? Y1/? Y2
     b) Workout price ratio (PR)
     Price Ratio (PR) = Price per unit of added product/Price per unit of replaced
product
PR= P y1/Py2 if it is MRSY1Y2
Py2/ Py1 if it is MRSY2Y1
     c) Optimum combination of enterprises is at where MRS=PR

$$\frac{\text{Number of units replaced product}}{\text{Number of units of added product}} = \frac{\text{Price per units of added product}}{\text{Price per units of replaced product}}$$
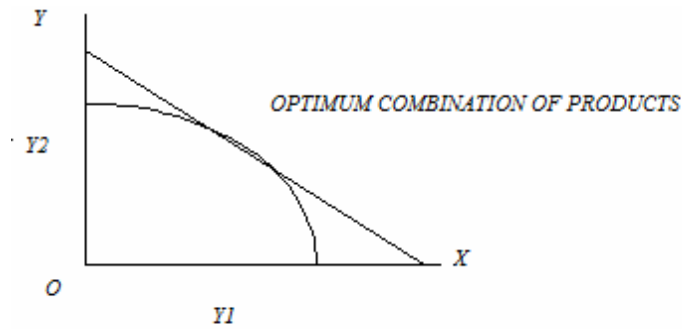
? Y2/?Y1= Py1/Py2
Or
? Y1/?Y2 = Py2/ Py1

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

OPTIMUM COMBINATION OF PRODUCTS

Draw production possibility curve and isorevenue line on one graph. Slope of production possibility curve indicates MRPS and the slope of isorevenue line indicates price ratio of products. The point of optimum combination of products is at where the isorevenue line is tangent to the production possibility curve. At this point, slope of the isorevenue line and the slope of the production possibility curve will be the same. In other words, the MRPS=PR.

3) Tabular Method:

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

Y1	Y2	Py1@Rs.50	Py2@Rs.80	Total revenue
8	2	400	160	560
5	3	350	240	490
6	4	300	320	620
4	5	200	400	600
3	7	150	560	710

3 units of Y1 and 7 units of Y2 yield maximum revenue

## Expansion path in Product-Product relationship

Several isorevenue lines are shown each indicating a different level of revenue. Prices are assumed constant and hence the slope of isorevenue lines remains the same.
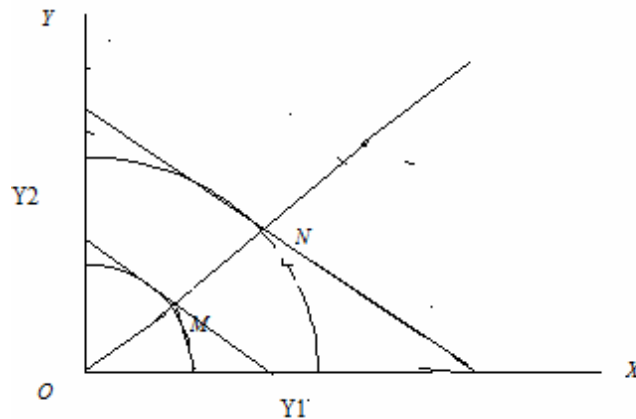
All the isorevenue lines are tangent to the production possibility curve at different points m,and n. The line connecting the points of optimum combination of the products is called expansion path. The points of tangency specify the most profitable enterprise combination for different possibility cur ves with the prices indicated by isorevenue line.

Ridge lines or border lines

Line OA intersects the each production possibility curve where the production possibility curve is horizontal. Line OB intersects each production possibility curve where it is vertical. The portions of production possibility curve falling within the ridge lines have negative slope indicating competition (MRS< 0). Portions of production possibility curve outside ridge line have positive slope indicating Complementarity (MRS> 0). On the ridge lines MRS is zero. Therefore ridge lines are used to separate ranges of product competition from ranges of product complementarity.
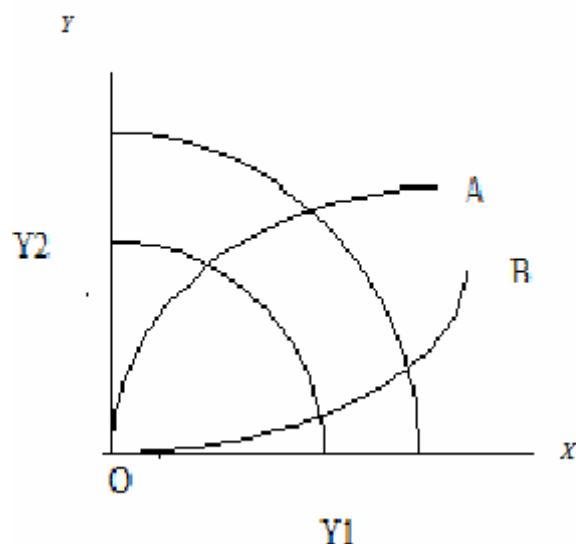
Lecture no. 27 Resource productivity – Returns to scale

