.2. Long Run Production Function

Long-run refers to that time period which is long enough to vary all the inputs or factors of production. In the long run no factor is fixed. In a simple production function, both labour and capital are variable. Long run production function studies the input-output relationship by changing all the inputs. In the long-run there are two related concepts of production, viz.,

1. **Isoquant**
2. **Iso-cost line**

Isoquant :

It is the graphic counter part of the long run production function $Q = f(L, K)$. Isoquant is the locus of a point. If shows all possible combination of factors physically capable of producing a given level of output. Since all the combinations are equally efficient in producing a given volume of output, the producer would be indifferent between them. Thus, isoquant is otherwise known as production indifference curve or equal product curve.

The table - 4.4 represents five different combinations of labour and capital which are equally efficient to produce 100 units of output.

Table - 4.4

Factor Combination	Units of Labour	Units of Capital
A	1	20
B	2	16
C	3	13
D	4	11
E	5	10

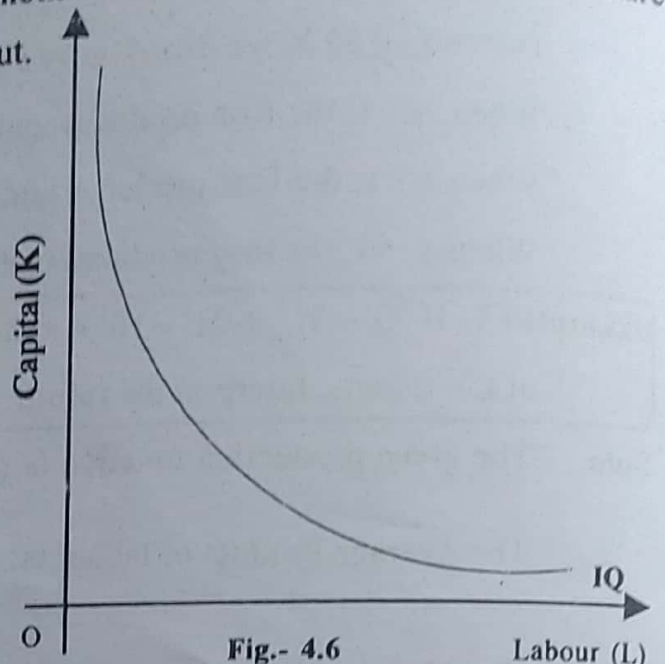

Fig.- 4.6

The Combination 'A', i.e., 1 unit of labour and 20 units of capital, is capable of producing 100 units of output. The combination 'B', i.e., 2 units of labour and 16 units of capital, is also capable of producing 100 units of output; and so on. The isoquant or equal product curve is shown here.

In the diagram IQ is the Isoquant representing a particular level of output, say, 100 units. It is downward slopping from left to right. It is convex to the origin. Isoquants can't intersect each other. An Isoquant can't touch any axis. Always a higher level of Isoquant represents a higher level of output in a map. An isoquant map is shown here.

