chapter Name

Production Function

Production Function

It shows the functional relation between physical inputs and physical output of a good.

It can be expressed as $Q = f(f_1, f_2, f_3 \ldots f_n)$. where Q = physical output of a good; $f_1, f_2, f_3, \ldots f_n$ = physical inputs.

Types of Production Function

There are two types of Production Function.

1 Short-Run Production Function

In this Production function one factor of production is variable and all others are fixed. So, law of return to a factor is applied. It is also called variable proportion type production function.

2. Long-Run Production Function

In this production function all the factors of production are variable. So, law of returns to scale is applied. It is also called constant proportion type production function.

Total Product

Total product refers to total amount of a good which is produced by a firm by using a given unit of variable factor in a given period of time.

Average Product

Average product is the per unit output of variable factor (labour) employed.

$$AP = \frac{TP}{\text{units of variable input}}$$

Marginal Product

Marginal Product is the change in total product resulting from employing one additional unit of variable input.

$$MP = \frac{\Delta TP}{\Delta L} \quad \text{or} \quad MP_n = TP_n - TP_{n-1}$$

Relation Between Total and Marginal Product.

1. As long as marginal product rises, total product increases at increasing rate.

2. When marginal product starts falling but remains positive, total product rises at diminishing rate.

3. When $MP = 0$, TP is maximum.

4. When marginal product becomes negative, then total product starts falling.

Relation between MP and AP

1. When $MP > AP$, AP rises.
2. When $MP = AP$, AP is maximum and constant
3. When $MP < AP$, AP falls.

Returns to a factor:

In a short period when additional unit of variable factor are employed with fixed factors, then returns to a factor operates. Returns to a factor shows the changes in total product of a good when only the quantity of one input
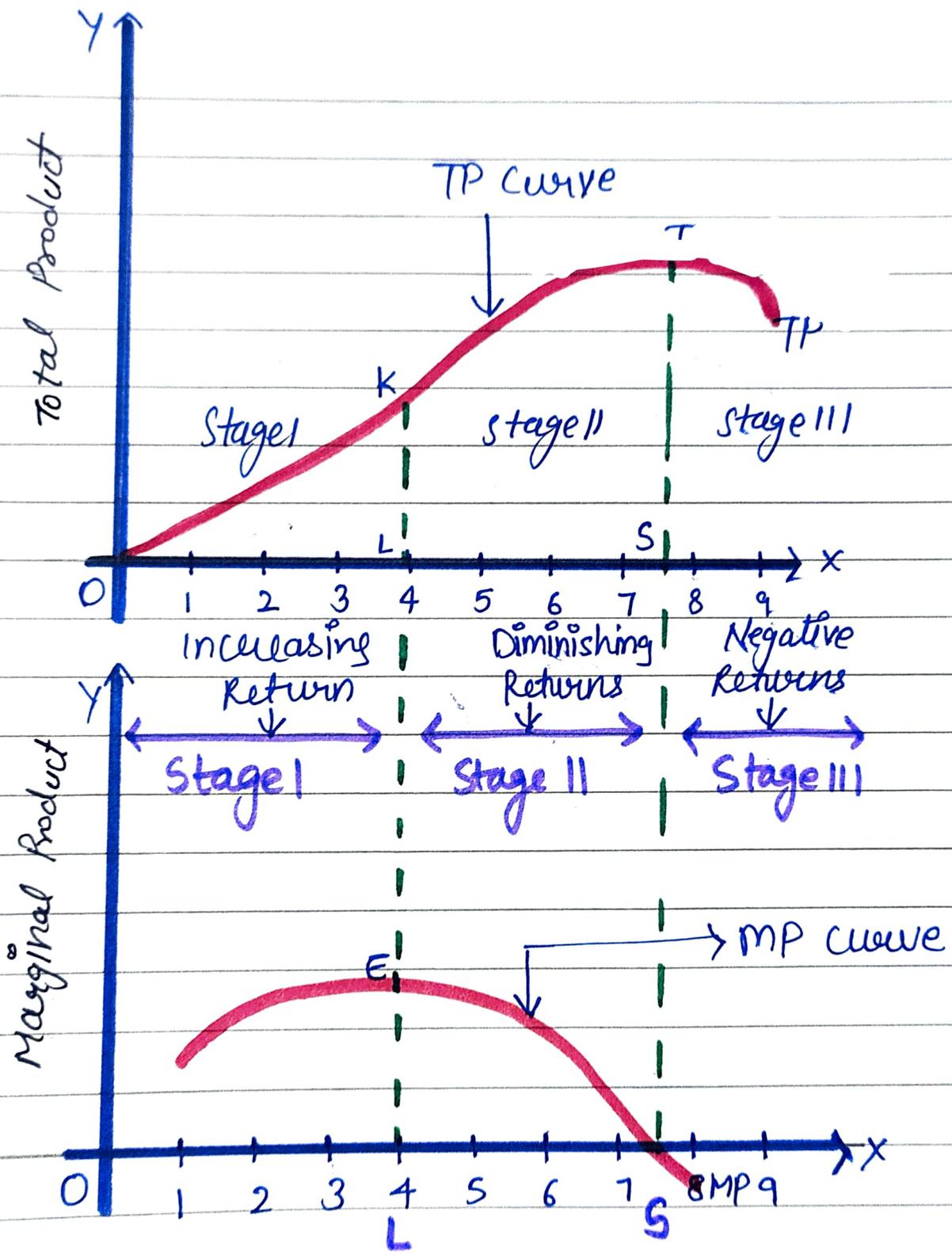
is increased, while other inputs kept constant.

