INDIAN SCHOOL MUSCAT
DEPARTMENT OF COMMERCE AND HUMANITIES
INTRODUCTORY MICROECONOMICS
CLASS – XI

PRODUCTION FUNCTION (RETURNS TO FACTOR)

MEANING OF PRODUCTION

Production is defined as the transformation of inputs into output. Production includes both production of physical goods and production of services

PRODUCTION FUNCTION

- The term production function means the technical and physical relationship between inputs used and the resulting output.
- It includes only technically efficient combinations of inputs (i.e., those which minimise the cost of production).
- A production function is expressed as:
  Q=f (K, L) Where Q is output, labour (L) and capital (K), required to produce a good

Types of Production Function

- **Short-run Production Function.** It refers to production in the short-run where there are some fixed factors. In short-run, production increases when more units of variable factors are used with certain amount of fixed factor.
- **Long-run Production Function**. It refers to production when all factors are increased in the same proportion

Fixed Factors and Variable Factors

Fixed factors refer to those factors whose supply cannot be changed during short run. E.g. land, plant, factory building, minimum electricity bill, etc.

Variable factors refer to those factors whose supply can be varied or changed. E.g. raw materials, daily wage workers, etc.

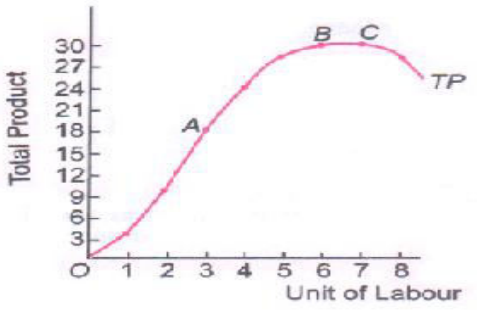
CONCEPTS OF PRODUCT

- **Total Physical Product (TPP) or Total Product (TP): It is defined as the total quantity of goods and services produced by a firm with the given inputs during a specified period of time.**
- In the short-run, TP can be increased by employing more units of the variable factor.
- In the long-run, TP can be increased by employing more units of all factors.

TP Curve

TP curve starts from the origin, increases at an increasing rate, reaches a maximum and finally decreases at an increasing rate

Shape of TP Curve
TP rises at an increasing rate(from origin till point A)
TP rises at a decreasing rate (from point A to B)
TP falls (beyond point C)

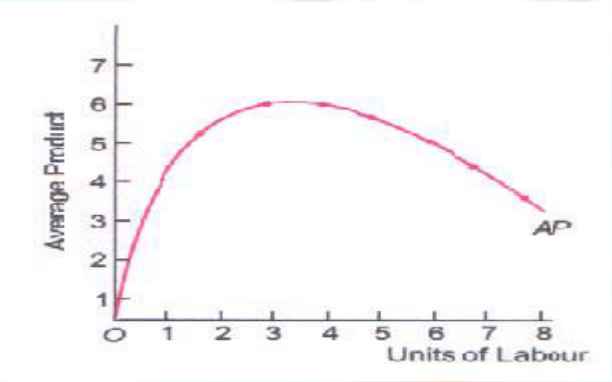


Average Product (AP)

Average Product (AP): It is defined as the amount of output produced per unit of the variable factor (labour) employed.

$$AP = \frac{\text{Total Physical Product}}{\text{Labour Input}} = \frac{TP}{L}$$

AP is zero when no labour is employed. Initially, AP increases, reaches maximum and finally starts declining. AP curve is an inverted U-shaped.

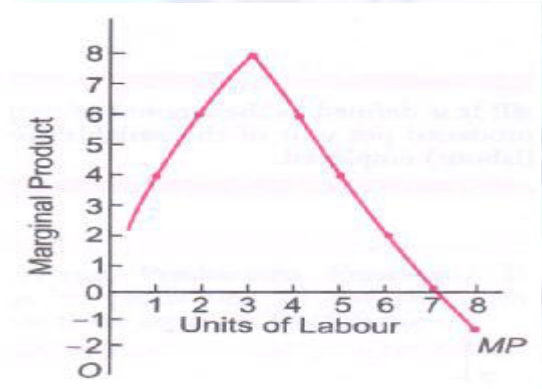


Marginal Product (MP)

It is defined as the change in TP resulting from the employment of an additional unit of a variable factor (labour). Symbolically, MP can be written as:

$$\text{Marginal Product} = \frac{\text{Change in Total Product}}{\text{Change in units of Variable Factor}} \quad \text{OR} \quad MP = \frac{\Delta TP}{\Delta L} \quad \text{OR} \quad MP = TP_N - TP_{N-1}$$

Initially MP increases with employment of units of labour. MP starts declining to become zero and finally becomes negative. MP curve is inverted U-shaped.



Relationship between TP, AP and MP Curves

- AP curve is the slope of the straight line from the origin to each point on the TP curve. MP curve is the slope of the TP curve at each point.
- When AP is maximum, MP = AP.
- When TP is maximum, MP = O.
- When TP is falling, MP is negative.

- Both AP and MP curves are inverted U-shaped.

