WELCOME

Forest Economics

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Topics to be covered...

- Sensitivity analysis and its application

- Application of forest economic principles to forestry operations

Sensitivity analysis and its application

- In project analysis, in reality, estimates of costs and returns goes away over time, as prices of agricultural produce as well as the costs of inputs are subject to change.
- Under these conditions, there is need for considering the probable changes in the data required for the project appraisal.
- It is also sometimes necessary to know as to how far our estimates of project appraisal remain constant under the changing situation of costs, prices and yields.
- In such cases, sensitivity analysis are very much useful.
- Forecasting is important.

Sensitivity analysis of the project appraisal includes the following points:

- Considering of the length of the period over the existing ones
- Changes (increase or decrease) in the prices of goods and services by certain proportions of the project, say, by 10%, 20%, 30%, 40%, 50%, etc.
- Changes (increase or decrease) in the levels of costs, say, by 10%, 20%, 30%, 40%, 50%, etc.
- Changes (increase or decrease) in the yield of crops and livestock
- Delays in the implementation, *i.e.*, varying the gestation periods.

Application of forest economic principles to forestry operations

1) Law diminishing returns

- **Factor-product relationship (Input-output relationship)**
- How much to produce?
- Determination of optimum input to use and optimum output to produce
- Law of variable proportions
- Law of life itself, as it is fundamental economic law
- Application of successive units of variables factor, to fixed factor, add more and more to the total product till the point of inflection (MPP is maximum) and thereafter add less and less to the total output
- Alfred Marshall stated the law thus: "An increase in labour and capital applied in the cultivation of a land causes, in general, a less than proportionate increase in the amount of produce raised, unless it happens to coincide with an improvement in the arts of agriculture"

Contd...

- Total Physical Product (TPP): Total amount of output obtained by using different units of inputs, measuring in physical units like quintals, kgs, etc.

- Average Physical Product (APP):

  APP= TPP/Input level=Y/X

- Marginal Physical Product (MPP):