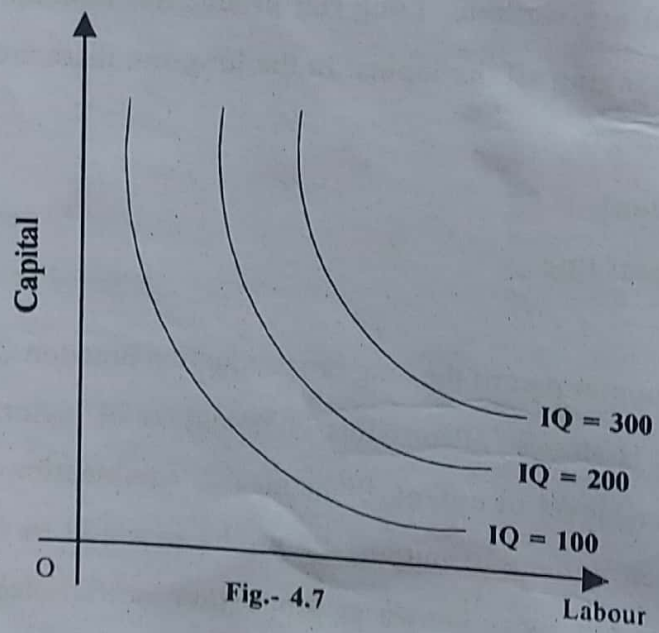

Fig.- 4.7

2. Iso-cost line

The Iso-cost line is the locus of all combinations of factors, the firm can purchase with a given monetary cost outlay and factor prices. The equation of the isocost line is $C = wL + rk$. In the adjacent diagram, the isocost line is shown :

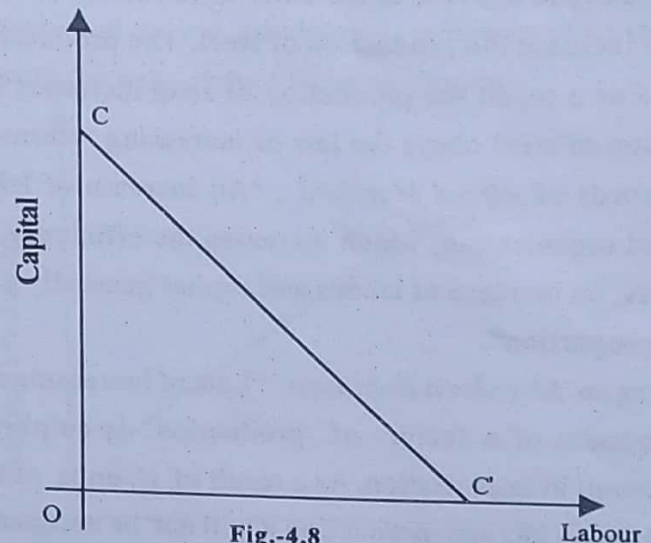

Fig.-4.8

industry. This law has been proved by empirical evidence.

4.7 RETURNS TO SCALE

Returns to scale relates to the behaviour of total output as all inputs are carried and is a long run concept. The term returns to scale refers to the changes in output as all factors change by the same proportion. When all factors change in the same proportion, the scale of production will change. The behaviour of production due to a change in the scale of production forms the subject-matter of the law of returns to scale. In case all inputs are increased in the same proportion and the scale of production is expanded, the effect on output may take three forms or stages. Such as increasing, constant and diminishing returns to scale.

When output increases more than proportionately to the increase in inputs, returns to scale are said to be increasing. Thus, if the quantity of inputs is increased by 20% and the output

increases by 30%, we have increasing returns to scale. When the inputs increase in a given proportion and the output increases in the same proportion, we have constant returns to scale. For example, under constant returns to scale if inputs increase by 10%, output also must increase by 10%. When all inputs are increased in a given proportion but output does not increase in the same proportion, then the returns to scale are decreasing. Under diminishing returns to scale, 20% increase of all factors will lead to an increase in output by less than 20%.

The law of returns to scale states that as all the factors in a combination of factors increase in the same proportion, total output, first increases at an increasing rate, then at a constant rate and finally at a diminishing rate.

Assumptions :

1. There should not be any change in technology.
2. The factor proportion is fixed.
3. The law is valid in the long-run.
4. Output is measured in physical units.

No. of Scale	Volume of Capital	Volume of Labour	K : L	Total Product	Marginal Product	Returns to Scale
1	2	1	2 : 1	4	4	
2	4	2	4 : 2	10	6	Increasing Returns to Scale
3	6	3	6 : 3	18	8	
4	8	4	8 : 4	28	10	
5	10	5	10 : 5	38	10	Constant Returns to Scale
6	12	6	12 : 6	48	10	
7	14	7	14 : 7	56	8	
8	16	8	16 : 8	62	6	Diminishing Returns to Scale
9	18	9	18 : 9	66	4	
10	20	10	20 : 10	68	2	

The law of Returns to Scale can also be illustrated with the help of the following diagram.

