

CHAPTER – PRODUCTION FUNCTION

- ❖ **PRODUCTION:-** The act of making goods and services and there by adding utility to the object is called production.
- ❖ **PRODUCTION FUNCTION:-** (Function relationship between inputs and output) It shows maximum quantity of a commodity that can be produced per unit of time with given amount of inputs, when the best production techniques is used. $Q_x = f(l, k)$ where Q_x = Quantity of x produced, l – labour, k = capital.
Thus production function refers to quantity of a commodity (x) produced in the function that depends upon the quantity of L and K.
- ❖ **SHORT RUN:-** It refers to the peperiod of time during which the amount of some inputs called fixed factors cannot be changed. This implies that an increase in output in short run can be brought about by increasing those inputs that can be varied, known as variable factor.
- ❖ **LONG RUN:-** It is defined as the time period during which all the factors of production can be varied.
- ❖ **Fixed factors and variables factors:- Factors of production can be defined as:-**
 1. Fixed factors
 2. Variables factors
 1. **FIXED FACTOR:-** Fixed factors are those the application of which does not change with change in output i.e. the supply of these can be neither be increased nor decreased in short run.
EXAMPLE:- Capital, equipment's, factory, building etc.
 2. **VARIABLES FACTOR:-** These are those, the application for which with the change in output i.e. the supply of which can be changed in the short run in a desired quantity.
- ❖ **DIFFERENCE BETWEEN SHORT RUN AND LONG RUN**

Basis	Short run	Long run
Meaning	It refers to a period in which output can be changed by changing only variables factors.	It refers to a period in which output can be changed by changing all the factors of production.
Classifying	Factors are classified as variable factors and fixed factors.	All factors are variable under long run.
Price determination	Demand is more active in price determination as supply cannot be inclined with increase in demand.	Demand, supply play equal role in price determination as both can be increased.

- ❖ **VARIABLE FACTORS AND FIXED FACTORS:-**

Basis	Variables factors	Fixed factors
Meaning	It refers to those factors which can be changed in short run.	It refers to those factors which cannot be changed in short run.
Relation with output	Varies directly	Do not vary directly with output.
Examples	Raw material, labour, power etc.	Building, plant and machinery etc.

- ❖ **TYPES OF PRODUCTION FUNCTION:-**
 1. **SHORT RUN:-** It refers to the situation when only 1 output is variable and all other inputs are in assumed to be constant. The behaviour of output when only one is changed, other inputs are fixed in known as return to a factor. Short run production is a subject of law of variable proportion.

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2. **LONG RUN:-** It studies when changes in output when all inputs used in the production of commodity are hanged simultaneously and in same proportion. It is subject matter of returns of scale.

❖ **CONCEPTS OF PRODUCTS:-**

1. **PRODUCT OR OUTPUT:-** It refers to quantity of goods produced by a firm or an industry during specified period of time.
2. **TOTAL PRODUCT /TOTAL PHYSICAL PRODUCT:-** It refers to a quantity of goods produced during a given period of time by combing a particular quantity of variable factor with given quantity of fixed factor. It is also called total returns or total output.

- ❖ In sort run, a firm can expand TP by increasing only variable factor.
- ❖ In long run, TP can be raised by increasing both fixed and variable factors.

3. **AVERAGE PRODUCT:-** It refers to output per unit of a variable factor.

$$AP = TP/(\text{units of variables factors, labour})$$

This is also called average returns.

4. **MARGINAL PRODUCT:-** It refers to change in TP, resulting from one additional unit of variable factor.

$$MP = TP_n - TP_{n-1}$$

$$MP = \Delta TP / \Delta L$$

Units of land	Units of labour	TP	MP	AP (TP/L)
1	1	2	2	2
1	2	5	3	2.5
1	3	9	4	3
1	4	12	3	3
1	5	14	2	2.5
1	6	15	1	2.5
1	7	15	0	2.14
1	8	14	-1	1.75

❖ **RELATIONSHIP BETWEEN AP AND MP:-**

1. As long as MP is more than AP, AP rises i.e. upto point 3 unit of variable factor.
2. When MP is = AP, AP is at its maximum, i.e. at 4 units of variable factor.
3. When MP is less than AP, AP fall from 5 unit of variable factor.

Thereafter both AP and MP falls but MP becomes negative, but AP remains positive MP falls at a faster rote than MP falls in AP.

Diagram:

❖ **RELATION BETWEEN TP AND MP**

Land	Labour	TP	MP
1	1	2	2
1	2	5	3
1	3	9	4
1	4	12	3
1	5	14	2
1	6	15	1
1	7	15	0

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1	8	14	-1
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Diagram:

❖ **EXPLAIN THE LAW OF VARIABLE IN TERMS OF TOTAL PHYSICAL PRODUCT:-**

- **STATEMENT OF LAW OF VARIABLE PROPORTION:-** The law states that as more and more units of variable factors are applied to the given quantity of fixed factor, TP initially at increasing rate. Initially and finally it increase at diminishing rate.