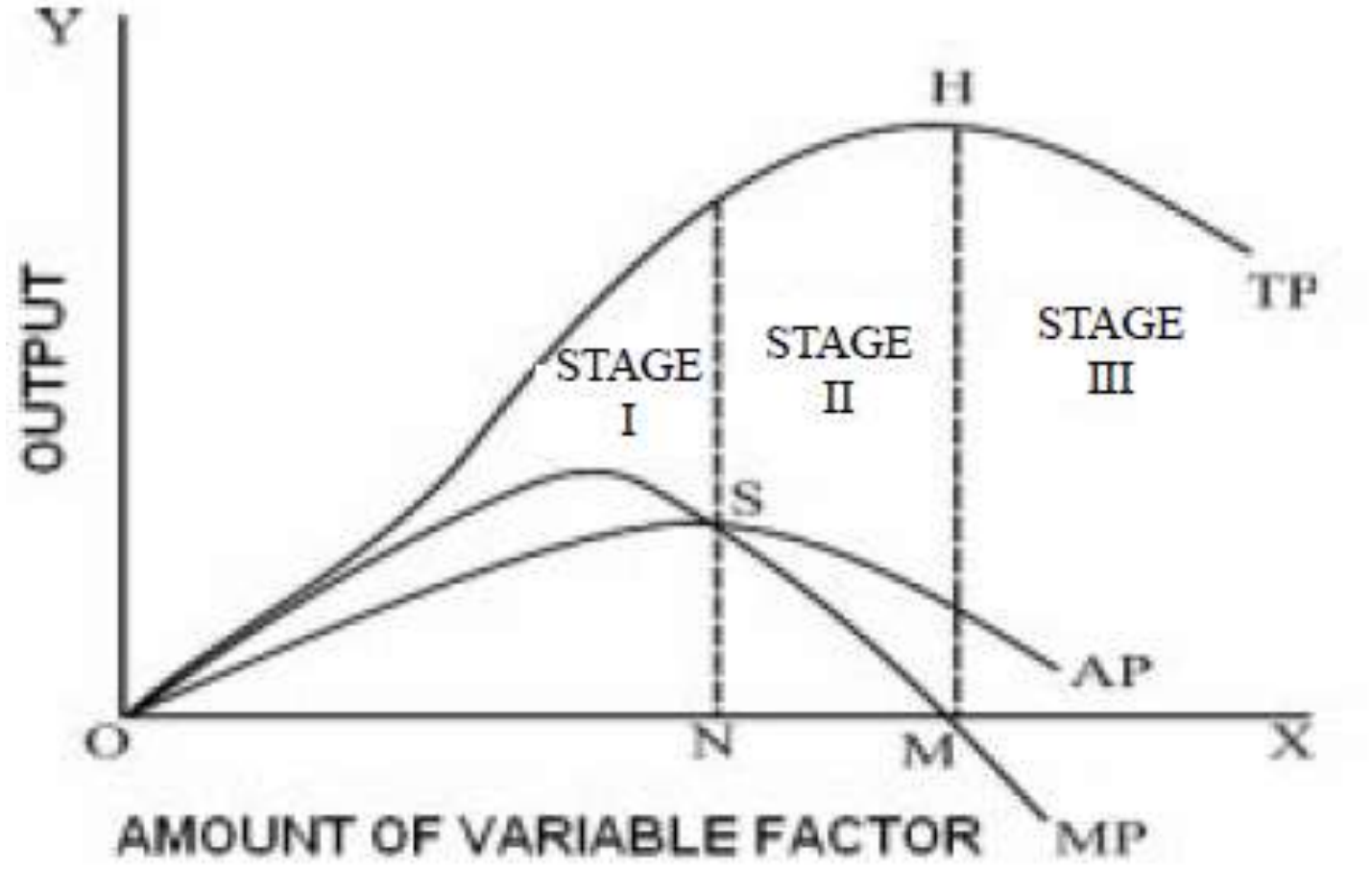
  MPP=Change in TPP/Change in input level= $\frac{\Delta Y}{\Delta X}$

- Elasticity of Production:

  Ep= Percentage change in output/Percentage change in input

  =MPP/APP

Figure: Factor-product relationship



2) Principle of factor substitution

- **Factor-facor relationship (Input-input relationship)**
- How to produce?
- Choice of methods of production or technology or type of combination of resources
- In most real world situations, two or more inputs are often varied simultaneously. So a farmer must choose the particular combination of inputs which would minimize the cost for a given output level

- Thus, the main objective here is minimization of cost at a given level of output.

- When two or more inputs are variables, a given amount of output may be produced in more than one way, i.e., there is a possibility of substituting one factor (X1) for another (X2) as product level (Y) is held constant.

- The objectives of factor-factor relationship are i) minimization of cost at a given level of output and ii) optimization of output to the fixed factors through alternative resource-use combinations.
- In this case, the production function is given by $Y = (X1, X2 / X3, \ldots, Xn)$, i.e., the production depends on the amounts of X1 and X 2 while the other inputs are held constant.

- **ISOQUANT (OR) ISO PRODUCT CURVE**

  An isoquant is defined as the locus of all combinations of inputs, X1 and X 2, for obtaining a given level of output

- The rate at which one factor is substituted for one unit increase in another factor at a given level of output is called Marginal Rate of Substitution (MRS).

$$MRS_{X_1X_2} = \frac{Quantity\ of\ input\ sacrificed}{Quantity\ of\ input\ gained} = \frac{\Delta X_2}{\Delta X_1}$$