RETURNS TO SCALE
By returns to scale, it is meant the behaviour of production when all factors (inputs) are increased or decreased simultaneously in the same proportion.
Scale relationship refers to simultaneous change in all the resources in the same proportion. In other words, in returns to scale, we analyze the effect of doubling, trebling and so on of all inputs on the output.
In returns to scale, all the necessary factors of production are increased or decreased to the same extent so that what ever the scale of production, the proportion among the inputs remain the same.
When all inputs are increased, in unchanged proportions, the scale of production is expanded, the effect on output shows three stages:
Firstly, returns to scale increase because the increase in total output is more than proportional to increase in all inputs.
Secondly, returns to scale become constant as the increase in total product is an exact proportion to the increase in inputs.
Lastly, returns to scale diminish because the increase in output is less than proportionate to increase in inputs.
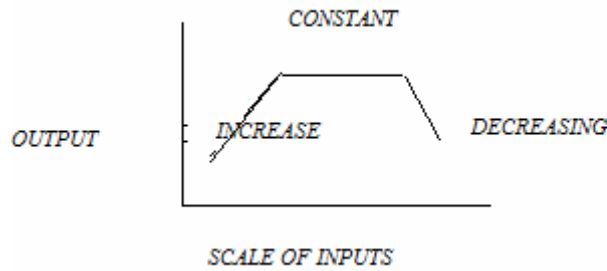
SCALE OF INPUTS

Returns to scale -Example

SNO	Scale of inputs	Total Physical Product in Quintals	Marginal Physical Product in Quintals	Remarks
1	1 Worker+3 acres	2	2	Increasing Returns
2	2 Workers+6 acres	5	3	
3	3 Workers+9 acres	9	4	
4	4 Workers+12 acres	14	5	
5	5 Workers+15 acres	19	5	Constant Returns
6	6 Workers+18 acres	24	5	
7	7 Workers+21 acres	28	4	Decreasing Returns
8	8 Workers+24 acres	31	3	
9	9 Workers+27 acres	33	2	

In the above example, we see that when we employ one worker on three acres of land, the total product is 2 quintals. Now to increase the output, we double the scale, but the total product increases to more than double (5 quintals instead of 4 quintals). When the scale is trebled, the total product increases from 5 quintals to 9 quintals- the increase this time being 4 quintals as against 3 quintals. In other words, returns to scale have been increasing. If the scale of production is further increased, the Marginal Physical Product remains constant up to certain point and beyond it starts diminishing.

Returns to scale are more theoretical interest than being relevant to actual practice. In practice, it is the law of variable proportions which has universal applications.

Returns to scale can also be explained by using the knowledge of scale line and that of isoquant map. In the case of constant returns to scale , the distance between successive isoquants is constant i.e., AB = BC = CD (Fig-A). The distance goes on widening between the successive isoquants and diminishing returns operate i.e., AB<BC< CD (Fig B). Finally, in the case of increasing returns to scale, the distance between the successive isoquants becomes smaller and smaller as we move away from the origin on the isoquant map i.e., AB> BC> CD .(Fig -C)

Returns to scale is frequently measured by fitting the least square Cobb- Douglas production function and then adding the exponents which are production elasticities of the inputs.

$$Y = a \, x_1^{b1} \, x_2^{b2} \, x_3^{b3} \ldots\ldots\ldots Xn^{bn}$$

Where Y= Total output

X1, X2, X3 …… Xn: variable inputs

b1, b2, b3 .... bn: elasticity coefficients

Returns to scale from this production function are given by the summation of individual

elasticities of coefficients.

