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.

Functional Approach :

The returns to scale can be explained with the help of the concept of Homogeneous Production Function.

A long-run production function $Q = f(L, K)$ is said to be homogeneous function of degree 'n' iff $f(\lambda L, \lambda K) = \lambda^n f(L, K)$, where '$\lambda$' is any positive constant and 'n' is a constant. The degree of homogeneity 'n' explains returns to scale.

If n>1, the production function represents increasing returns to scale.

If n=1, the production function represents constant returns to scale.

If n<1, the production function represents decreasing returns to scale.

Scale Elasticity Approach :

The returns to scale can be explained with the help of the concept of scale elasticity. Scale elasticity is defined as the degree of responsiveness of total output to a very small change in all inputs (denoted by 'δ'). Symbolically,

$$\eta = \frac{\text{proportionate change in total output (Q)}}{\text{proportionate change in all inputs}(\delta)}$$

$$= \frac{d(\log Q)}{d(\log \delta)} = \frac{\frac{dQ}{Q}}{\frac{d\delta}{\delta}} = \frac{dQ}{d\delta}.\frac{\delta}{Q}$$

$$\text{i.e. } \eta = \frac{\frac{dQ}{d\delta}}{\frac{Q}{\delta}} = \frac{MP_\delta}{AP_\delta}$$

where MP_δ is the marginal productivity of all inputs, and AP_δ is the average productivity of all inputs.

If $\eta > 1$, then $MP_\delta > AP_\delta$, and the production function represents increasing returns to scale.

If $\eta = 1$, then $MP_\delta = AP_\delta$ and the production function represents constant returns to scale.

If $\eta < 1$, then $MP_\delta < AP_\delta$, and the production function represents decreasing returns to scale.

The stages of the law of returns to scale can be clarified from the following table:

Table - 4.9

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	Increasing Returns to Scale
2	4	2	4 : 2	10	6	
3	6	3	6 : 3	18	8	
4	8	4	8 : 4	28	10	Constant Returns to Scale
5	10	5	10 : 5	38	10	
6	12	6	12 : 6	48	10	
7	14	7	14 : 7	56	8	Diminishing Returns to Scale
8	16	8	16 : 8	62	6	
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.