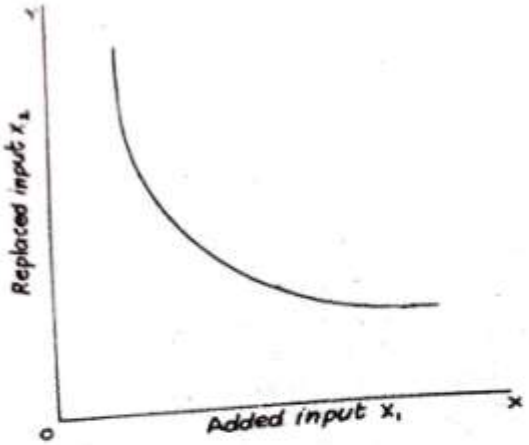


Fig. 19.1 Iso-quant

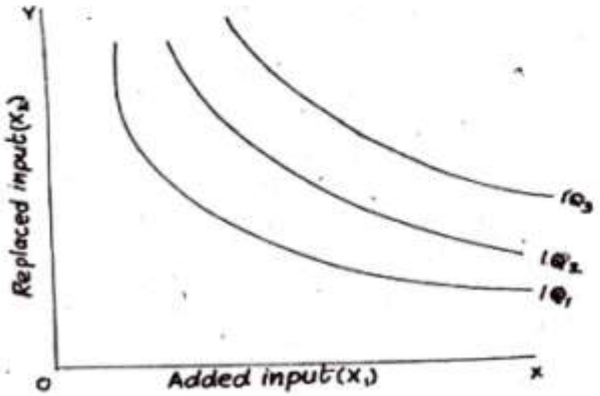


Fig. 19.2 Iso-quant map.

- **Iso-cost line**

  It represents the various combinations of two inputs that can be purchased with the given outlay of funds

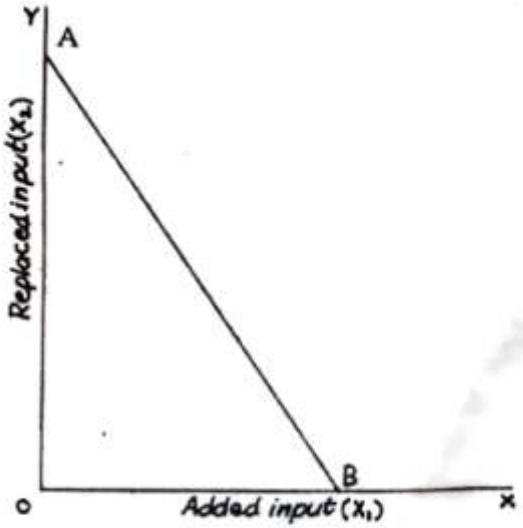


Fig. 19.8 Iso-cost line.