Returns to scale: ? bi where i=1 to n

n

? bi < 1 Decreasing returns to scale

i=1

n

? bi = 1 Constant returns to scale

i=1

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n

? bi > 1 increasing returns to scale

i=1

Differences between Law of variable Proportion and Returns to scale

Law of Variable Proportion	Returns to Scale
Describes the response in output when a single input is varied	Examines the response in output when all inputs are varied in equal proportions
At least one factor is kept constant or fixed	All factors are varied
Factors are combined in different proportions	Proportion among factors remains the same
Short run production function	Long run production function
Y=f(X1 | X2, X3 ....Xn)	Y=f (X1,X2,X3,…..Xn)
Output exhibits three stages: increasing, constant, diminishing	Output exhibits three stages: increasing, constant and diminishing returns to scale.
Increasing returns are due to better use of fixed factors	Increasing returns are due to the appeara nce of internal economics
Maximum output is due to the best proportion between fixed and variable factors	Maximum output is due to the optimum size of production.
Diminishing returns are due to inefficiency arising out of over utilization of fixed	Diminishing returns to scale are due to internal dis economies of scale

| factors beyond the optimum point. | |

Lecture no. 28
Resource economics – Definition, subject matter and scope - Differences between NRE and agricultural economics

ECONOMIC RESOURCES
Economic resources are the factors used in producing goods or providing services. **Economic resources** can be divided into **human resources**, such as **labor** and **management**, and **nonhuman resources**, such as **land, capital goods, financial resources, and technology.**

Subject Matter Of Resources Economics
- As such it deals with resource allocation, resource combinations, resource use efficiency, resource management and resource administration.
- Natural resource economics deals with the supply, demand and allocation of the earth natural resource.
- Main objective of natural resource economics is to better understand the role of natural resources in the economy in order to develop more sustainable methods of managing those resources to ensure their availability to future generations.
- Resource economists study interactions between economic and natural systems, with the goal of developing a sustainable and efficient economy. It is a multi - disciplinary field of academic research.

Lecture no. 29
Natural resources classification and characteristics–Resource depletion and causes for the same.

Definition
   "Natural resources are resources that exist without the actions of humankind".

Characteristics
- This includes all valued characteristics such as magnetic, gravitational, and electrical properties and forces.
- On earth we include sunlight, atmosphere, water, land, air (includes all minerals) along with all vegetation and animal life that naturally subsists upon or within the heretofore identified characteristics and substances.‖

Classification of Natural Resources
   1. **Renewable and Non-renewable Natural Resources**
a. Renewable natural resources
- Renewable resources are the ones that are consistently available regardless of their use. They can be fairly recovered or replaced after utilization.

- Examples include vegetation, water, and air. Animals can also be categorized as renewable resources because they can be reared and bred to reproduce offspring to substitute the older animals.
- As much as these resources are renewable, it may take tens to hundreds of years to replace them.
- The renewable raw materials that come from living things namely animals and trees are termed as organic renewable resources while those that come from non-living things such as sun, water and wind are termed as inorganic renewable resources.

b. Non-renewable natural resources
- Non-renewable resources are the ones that cannot simply be substituted or recovered once they have been utilized or destroyed.
- Examples of such natural resources include fossil fuels and minerals.
- Minerals are categorized as non-renewable because, even though they take shape naturally through the rock cycle, their formation periods take thousands of years.
- Some animals mostly the endangered species are similarly regarded as non-renewable because they are at the verge of extinction.
- It brings about the many reasons the endangered species have to be protected by all means.
- The non-renewable materials that come from living things such as fossil fuels are known as organic non-renewable resources while those that come from non-living things such as rocks and soil are referred to as inorganic non-renewable resources.

2. Biotic and Abiotic Natural Resources
a. Biotic natural resources
- The Biotic natural resources are the ones that come from the ecosphere (organic and living materials).
- These include resources such as animals, forests (vegetation), and other materials obtainable from them.
- Fossil fuels such as petroleum, oil, and coal are also included in this grouping because they are generated from decayed organic matter.

b. Abiotic natural resources
- The abiotic natural resources are the ones that come from non-organic and non-living materials.
- Examples of abiotic natural resources are water, land, air and heavy metals like iron, copper, silver, gold, and so on.