Law of Variable Proportion

The law states that "as more and more" units of a variable factor is used with a fixed factor then, Initially TP increases at increasing rate, TP increase at decreasing rate and finally TP starts falling.

Assumption of the Law of variable proportion :-

1. The technology of production remains constant
2. There is short period of operation.
3. All units of variable factor are equally efficient
4. Factor of production are not perfect substitutes of each other.

Further, the law of variable proportion is explained in following diagram:

Y — Total Product

TP Curve

T

TP

K

Stage I   stage II   Stage III

L   S   X

O   1   2   3   4   5   6   7   8   9

Increasing   Diminishing   Negative
Return   Returns   Returns
↓   ↓   ↓

Stage I   Stage II   Stage III

Y — Marginal Product

MP curve

E

O   1   2   3   4   5   6   7   8 MP 9   X

L   S

Units of the Variable Factor

The above diagram includes two panels i.e (i) and (ii). X-axis of both panels shows variable factor and y-axis of panel (i) show TP & panel (ii) shows MP.

According to above Diagram, the law of variable proportion is classified into three phases:

PHASE I : This phase is also known as the phase of increasing returns where TP increases at increasing rate and MP also rises. It is shown, till K point on TP - curve and Till E point on MP - curve. The Reasons for this phase are:

(1) Full utilisation of fixed factor

This phase operates because the under utilized fixed factors get fully utilized and its fuller utilization invites greater benefit from the use of variable factor.

(2) Increased efficiency of variable factor/ specialization.

Additional use of variable factor leads to division of labour that raises the efficiency of the factor and hence, helps in getting increasing returns.

(3) Better co-ordination b/w the factor
(4) Division of labour
(5) Before the point of optimum combination.

PHASE II : This phase is also known as the phase of diminishing returns where TP increase of decreasing rate and MP falls but remains positive. It is shown, till T point on TP- curve and till S point on MP- curve. The reasons for this phase are :

(1) Better use of fixed factor

The returns start diminishing when fixed factor (land) is fully utilized in relation to labour. This increases burden on fixed factor.

(2) **Lack of Perfect substitutes b/w factors**

There is a limit to the extent of which on factor of production can be substituted for another. E.g. more and more labour cannot be continuously used in place of additional land hence, it leads to diminishing returns.

PHASE III : This phase is also known as the phase of negative returns where TP starts falling and MP becomes negative. It is shown, after T point on TP – curve and after s point on MP– curve. The reasons for this phase are :

(1) **Over utilization of fixed factor**

The returns become negative when fixed factors become over utilized and they are used beyond optimum capacity. This reduces the efficiency of variable factor.

(2) **Poor co-ordination b/w variable factor and fixed factor.**

The continuous increase in variable factor beyond a point crosses the unit ideas combination. This result in poor co-ordination and negative returns.