Least cost combination

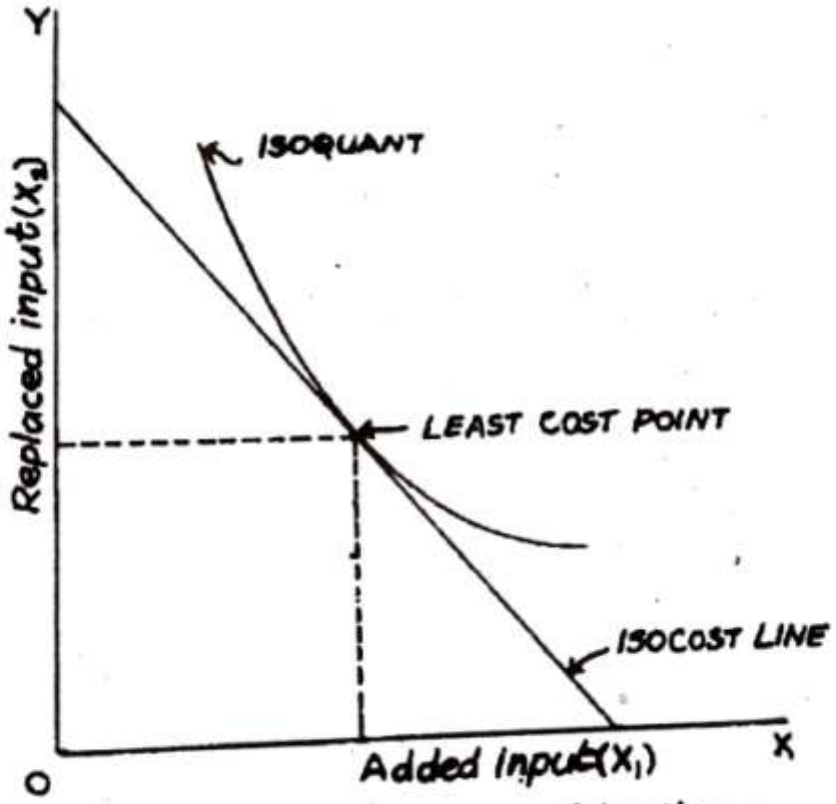


Fig. 19.9 Least cost combination.

- **Ridge lines**

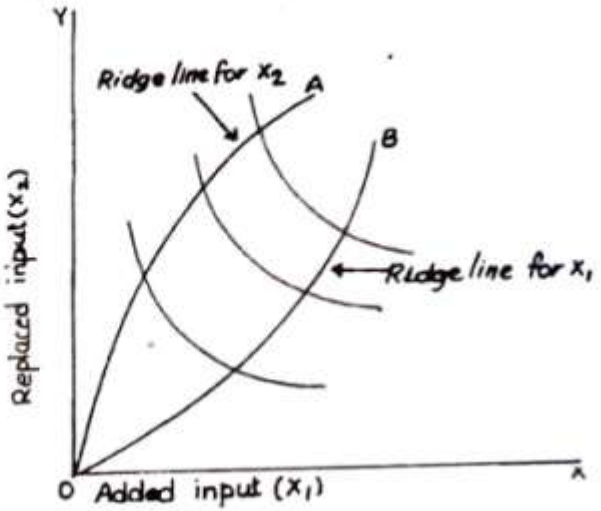


Fig. 19.11 Ridges lines.

3) Principle of product substitution

- Product-product (output-output) relationship
- What to produce?

PRODUCTION POSSIBILITY CURVE (ISO-RESOURCE CURVE)

The production possibility curve or product transformation curve is the locus of maximum amounts of two products, say Y1 and Y2 , that can be produced from a given quantity of resources (X0).

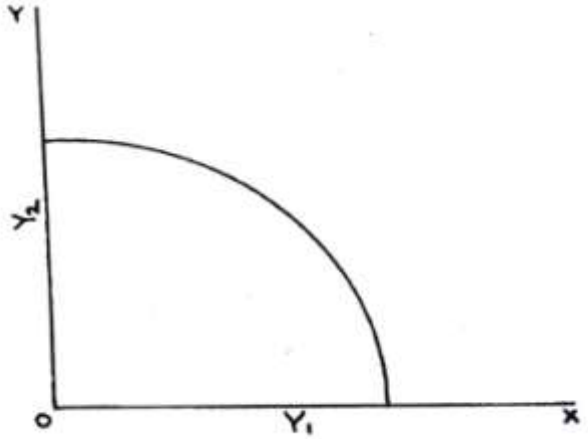


Fig. 20.1 Production possibility curves.

MARGINAL RATE OF PRODUCT SUBSTITUTION

Like factors, products also substitute each other. *The absolute amount, by which one product is decreased in order to gain another product by a unit is called marginal rate of product substitution.*

$$\text{Marginal rate of substitution} = \frac{\text{Number of units of replaced product}}{\text{Number of units of added product}}$$

$$MRS_{Y_1Y_2} = \frac{\Delta Y_2}{\Delta Y_1}$$

Marginal rate of product substitution of Y_1 for Y_2 implies that the amount of Y_2 to be given up in order to gain Y_1 by one unit.