3. Stock Natural Resources
- Stock natural resources are those that are present in the environment but t the necessary expertise or technology to have them exploited. Hydrogen is an example of a stock natural resource.

Causes The Depletion Of Our Natural Resources?
1. Overpopulation Which Brings About Over-exploitation
- As the human population keeps on enlarging, there is a lot of pressure on the utilization of almost all natural resources.
- This often causes over-exploitation of the natural resources.

- To worsen matters, exhaustible natural resources such as arable land, coral reefs, fresh water, fossil fuels, and wilderness forests drop sharply due to over-exploitation to sustain the ever increasing population.
- This creates competitive demands on the vital life-sustaining resources and contributes to an incredible decline in the quality of life.
- According to a study by the UNEP Global Environment Outlook, excessive human consumption of the naturally occurring non-renewable resources can outstrip available resources in the near future and remarkably depletes them for future generations. Overpopulation typically heightens the demands of natural resources such as food, timber, fish, clothes, leather, natural gas, electrical equipment and so on.

2. Intensive Agricultural and Farming Practices

- Intensive agricultural practices have claimed much space of the natural resources because farmers resort to converting forests and grasslands to croplands.
- In the modern world, the pressure to convert lands into resource areas for producing priced foods, crops, and livestock rearing has increasingly led to the depreciation of natural resources especially forests, wild life and fertile lands.
- Runoff of agricultural waste, fertilizers, and pesticides into marine and freshwater environments has also negatively threatened various natural crop species, natural water resources and aquatic life.

3. Climate Change and Global Warming

- The severe changes in climate patterns as a result of human activities and overpopulation that generate greenhouse gases and carbon footprint in the atmosphere threatens biodiversity as well as other numerous natural resources.
- Species that have acclimatized to specific environments are highly affected as the climate change and global warming alters the favorable survival conditions.
- The profound effect of climate change and global warming is habitat loss to an extent of threatening biodiversity and the survival of species.
- For instance, wildlife that requires cool temperatures of high elevations such as the rock rabbit and mountain gorillas may in the near future run out of habitat due to global warming.

4. Environmental Pollution

- The majority of natural resources have been destroyed and a large portion is under immense threat due to the toxic substances and chemicals emitted from industries, homemade utilities, and agricultural products among other processed materials.
- Land, air, and water pollution pose long-term cumulative impacts on the natural resources and the quality of the environments in which they occur.
- Seriously polluted natural resources have become obsolete in value because pollution makes it harsh for the sustainably of biotic and abiotic components.
- Pollution impacts the chemical compositions of lands, soil, ocean water, underground water and rocks, and other natural processes.
- A good example is an acidic lake which cannot support aquatic life forms.

5. Land Use and Development

- The conversion of lands into urban settings, housing development projects, office spaces, shopping malls, industrial sites, parking areas, road networks, and so on takes away the naturally occurring land that <u>provided habitat</u> for wildlife and other living organisms.
- This practice has substantially led to the loss and destruction of millions of acre of natural habitable environments.

6. The 20th Century Lifestyle

- Human lifestyle in the 20th century tremendously threatens the sustainability of natural resources.
- In this era, humans demand more comfortable living in terms of education, entertainment, recreation, transport, clothing, and shelter which will demand use of more resources and more production.
- Accordingly, it simply means more industrial processes which will definitely demand more energy, more natural resources and more raw materials.
- The solution is adopting a sustainable lifestyle.
7. **Overconsumption and waste. ...**
8. **Deforestation and the Destruction of Ecosystems leading to loss of biodiversity.**
9. **Mining of Minerals and Oil.**
10. **Technological and Industrial Development.**
11. **Erosion.**
12. **Pollution and Contamination of resources**.

Lecture no. 30 Positive and negative externalities in agriculture.

