Production

Production is the process of transforming the inputs or raw materials into the outputs or the final goods. The rate at which the inputs can be converted into output is governed by the laws of production. Laws of production are also known as theory of production or laws of returns. Theory of production explains the relationship between the inputs and the outputs and how the change in the inputs leads to a change in the outputs. The relationship between the input to the production process and resulting output is described by a production function. There are various inputs which are required in the production but only considers four factors of production such as, land, labour, capital and entrepreneur, where each factor of production renders its services in order to produce the final good and in return it is paid factor payment. Since nothing comes free, therefore, factors of production also have a cost and that cost is known as factor payment, where land earns rent, labour get wages, capital earns interest and entrepreneur gets profit. Hence, the production of a commodity involves cost of production, which is in turn the main component of the supply of the commodity. Moreover, cost of production shows cost – output relationship i.e. how the change in the output leads to a change in the cost of production.

Production Function

Production function shows the relationship between the output and inputs. In other words it shows that output is a function of inputs (land, labour, capital and entrepreneur) and how the change in inputs affects the change in the output.

Mathematically; Q= f (LA, L, K, E)

This is known as production function,

where LA is land,

L is labour,

K is capital and

E is entrepreneur.

The land, labour, capital and entrepreneur are known as agents of production.

Moreover, the production function also represents the technology of a firm, of an industry or of the economy as a whole. A production function may take the form of a schedule or table, a graphed line or curve, an algebraic equation or a mathematical model. But each of these forms of a production function can be converted into its other forms.

The production function is purely a technical relation. Prices of factor do not enter into the production function.

If we take two inputs, labour and capital, the Production function assumes the form

Q = f (L, K)

Short run and long run production functions

In short run some factors of production are fixed and some are variable, whereas in long run all factors are variable. Thus, a short run production function has inelastic capital i.e., the capital is fixed in short run and elastic labour i.e., labour is variable. On other words, output can be increased by increasing labour only because capital is fixed. On the other hand, long run production function all the factors of production are variable i.e., output can be increased in long run by increasing either one or both of labour and capital. Hence, in long run the supply of both labour and capital is elastic in nature. Therefore, the short run production is also known as single variable production function and it is termed as:

$Q = f(\bar{K}, L)$

Here a bar on K represents that capital is fixed and the producer cannot infuse more capital in the production in short run, whereas labour, L, is variable and changeable. Hence, the laws of production under short-run conditions is called 'the law of variable proportions', the 'law of returns to a variable input' and the 'law of diminishing marginal returns'; whereas, in the long-run, it is known as the 'law of returns to scale'.

Law of Variable Proportions

The law of variable proportions is widely observed law of production which takes place in the short-run. In the short-run, production can be increased by using more of variable factors. The law of variable proportion states that when the total output or production of the commodity is increased by adding units of a variable input while the quantities of other inputs are held constant, the increase in total production becomes after some point smaller and smaller. It is also known as law of diminishing marginal return.

The law of returns to a variable proportions states that when output is increased by using only one variable input, as the all other inputs is fixed, then initially the output increases at an increasing rate, then at a constant rate and finally it keeps on increasing at a diminishing rate. In other words, if more and more of labour is used, then the output initially increases at an increasing rate, when more labour is again used then the output increases at a constant rate and then when again the labour is increased then the output increases but it increases at a diminishing rate. The ultimate law is that the marginal increase in total output eventually decreases when additional units of a variable factor are applied to a given quantity of fixed factors. Accordingly, there are three laws of returns to variable inputs

(i)   The law of increasing returns
(ii)   The law of constant returns and
(iii)   The law of diminishing returns.

Total product (TPL) is defined as the total output produced with the help of labour.

Average product (APL) is defined as total product divided by the number of labour used in the production process.

Marginal product (MPL) is defined as the additional output produced by employing / increasing one more labour.

That is, TPL - TPL-1 = MPL.

Assumptions:

1) State of technology remains the same.
2) All units of the variable factors are homogenous.
3) There must always be some fixed input which can not be increased in the short-term.
4) Only one factor is variable and the other factors are kept constant.
5) It is possible to vary the proportions in which the various inputs are combined.

Table 1.