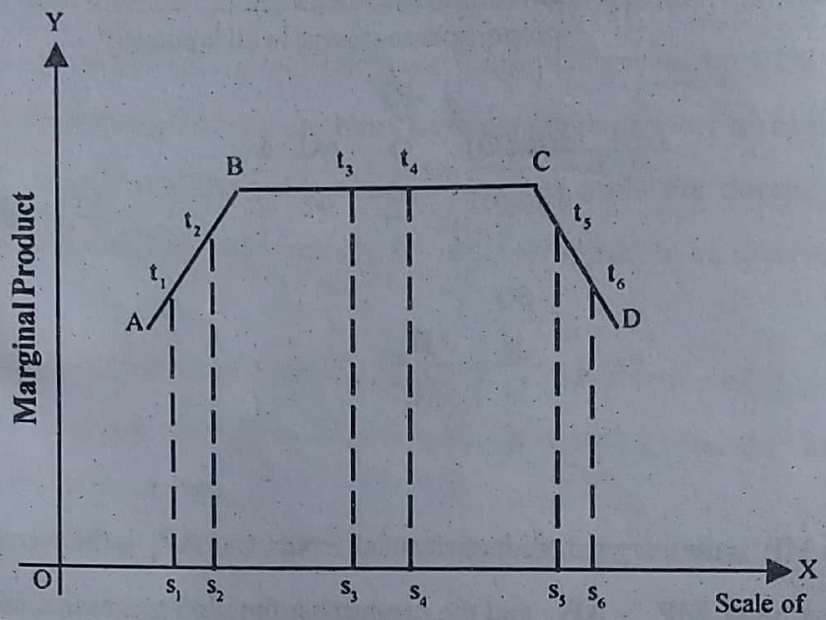

Fig. - 4 .13

In the diagram, X-axis measures the scale of production, and Y-axis measures the marginal product. ABCD is the marginal product curve. It reflects the returns to scale.

The curve has three segments viz., AB, BC and CD. The segment AB is upward sloping. It indicates that as scale of production increases from S_1 to S_2, total production increases at an increasing rate, i.e., Marginal Product increases from s_1t_1 to s_2t_2. So the segment 'AB' represents the law of increasing returns to scale. Likewise, the segment 'BC' is horizontal. It means returns to scale remain constant, even there is increase in scale of production. Thus it reflects the law of constant returns to scale. The last segment 'CD' is downward sloping. Thus, it reflects the law of diminishing returns to scale.

Isoquant Approach :

The law of returns to scale can be better understood it we employ the isoquant technique. The law can be studied by considering the gap between successive isoquants showing different levels of output.

1. Increasing Returns to Scale

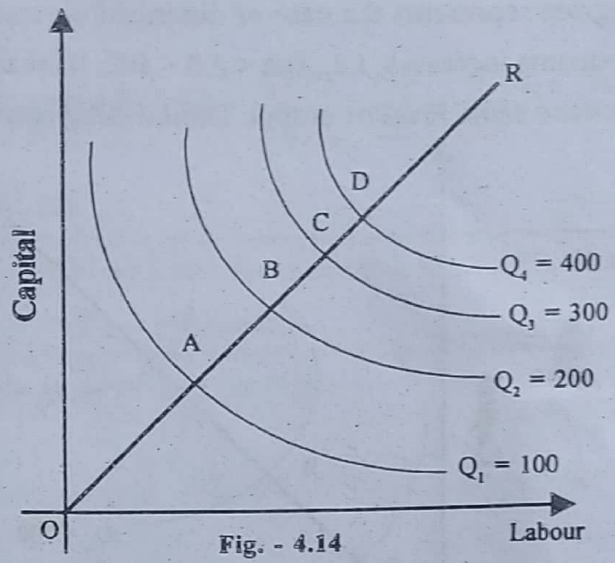

Fig. - 4.14

The law of increasing returns to scale is said to present when the gap between successive isoquants diminishes. It means to produce the same level of output, less and less of factors will be required. In the diagram, OA>AB>BC>CD, i.e., the gap is successively declining. Hence it represents the law of increasing returns to scale. Increasing returns to scale are due to

(i) indivisibilities of factors of production
(ii) technical and managerial indivisibilities
(iii) greater possibilities of specialisation of labour and machinery
(iv) external economies which are available to all the firms in the industry.