Positive externalities	Negative externalities
Cultural	
The landscape itself (good/goods) Enhanced cultural landscape, geographical identity Sense of place, heritage, leisure, recreational and tourism.	Impoverished landscape Damaged geographical identity Devastated heritage.
Environmental	
Viable ecosystems Biodiversity and its preservation Water quality and water availability Soil quality, air quality Climate stability Resilience to fire, resilience to flooding.	Damage for populations of flora and fauna Damaged soil, biodiversity loss, soil erosion Water, air pollution, gas emissions Destruction of protected objects of nature Polluted environment from different chemical nutrients, fertilizes.
Social	
Maintenance of rural viability and other Employment of rural inhabitants Food security and safety Stable income, cultural heritage.	Destruction of cultural objects Food insecurity.
Other	
Welfare of inhabitants, livestock welfare.	Human health problems caused by agricultural activity, noise**.**

Lecture no. 32
Important issues in economics and management of common property resources of land, water, pasture and forest resources, etc.

Important Issues In Common Property Resources:
In past, these **resources** were neglected by policy makers and planners.
The **increasing population pressure, institutional changes, privatization, commercialization, mechanization have played important role in the deterioration** of these **resources**.

Formulae
1. **Production function:** $y = f(x1, x2, x3,.....xN)$
   where y is output of a crop, $x1, x2, x3,.....xN$ are inputs, f denotes function of

2. **Linear production function** $y = a + bx$
   where y is dependent variable (output), a is constant, b is coefficient, x is independent variable (input)

3. **Cobb-douglas** (non linear production function) $y = axb$
   where y = dependent variable, a constant, b coefficient, x independent variable

4. **Quadratic function** $y = a + bx - cx2$
   where y = output or yield dependent variable, a constant, c & b coefficient, x input (independent variable)

5. **Marginal physical product (MPP)**

$$MPP = \frac{\text{Change in total physical product}}{\text{Change in input level}}$$

$$MPP = \frac{?\square\square\square}{?\square} = \frac{?\square}{?\square}$$

6. **Average products (AP)** $= \dfrac{\text{Total output}}{\text{Quantity of input}} = y/x$

7. **Marginal value product (MVP)**

$$MVP = \frac{\text{Change in total value product}}{\text{Change in input level}}$$
$$MVP = \frac{? \text{ T. Py}}{? \text{ X}}$$

8. **Marginal Revenue (MR)**

   a. $MR = \dfrac{\text{Change in total revenue}}{\text{Change in output level}} = \dfrac{?\square}{?\square} P_y = P_y$

9. **Short run production function** $y = f(x_1 / x_2, x_3 \dots x_n)$

10. **Long run production function** $y = f(x_1, x_2, x_3 \dots x_n)$

11. **Least cost combination of resources.**

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

$$\text{LCC} = \frac{?X_2}{?X_1} = \frac{P\,X_1}{P\,X_2} \quad \text{or} \quad \frac{?X_1}{?X_2} = \frac{P\,X_2}{P\,X_1}$$

12. **Future value of present sum (compounding)**
$FV = P(1+i)^n$
FV: Future value; P: present sum (original investment); i : rate of interest;
n : number of years.

13. **Present value of Future sum (Discounting)**
$PV = \dfrac{P}{(1+i)n}$
Where
PV: Present value; P: sum to be received in future); i : rate of interest;
n : number of years.

14. **Total cost (TC)** = Total variable cost + Total fixed cost
TC = TVC + TFC

15. **Variable cost (TVC)** = P x1×X1
Px1 = price per unti of X1, X1 = Quantity of X1 input

16. **Average variable cost (AVC)** = $\dfrac{\text{Total variable cost}}{\text{Output}}$

$\text{AVC} = \dfrac{\text{TVC}}{Y}$

17. **Average fixed cost (AFC)** = $\dfrac{\text{Total fixed cost}}{\text{output}}$

$\text{AVC} = \dfrac{\text{TFC}}{Y}$

Average total cost (ATC) = $\dfrac{\text{Total cost}}{\text{Output}}$

i. or
Average total cost (ATC) = Average variable cost + Average fixed cost

$\therefore TC = AVC + ATC$ or $\dfrac{\square\square}{\square}$

18. **Cost A2** = Cost A1 + Rent on leased in land

19. **Cost B** = Cost A1 / A2 + Rent on owned land + Interest on owned fixed capital

20. **Cost C** = Cost B + Value of family labour

21. **Farm business income** = Gross income – Cost A1 / A2

22. **Family labour income** = Gross income – Cost B

23. **Net income** = Gross income – Cost C

24. **Farm investment income** = (Gross income – Cost C) + (Cost B – Cost A)