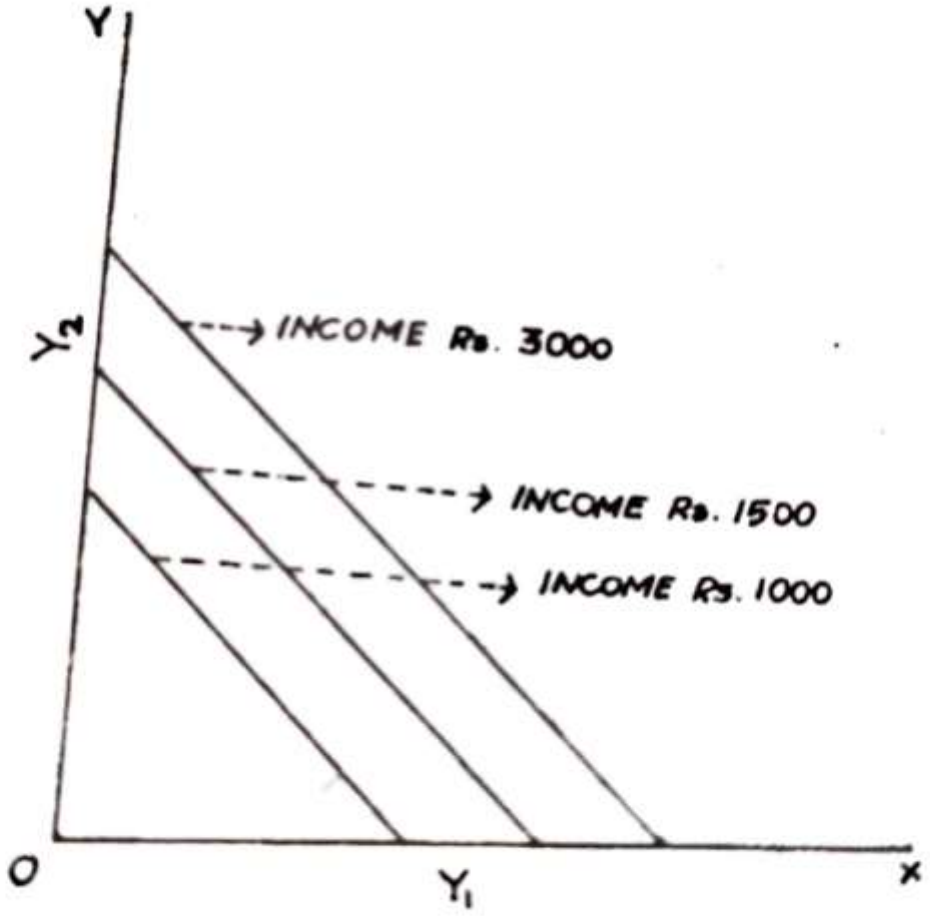


Fig. 20.8 Iso revenue line.