There are three phrases in the law:-

1. **I – Phase:-** TP rises at increasing rate, MP increase.
 2. **II – Phase:-** TP rises at decreasing rate. MP and is t.
 3. **III – Phase:-** TP falls, MP becomes –ve.
- LVP is also known as laws of return or returns to variable factors.

❖ **ASSUMPTIONS OF LAW:-**

1. It operates in short run.
2. Law applies to all fixed factor like land etc.
3. Under LVP, diff. units of variables factor can be combined with fixed factors.
4. Law applies in the field of production only.
5. Technology remains constant.
6. All units of variable factors are homogeneous and are equally efficient.
7. It is assumed that some inputs are kept fixed while other are varied. It is then only that the factor proportion can be changed.

Units of land	Units of labour	TP	AP	MP
1	1	2	2	2
1	2	5	2.5	3
1	3	9	3	4
1	4	12	3	3
1	5	14	2.8	2
1	6	15	2.5	1
1	7	15	2.1	0
1	8	14	1.7	-1

❖ **THREE STAGES OF PRODUCTION:-**

1. **STAGE 1:- INCREASING RETURNS OF FACTOR:-** In the 1st phase, every additional variable factor adds more and more to the total output. It means TP at increasing rate, MP rises. It implies TP at rate (till point Q and MP till it reaches its maximum point P).
2. **STAGE 2:- DIMINISHING RETURNS OF FACTOR:-** In this, every additional variable factor adds lesser and lesser amount of output. It means TP at diminishing rate and MP with rise in variable factors. The 2nd phase ends at point S, when MP is zero and TP is maximum at point M.
3. **STAGE 3:- NEGATIVE RETURNS OF FACTOR:-** In this, the employment of additional variable factor causes TP to decline. MP now becomes –ve. The 3rd phase starts after point S on MP curve and point M on TP curve. MP of each variable factor is negative in the 3rd phase. So, no firm would deliberately choose to operate in this phase.

2nd phase in very crucial as a rational producer will always to produce in this phase because TP is maximum and MP of each variable factor is positive.

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- ❖ **REASONS FOR LAW OF VARIABLE PROPORTIONS:-** These are Reason for increasing returns to factor (Phase –I)
 - a. **FULLER UTILIZATION OF FIXED FACTORS:-** In the 1st phase, the supply of fixed factor (land, building) is too large whereas variable factors are too few. So, the fixed factor is not fully utilized. When variable factors are increased and combined with fixed factors then fixed factor is better utilized and output increases at increasing rate.
 - b. **INCREASED EFFICIENCY OF VARIABLE FACTOR:-** When variable factors are increased and combined with fixed factors, they can be utilized in more efficient manner. At the same time it leads to co-operation and specialization.
 - c. **INDIVISIBILITY OF FIXED FACTOR:-** Generally, the fixed factors which are combined with variable factors are indivisible. Such factors cannot be divided into smaller units. Once an investment is made in these factors, then addition of more and more units of variable factor improves the utilization of fixed factors and leads to increasing returns to factor.

- ❖ **REASONS FOR DIMINISHING RETURNS TO FACTORS:-**
 1. **DISTURBING THE OPTIMUM PROPORTION:-** As more and more quantity of variable factor is employed on given fixed factor. The fixed factor is better utilized. But, there is limit upto which this happens. If more workers are put on the fixed factor, optimum factor combination is disturbed. This leads to a fall in the average and marginal product.
 2. **IMPERFECT SUBSTITUTES:-** Upto some stage, we can substitute one factor for another factor. Example:- Labour can be substituted in place of capital. But beyond the optimum limit they become imperfect substitutes of one another which leads to diminishing returns.

- ❖ **CAUSES OF NEGATIVE RETURNS TO FACTORS:-**
 1. **LIMITATION OF FIXED FACTOR:-** Negative returns apply because some factors of production are of fixed nature which cannot be increased with increase in variable factor in short run.
 2. **OVER CROWDING:-** If we keep on adding variable factor with the given quantity of fixed factor, this will lead to over crowding of variable factor on fixed factor i.e. excessive variable factor. On the given quantity of fixed factor. There will be lower availability of tools per workers which will cause a fall in productivity. Moreover, if too many workers are there, they will come in each others way and disturb others. “Too many cooks spoil the both ability implies to this situation”.
 3. **MANAGEMENT PROBLEM:-** Use of too many of variable factor like labour also creates the problem of effective management. Too many workers may shift responsibility to others and it may become difficult to manage then. All this leads to decrease in efficiency.

- ❖ **DIFFERENCE BETWEEN RETURNS TO FACTOR AND RETURNS TO SCALE:-**

Basis	Returns to factor	Returns to scale
Meaning	It refers to an increase in total product when only one factor is increased, keeping all other factors fixed.	It refers to change in output product, when all the factor inputs are changed simultaneously in the same of proportion in the long run.
Time period	Applies to short run production function.	Applies to long run production function.
Factor proportion	There is a change in a ratio of fixed and variable factors as variable factors goes on changing.	There is no change in the factor proportion.
Scale of production	There is no change in the scale of production. Only level of production changes.	There is change in scale of production.
Reasons for operation	Output changes due to change in marginal productivity of variable factor.	Output changes due to change in efficiency of all the factors.