Lesson – 17

Production Function

Summary

The concept of production function is the subject matter of producers` behaviour who play an important role in the production of goods and service by establishing physical relationship between input and output. This is evident from the fact that no single commodity can be produced without the help of any one of these four factors of production. Therefore, the producer combines all the four factors production i.e. land. Labour, capital and entrepreneur for producing variety of goods and services in a technical proportion which, in turn, provides the basis of studying the concepts of cost of production, different market forms, concept of supply etc. Let us discuss about various concepts like TPP, APP, MPP, short run and long run production function, law of variable proportion in this topic.

Meaning of Production

- Production is defined as the process of creating goods and services with the help of factors of production or inputs for satisfaction of human wants.
- In other words, 'transformation of inputs into output' whereby value is added, is broadly called production.

Different Concept Related to Production Function –

a. Short run and long run

- **Short run** refers to a time period in which a firm does not have sufficient time to increase the scale of output.
- It can increase only the level output by increasing the quantity of a variable factor and making intensive use of the existing fixed factors.
- **Long run** refers to the time period in which the firms can increase the scale of output by increasing the quantity of all the factor inputs simultaneously and in the same proportion.

b. Fixed factors and variable factors

- **Fixed factors** are those factors of production whose quantity can not be hanged with change in the level of output.

- For example, the quantity of land, machinery etc. can not be changed during short run.
- **Variable factors** are those factors of production whose quantity can easily be hanged with change in the level of output.
- For example, we can easily change the quantity of labor to increase or decrease the production.

c. Level of production and scale of production

- When firm changes production with change in quantity of one factor while other factors remains constant , it is known as change in **level of production.**
- It provides the basis for 'Law of Variable Production'.
- When the firms increase production by increasing the quantity of all the factors of production simultaneously and in the same proportion, it increases the **scale of production.**
- It provides the basis of for 'Law of Returns to Scale'.

Definition of Production Function

- Production function refers to the physical relationship

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between inputs and output under given technology.

$$Ox = f(L, K)$$

Where, Ox=Quantity of commodity X

f is the function and L and k

L = Unit of Labour

K = Unit of Capital

Short run production function

- A short run production function that shows the changes in output when only one factor is changed while other factor remains constant is termed as a short run production function. In the above example of production function.
- The underlying theory to the short run production function is the "**Law of variable proportion or Returns to a factor".**

Long run production function

- A long run production function studies the impact on output when all the factors of production can be changed simultaneously and in the same proportion.
- The underlying theory to the long run production function is the 'Returns to Scale'.

Three Measures of Production and their Relationship

Total Physical Product (TPP)

- TPP is the total amount of a commodity that is produced with a given level of factor inputs and technology during a given period of time.

Formula, $TPP = \sum MPP$

Or $TPP = MPP_1 + MPP_2 + Mpp_3 + \cdots MPP_n$

Average Physical Product (APP)

- APP is the output produced per unit of input employed. It can be obtained by dividing TPP by the number of units of variable input.

Formula, $APP = \frac{TPP}{L}$

L = no. of Variable Unit

Marginal Physical Product (MPP)

- MPP of an input is the additional output that can be produced by employing one more unit of that input while keeping other inputs constant

$$MPP = \frac{\Delta TPP}{\Delta L}$$

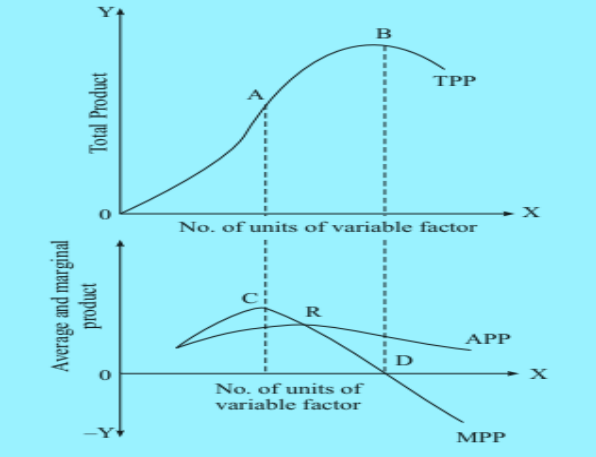
Where, ΔTPP = Change in TPP

And ΔL = Change in Unit of Labour

$$MPP = TPP_n - TPP_{n-1}$$

Relationship among TPP, APP and MPP

Units of Labour	Units of Capital	TPP in Units	APP in Units	MPP in Units	
1	1	2	2	2	MP 1ST Stage
2		5	2.5	3	
3		9	3	4	
4		12	3	3	MP 2nd Stage
5		14	2.8	2	
6		15	2.5	1	
7		15	2.1	0	
8		14	1.7	-1	MP (-ve) 3rd Stage



Relationship between TPP and MPP

- As long as MPP increases, TPP increases at an increasing rate.
- When MPP falls but remains positive, TPP increases but at a diminishing rate.
- When MPP becomes zero, TPP is maximum.
- If MPP becomes negative, TPP starts decreasing.