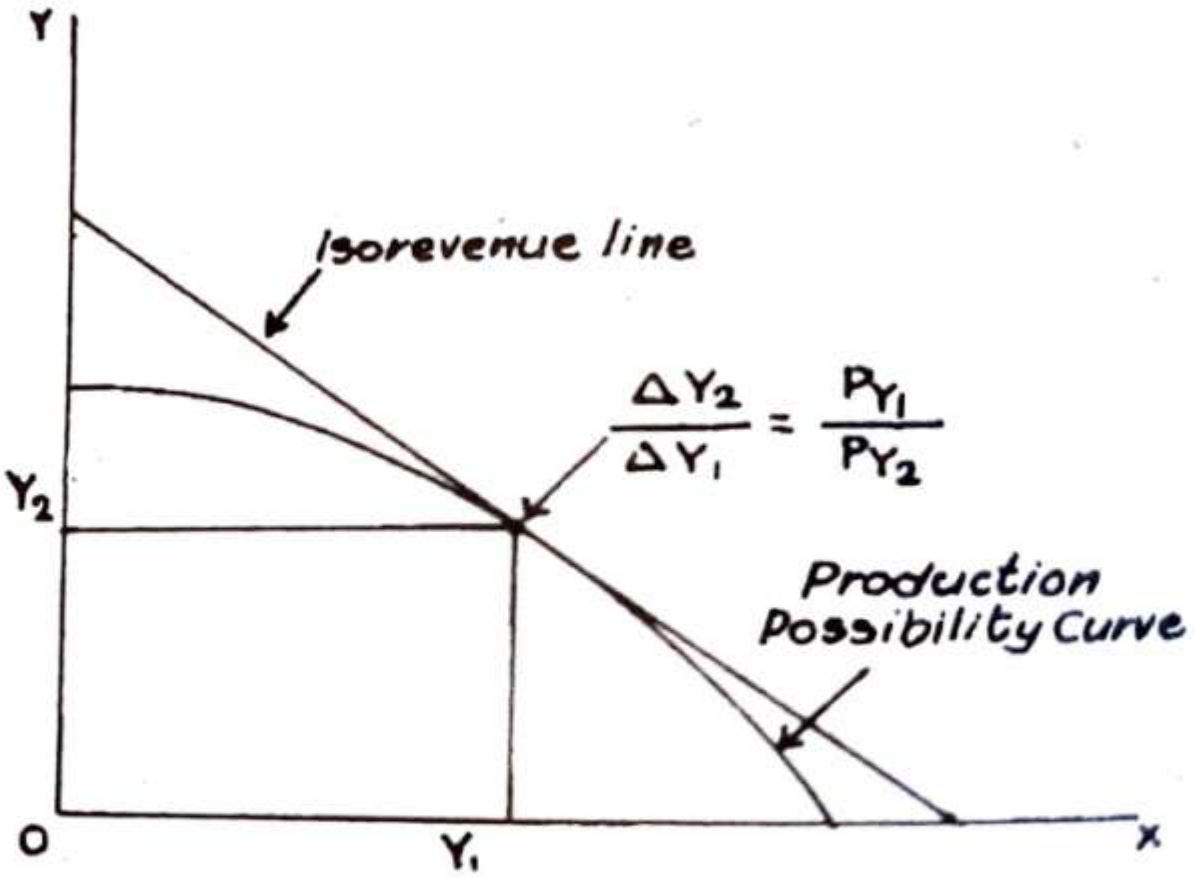


Fig. 20.9 Optimum combination of products.