25. **Net cash income** = Total cash income – Total cash operating expenses

26. **Net Farm income** = Net cash income + Change in inventory and depreciation

27. **Farm earning** = Net farm income + Value of farm products consumed in home

28. **Family labour earnings** = Farm earnings – Interest on capital

29. **Returns to management** = Family labour earnings - Value of family labour

30. **Operating cost ration (OCR)** = $\dfrac{\text{Operating expenses}}{\text{Gross income}}$

31. **Fixed cost ratio (FCR)** = $\dfrac{\text{Total fixed costs}}{\text{Gross income}}$

32. **Gross cost ratio (GCR)** = $\dfrac{\text{Total cost}}{\text{Gross income}}$

33. **Rate of capital turnover** = $\dfrac{\text{Gross income}}{\text{Total capital invested}}$

34. **Net capital ratio (NCR)** = $\dfrac{\text{Total assets}}{\text{Total liabilities}}$

35. **Working ratio (WR)** = $\dfrac{\text{Current assets + Working ssets}}{\text{Current liabilities + Working liabilities}}$

36. **Current ratio (CR)** $= \dfrac{\text{Current assets}}{\text{Current liabilities}}$

37. **Debt/equity ratio** $= \dfrac{\text{Total liabilities}}{\text{Owners equity or net worth}}$

38. **Production efficiency** =

   i. $\dfrac{\text{Yield of crop on the farm}}{\text{Average yield of the same crop in the locality}} \times 100$

39. **Cropping intensity** $= \dfrac{\text{Gross cropped area}}{\text{Net sown area}} \times 100$

40. **Productive man work units per mar equivalent**

   $= \dfrac{\text{Total productive man work units}}{\text{Number of man equivqlents}}$

41. **Straight line method** $= \dfrac{\text{Original cost} - \text{Junk value}}{\text{Useful life}}$

42. **Diminishing balance method** = (Book value at the biginning) x R

   1. where R is rate of depreciation

43. **Sum of the years digits method** = (Original cost − Junk value) X $\dfrac{\text{RL}}{\text{SoYD}}$

   RL : Remaining years of useful life

   SoYD : Sum of the years digits

44. **Income capitalization** V = R / r

   a. where V = capitalized value, R = Net income per unit of land per annum, r = rate of interest

45. **Break-even output** $= \dfrac{\square\square\square\square\square\ \square\square\square\square\square\ \square\square\square\square}{\square\square\square\square\square\square\square\ \square\square\square\square\square\ \square\square\square\ \square\square\square\square\ \square\square\square\square\square\square\square\square\ \square\ \square\square\square\square\ \square\square\square\ \square\square\square\square\ (\square\square\square)}$

ABBREVIATIONS

1. PF : Production Function
2. EP : Elasticity of production
3. SRPF : Short run production function
4. LRPF : Long run production function
5. TP : Total Product
6. MP : Marginal product
7. AP : Average Product
8. TPP : Total physical product

9. APP : Average physical product
10. MPP : Marginal physical product
11. TVP : Total value product
12. AVP : Average value product
13. MVP : Marginal value product
14. MFC : Marginal factor cost
15. MIC : Marginal input cost
16. MC : Marginal cost
17. MRS : Marginal rate of substitution
18. MRTS : Marginal rate of technical substitution
19. MRPS : Marginal rate of product substitution
20. PR : Price ratio
21. TFC : Total fixed cost
22. TVC : Total variable cost
23. TC : Total cost
24. AFC : Average fixed cost
25. AVC : Average variable cost
26. ATC : Average total cost
27. PPC : Production possibility curve
28. LCC : Least cost combination of resources
29. LDR : Law of diminishing returns
30. LEMR : Law of equi-marginal returns.
31. CYI : Crop yield index
32. CI : Cropping intensity
33. GI : Gross income
34. NI : Net income
35. PMWC : Productive man work unit
36. BEO : Break-even output
37. BEP : Break-even point
38. NCR : Net capital ratio
39. WR : Working ratio
40. CR : Current ratio
41. MR : Marginal revenue
42. OCR : Operating cost ratio
43. FCR : Fixed cost ratio
44. GCR : Gross cost ratio
45. FBI : Farm business income
46. FLI : Family labour income
47. LP : Linear programming