Relationship between APP and MPP

- As long as MPP is greater than APP, APP increases.
- When MPP is equal to APP, APP is maximum and constant.
- When MPP is less then APP, APP decreases.
- MPP can be zero and negative but APP is never zero or negative.

Law of Variable Proportion

- The law states that if you go on using more and more units of variable factor (labour) with fixed factor (capital), the total output initially increases at an increasing rate but beyond a certain point, it increases at a diminishing rate and finally it falls.

Assumptions of the law-

- There is no change in technology of production.
- The production process allows the different factor ratios to produce different levels out output.
- There is no change in technology of production.
- All the units of variable factor are equally efficient.
- Full substitutability of factors of production is not possible.

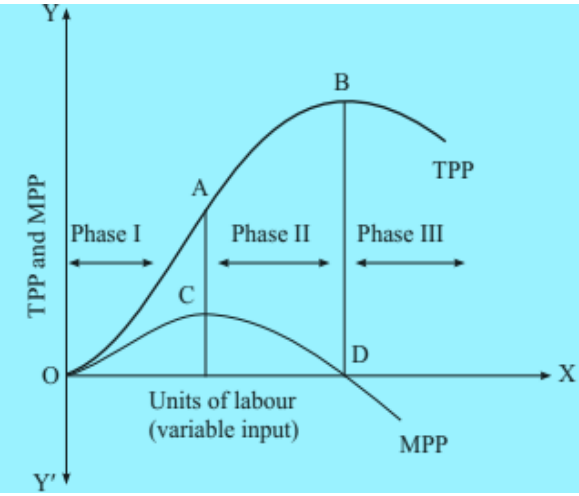
There are three phases of returns to a variable factor which are discussed below –

- **Phase I:** Increasing Returns to a factor - In this phase TPP increases at an increasing rate and marginal product of variable factor increases.
- **Phase II:** Diminishing Returns to a factor - In this phase TPP increases at an increasing rate and marginal product of variable factor increases.
- **Phase III:** Negative Returns to a factor - In this phase, MPP declines and it becomes negative. Here the TPP also starts falling.

Schedule for Law of Variable Proportion

Units of Capital	Units of Labour	TPP in Units	MPP in Units	Phases
1	1	2	2	TPP increases at increasing rate, MPP also increases
	2	5	3	
	3	9	4	
	4	12	3	TPP increases at a diminishing rate, and MPP falls but remains positive
	5	14	2	
	6	15	1	
	7	15	0	
	8	14	-1	TPP falls and MPP becomes negative

Graphical presentation Law of Variale Proportion



Reasons Behind Different Phases of the Law Of Variable Proportion

In phase I, we get increasing returns to a variable input because-

- Greater use of variable inputs makes it possible to utilize fixed indivisible factor more efficiently and also to introduce a greater division of labour and specialization.
- It leads to optimum combination of fixed and variable inputs.

In phase II, we get diminishing returns to a variable input because –

- In this stage the proportion between variable and fixed inputs has crossed the optimum proportion between them and a variable input such as labour has less and less fixed input to work with.

In phase III, this stage operates because –

- The variable input becomes too much relative to fixed inputs which obstructs the production process and therefore results in fall of TPP. because MPP becomes negative.
- So, phase III is called the stage of negative returns to variable factor.

Law of Diminishing Marginal Product

- The law of variable proportions is an extension of the law of diminishing returns to a factor.
- The law of diminishing returns to a factor states that as more and more units of a variable factor are employed with fixed factors and technology, its marginal product eventually declines.
- The difference between this law and the law of variable proportions is that the former does not take into account increasing returns to a factor.
- According to the law of diminishing returns to a factor, the firm can operate only in phase II and III of the law of variable. proportions

Evaluate Yourself

Q. Distinguish between short run and long run production function.

Q. Define TPP, APP and MPP and mention formula for the same.

Q. Explain law of variable proportion with the help of schedule and diagram.

Q. Mention relationship between APP and MPP with the help of