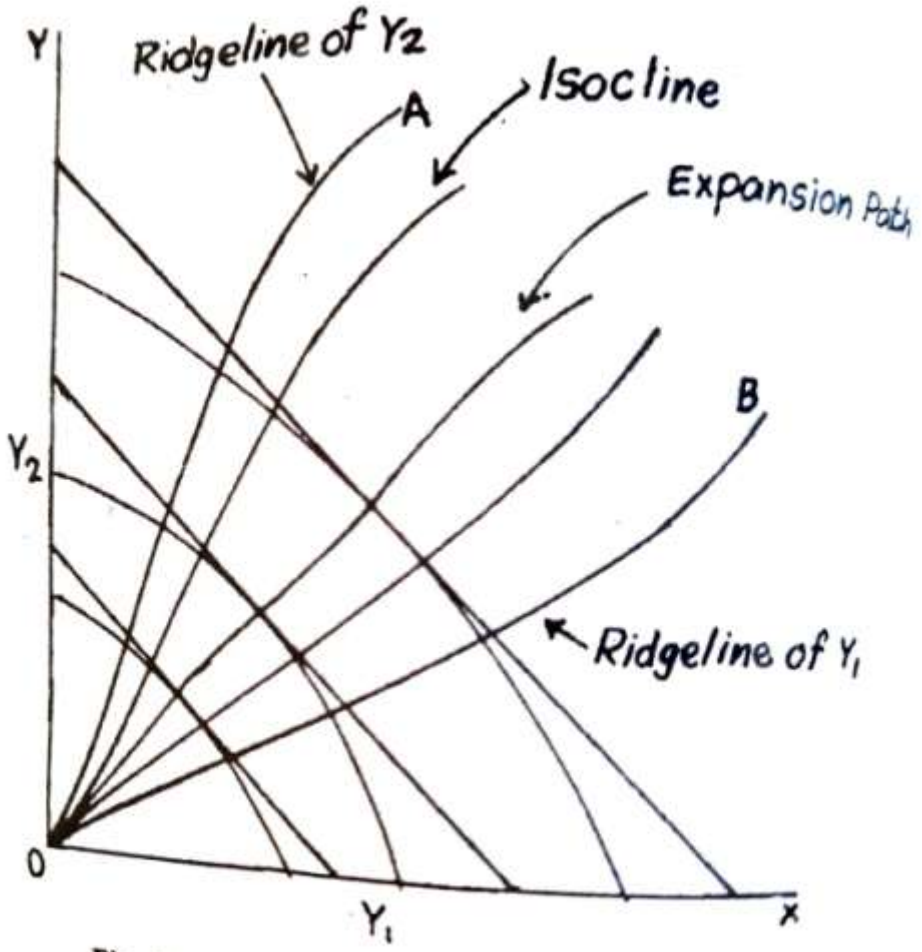


Fig. 20.10 Expansion path and ridge lines.

Summary of Three Basic Production Relationships.

Relationships		
Factor-product	Factor–factor	Product-product
It is concerned with resource use efficiency	It is concerned resource combination and Substitution	Resource allocation
Objective is optimization of resource use	Cost minimization	Profit maximization
Management problem: How much to produce	How to produce	What to produce
Determination of optimum input to use and optimum output to produce	Least cost combination of resources	Optimum combination of enterprises
Choice indicator		
Price ratio	Substitution ratio and price ratio	Substitution ratio and price ratio
Single variable production function Law of diminishing returns explains the factor–product relationship $Y = f(X_1 \mid X_2, X_3 \ldots X_n)$	Output is constant and inputs are varied Principle of factor substitution, explains factor–factor relationship $Y = f(X_1, X_2)$	Input is constant and products are varied Principle of product substitution explains product-product relationship $Y_1 = f(Y_2, Y_3 \ldots Y_4)$

Other Principles

4. Principle of equimarginal returns
5. Opportunity cost principle
6. Minimum loss principle
7. Principle of comparative advantage
8. Time comparison principle- Compounding and discounting
9. Partial budget models to estimate profitability of a forestry enterprise
10. Optimization models to estimate land expectation values assuming that the land will be used for forestry (the best possible productive use) in perpetuity
11. Linear and non-linear programming models to estimate optimum resource allocation subject to various constraints faced by the decision-maker

12. Econometric models to estimate the relationships among variables under investigation for forecasting, policy analysis, and decision-making

13. Stated and revealed preference based contingent valuation models to estimate values for environmental goods and services such as recreation, soil conservation, and water quality

14. Economy-wide models such as input-output, social accounting matrix, and computable general equilibrium models to estimate income, employment, and price levels at regional or national level, in response to a policy or program

Important books

- Forest Economics, Valuation & Projects- Dr. S.S. Negi
- Agricultural Economics- S. Subba Reddy, P. Raghu Ram, T.V. Neelakanta Sastry and I. Bhavani Devi
- Forest Economics: Principles and Applications- J.C. Nautiyal
- Forest Economics & Valuation- Madan Mohan Pant
- Forest Project Analysis and Management by Dr. P. Subramanian and Dr. S. Senthilnathan
- Environmental Economics: Theory, Management & Policy- M.L. Jhingan and Chandar K. Sharma
- Basic Readings in Forest Economics- P.K. Muraleedharan, K.K. Subramanian and P.P. Pillai (KFRI Publication)

THANK YOU