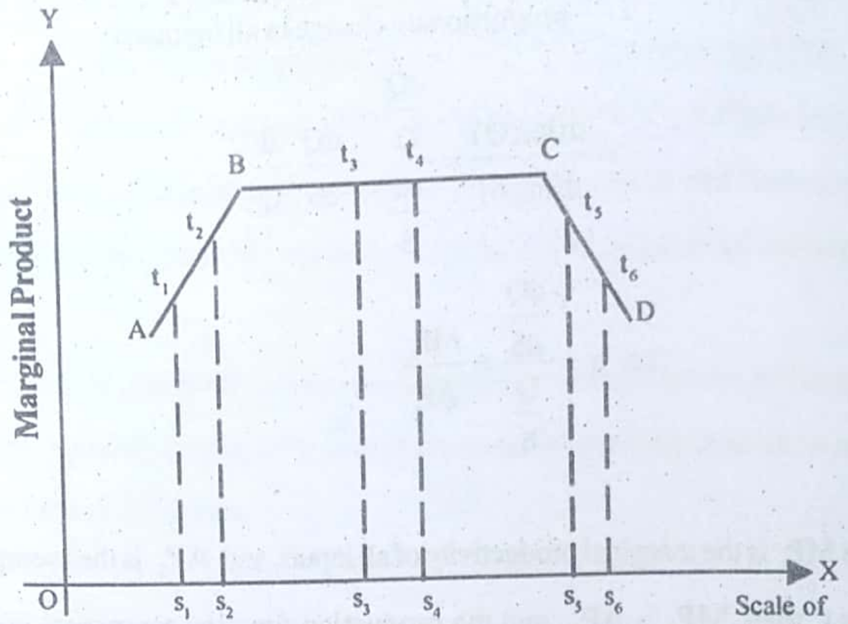

Fig. - 4 .13

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**

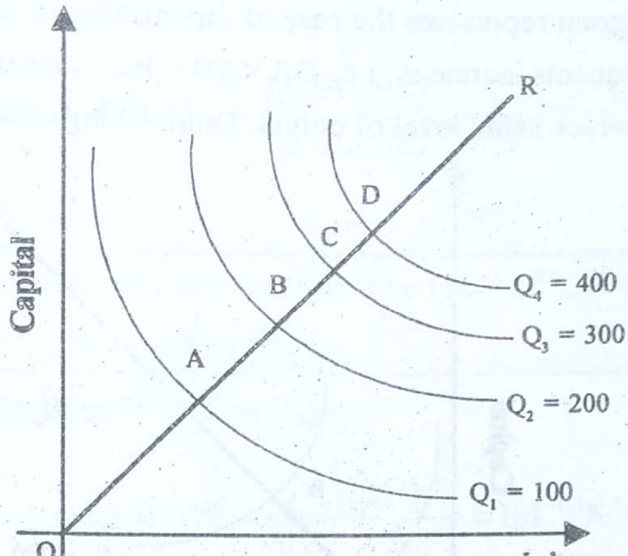

Fig. - 4.14

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.

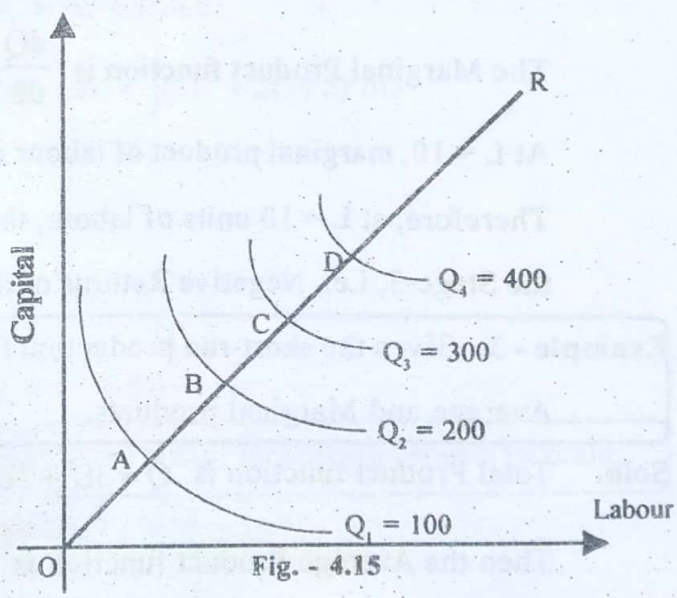

Fig. - 4.15

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

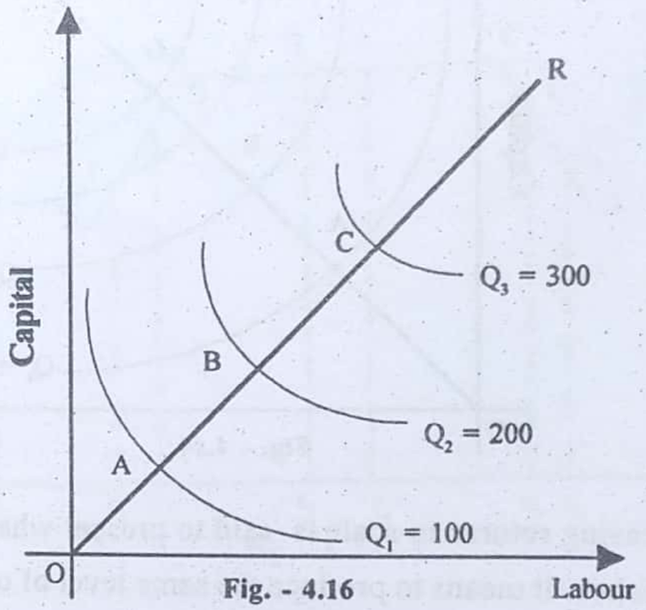

Fig. - 4.16

(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.