2. Constant Returns to Scale :

The law of constant returns to scale is said to present when the gap between successive isequants are equal along the scale line 'OR'. In the diagram, OA= AB = BC = CD.

It means equal doses of labour and capital are required to produce same amount of output. In other words, the diagram, represents the situation of constant returns to scale. Constant returns to scale are due to the fact that beyond a certain point internal and external economics and diseconomies are just equal.

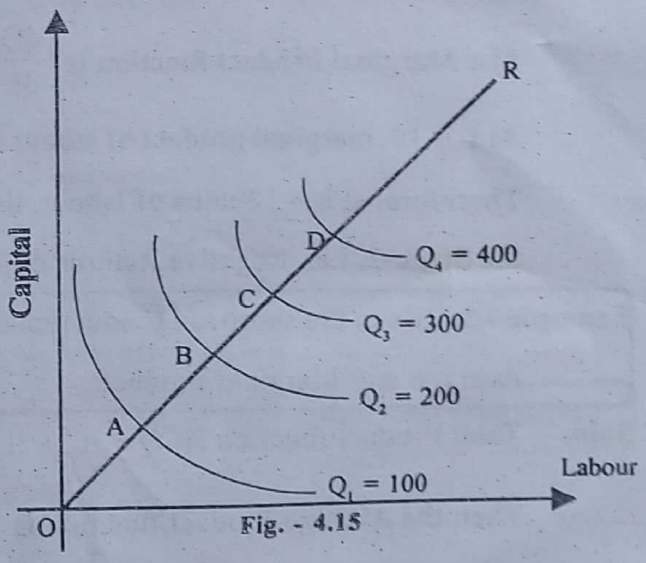

Fig. - 4.15

3. **Diminishing Returns to Scale :**

The above diagram represents the case of diminishing returns to scale as the gap between successive isoquants increases, i.e., OA < AB < BC. It means more and more of factors are required to produce same level of output. Diminishing returns to scale are due to

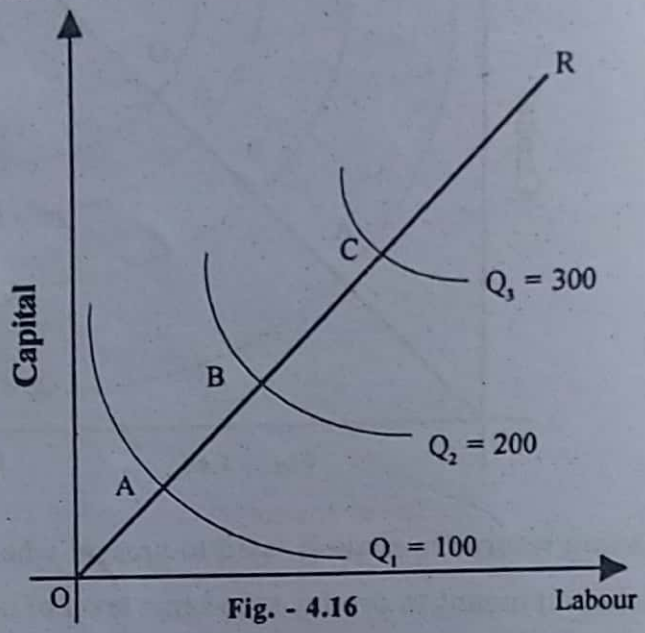

Fig. - 4.16

(i) internal diseconomies like difficulties in co-ordination, management problem entrepreneurial inertia, technical diseconomies, shortage of capital and increasing risk.

(ii) diminishing returns to the management.

(iii) exhaustible natural resources.