Units of Land	Units of Labour	Total Production	Average Production	Marginal Production	
10 Acres	0	–	–	–	
,,	1	20	20	20	
,,	2	50	25	30	1st stage
,,	3	90	30	40	MP > AP
,,	4	120	30	30 } AP = MP	
,,	5	140	28	20	
,,	6	150	25	10	2nd stage
,,	7	150	21.3	0	MP=0 and TP Maximum
,,	8	140	17.5	–10 } 3rd stage MP < 0	

As represented in the above table, in stage I, total product increases as an increasing rate as labour increases. This is indicated by the rising marginal product until the employment of the third worker; after that, the fourth labour represents a constant return to a variable factor. In stage II, total product is still increasing but this time it is increasing at a diminishing rate which is indicated by a falling marginal product. This stage is hence known as the stage of diminishing returns to a variable factor, as in this stage when more of labour is used, the total product increases at a diminishing rate. In this stage the total product also reaches to its maximum, as in the table above, total product reaches to its maximum at 150 at sixth and seventh labour, but when the labour is increased from seventh to eighth, then the total product started falling and correspondingly marginal product becomes negative. This is known as stage III of negative returns. Hence the three stages represents that the total product initially increases at an increasing rate and marginal product also increases but when more labour is used then it starts increasing at a diminishing rate and marginal product start falling but when the total product reaches to its maximum and then when the labour is still increased then the total product do not increase rather it falls and correspondingly the marginal product becomes negative.

The law of variable proportion can be represented by the following diagram:

1st STAGE   2nd STAGE   3rd STAGE

Fig 1.
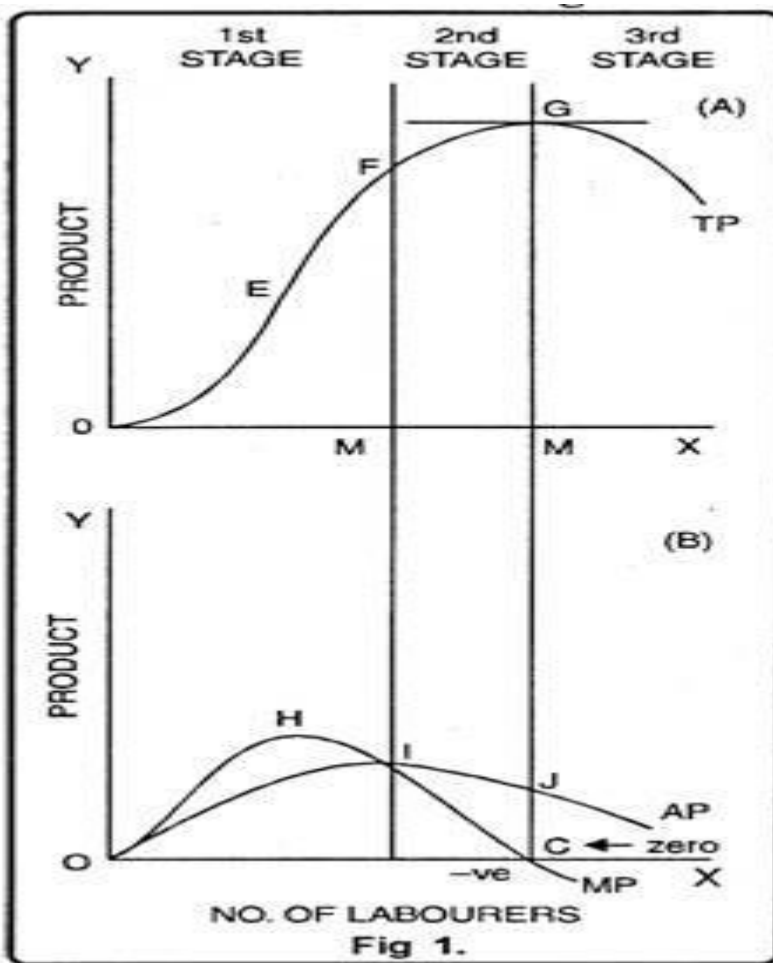
From the above diagram, we can summarize that

- Increasing returns: Both TP and MP increases at an increasing rate.
- Decreasing / diminishing returns: TP increases at a diminishing rate and MP starts falling.
- Negative returns: TP reaches to its maximum and then falls and correspondingly MP reaches zero and then becomes negative.

   Relationship between AP and MP:
- Increasing returns: Both AP and MP increases but MP increases at an increasing rate as compared to AP and reaches to its maximum.
- Decreasing / diminishing returns: MP starts falling whereas AP increases at a diminishing rate and reaches to its maximum.
- Negative returns: MP touches the x- axis, i.e. becomes zero and goes to negative but AP continues to fall.

In other words, the features of the three stages of production may be described as follows:

➢ Stage I: The marginal product of the variable factor (labour) is higher than its average product, i.e., MPL > APL
➢ Stage II: The marginal product of the variable factor (labour) falls below its average product, i.e., in Stage II, MPL < APL, but both remaining greater than zero.

- Stage III: The marginal product of the variable factor (labour) turns negative, while average product remains greater than zero.