Fixed Factor (Units of Land)	Variable Factor (Units of labour)	Total Product (TP)	Average Product (MP)	Marginal Product (MP)	Phase of production
1 acre	0	0	0	-	Increasing Returns
1 acre	1	4	4	4	
1 acre	2	10	5	6	
1 acre	3	18	6	8	
1 acre	4	24	6	6	Diminishing Returns
1 acre	5	28	5.6	4	
1 acre	6	30	5	2	
1 acre	7	30	4.3	0	
1 acre	8	28	3.5	-2	Negative Returns

Law of Diminishing Marginal Product

If we keep increasing the employment of the variable input with other fixed inputs then eventually a point will be reached after which the marginal product of that input will start falling. MP of a factor input initially rises, when the level of employment of the input is low, but after reaching a certain level of employment, it starts falling.

The Law of Variable Proportion

Statement of the laws Law of Variable Proportion

The law of variable proportion states that when total output or production of a commodity is increased by adding units of a variable input, while the quantities of other inputs are held constant, the increase in total production, after some point, diminishes.

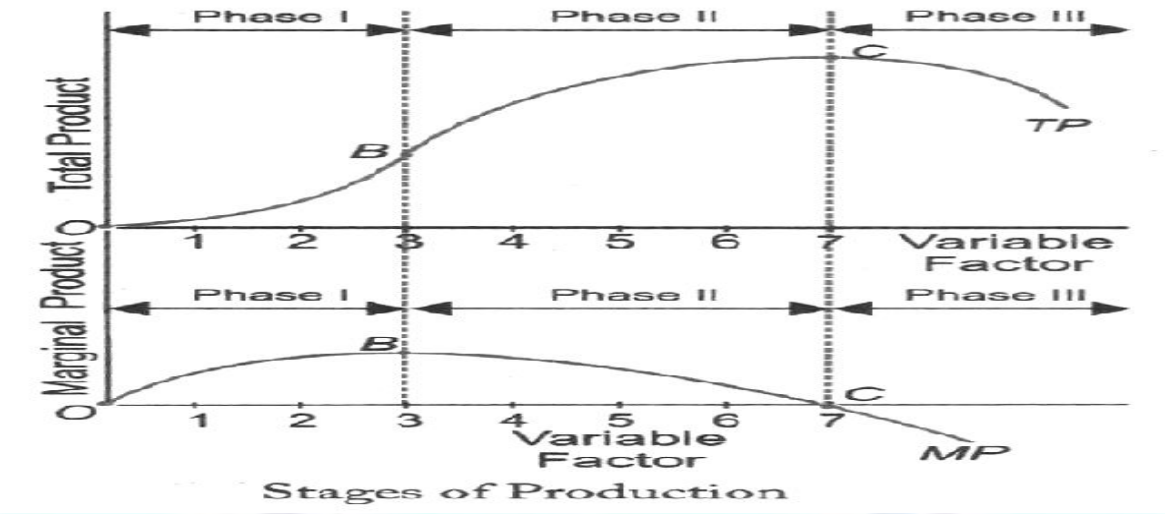
- **Assumptions of the Law**

⇨ The assumptions of the law of variable proportion are:

⇨ State of technology remains the same.

⇨ All units of the variable factor, labour, are homogenous.

⇨ There must always be some fixed input and diminishing returns results due to fixed supply of the fixed factor.



Three Phases of Production

- **Stage I: Increasing Returns**

TP curve is increasing at an increasing rate. MP curve rises and reaches a maximum (From point of origin O to point B). Factor proportions become more and more suitable for the production and Marginal Product increases.

- **Reasons for increasing Returns**

❖ The reasons for increasing returns are:
❖ Underutilisation of fixed factor (land),
❖ Indivisibility of factors, and
❖ Specialisation of labour.

A rational producer will not operate in this stage because the producer can always expand through Stage I. It is a non-economic range

- **Stage II: Diminishing Returns**

Stage II of production starts from the point where MP curve is maximum to the point where the MP curve is zero. MP is positive but diminishes as more variable factors are employed. TP curve increases at a decreasing rate and reaches a maximum. Factor proportions become less and less suitable for the production.

- **Reasons for diminishing Returns**

❖ The reasons for diminishing returns are:
❖ Optimal use of fixed factor, and
❖ Lack of perfect substitution between factors

A rational producer will always operate in this Stage. The law of diminishing returns operates in Stage II

- **Stage III. Negative Returns**

TP curve declines rapidly. MP curve is negative. Factor proportions are no suitable for production. A rational producer will not operate in this stage, even with free labour, because output can be increased using less labour.

Reasons for Negative Returns

- Over utilisation of fixed factor

ISOQUANTS

- It is defined as the locus of all the technically efficient combinations of inputs which yield a given amount of output.
- **Features of Isoquants**

- **Isoquants are Downward Sloping**
- **Isoquants are Convex to the Origin**

RETURNS TO SCALE
(LONG RUN PRODUCTION FUNCTION)

- Returns to scale are applicable in the long-run, where all factors of production in variable supply. Output can be increased by increasing all factors of production or the 'scale' of production.

DISTINCTION BETWEEN RETURNS TO A FACTOR AND RETURNS TO SCALE

Returns to a Factor (Short run Production Function)	Returns of Scale (Long run Production Function)
This law applies in the short-run	**This law applies in the long-run.**
In this law, the level of production is changed	**In this law, scale of production is changed.**
In this, only the units of variable factor changes and the units of fixed factors remain the same.	**In this, all factors of production are changed in the same proportion.**