LEVELS AND PATTERNS OF PRODUCTION OF THE FOREST-BASED INDUSTRIES AND THEIR IMPACT UPON ECOLOGICAL-BALANCE IN MEGHALAYA.

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Certified that Ms. Sumitra Chowdhury has worked under my supervision for her M.Phil Dissertation entitled 'Levels and Patterns of Production of Forest-Based Industries and their Impact upon Ecological-Balance in Meghalaya', and no part of it has been submitted elsewhere for the award of any other degree. The dissertation, in my opinion, is worthy of awarding the said degree.

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CHAPTER - I

INTRODUCTION

Socio-economic processes have generally been evolutionary in nature though revolutionary changes have also been recorded at times. The process of development is also evolutionary by and large though planned efforts to accelerate it may also be designed and executed. Economic development[1] may be understood to refer to the advancement of society which brings in its trail increased material welfare through increased consumption and increased production. Production and hence consumption may be increased by the application of better methods of production, by the adoption of better techniques of production, employment of higher human skills and energy, better organization and increased investment of capital and other resources in the production processes. All developmental activities should ideally be directed towards a common goal - the rational use of all resources to achieve the highest quality of living for the human society. But if the achievement of welfare through increased material wealth and development is seen as the natural and proper goal of men's activities, then the mastery of men over nature becomes a fulfillment of human goals thereby bringing a close relationship between the economy and the ecosystem. Because, human beings cannot survive without consumption and increased consumption and increased material welfare go hand in hand. Greater the consumption needs, gross outputs are needed to be produced in ever increasing quantities to produce which we will require ever increasing resources of several kinds. When these resources are used in the production processes, either:

a) these are exhausted by single use, like raw materials, or

b) these are capable of being used again and again in the production processes for a considerable period of time, like buildings, plants and machineries, etc.

The first category of resources are known in economics as working capital, whereas, the second category is known as fixed capital.

Working capital may again be divided into

i) man-made working capital, like chemicals, and
ii) natural resources or partly processed natural resources. These natural resources may or may not be renewable. But whatever resources are used in the production processes, these are extracted from nature either directly or indirectly. Thus, a faster rate of economic development requires a faster rate of extraction of natural resources. Not only that, both in the consumption and production processes a part of the resources get converted into wastes which may tend to flow again into nature. This reflow of the waste materials into nature may or may not be autonomous; and the autonomous

reflows wherever these occur may be injurious to the system. Several advanced technologies of production tend to create some undersirable side effects which may have serious adverse effects on the environment. Hence, the planners and policy makers will have to be careful about the fact that the mother earth is ecologically a delicate system even though it is astonishingly resilient within specified limits. Once the limits are transgressed, however, irreversible processes may easily be set in motion which will make it impossible for it to return to the original state.

The environmental effects of the industrial revolution have been massive. We have a global environmental crisis - a conflict between development and environment - caused by industrial and urban pollution, ill-conceived management of the environment, thoughtless consumerism, almost perverse political considerations of defence and above all an uncontrolled growth of population. These problems are very serious, but unfortunately, these are not always fully recognised or understood in all their ramifications. The developed coutries of the West realised the implications of the modern economic development for ecological balance only when serious damage has already been done.

However, the developing countries have an advantage in so far as some of the serious consequences of economic development to ecosystem have by now become obvious and these have come to be recognised as such. Some of the damages to ecology have been caused by the wrong and improper priorities of development. The developing countries seem as yet to be inclined to think that the negative aspects of economic development are bearable if they bring with them the enhanced prosperity which is currently enjoyed only by the industrialised countries. Perhaps, this is due to the fact that people facing immediate and elementary problems of survival resulting from the deficiencies of nourishment, inadequacy of the housing facilities, want of ever minimum clothing, etc. are hardly able to perceive the adverse effects upon ecology or to understand the seriousness of the likely consequences that may become effective in future. The lack of understanding of ecological effects of technical development have already resulted in many a valuable natural resources being pushed to near exhaustion. Ecological-balance has greatly been disturbed. Indeed, we face a major environmental crisis ahead which we may not be able to surmount.

Nature of the problem

Ecological imbalance in the hilly areas of the north-eastern region of India in general, and particularly in Meghalaya, is mostly the consequence of the large-scale deforestation that has been taking place for long. The economy of the state can indeed be described as a forest-based economy. The forests play a dominant role in the economy of its inhabitants. There are multi-purpose uses of forest resources. For example, forest resources are used directly or indirectly -

i) to meet fuel demand for charcoal and firewood;

ii) to meet demand for conveniences and luxuries, like baskets, furniture and other household materials for decoration;

iii) to meet the needs of the construction-industry which is much more wood intensive in this region than what it is in other parts of the country;

iv) to meet the demand for necessities, like brooms, etc.;

v) to meet demand for sports goods industries;

vi) to meet demand for wooden sleepers for railways and wooden railway wagons;

vii) to build vehicle bodies, bridges, etc.;

viii) to meet the demand for forest-land for cultivation in the 'slash and burn' method of 'jhum cultivation';

ix) to meet the ever increasing demand for land for housing which the explosively growing population demand for, and for roads and other infrastructural facilities that expand concomitantly with economic development in general and urban development in particular;

x) for supplying the people with wide varieties of food materials - roots, shoots, tubers, leaves, etc.;

xi) to meet the demand for herbal medicines, etc.; and

xii) to meet the demand for exports both to the other states of the country and to other countries.

In order to meet all these requirements the pattern of production has to match the patterns of demand. The indiscriminate cutting of forests for meeting all these diverse demands at an ever increasing scales for forest products has resulted in large-scale deforestation that has been intensifying at very rapid rates. It appears, therefore, that we have given least importance to the fact that forests play some very important roles in the maintenance of ecological balance. Some of these roles are described below:

i) Trees have an important role in the absorption of carbon-dioxide and in the releasing of the oxygen into the atmosphere. By converting carbon-dioxide into oxygen, they tend to keep the atmosphere healthy. A hectare of natural green forests yields 600 kgs. to 650 kgs. of oxygen within 18 hours in which process upto 900 kgs. of carbon-dioxide is used up.

ii) A healthy forest supports a number of micro systems of fungus, insects, birds and other animals which feed on each other and depend on each other in a variety of ways.

These organisms contribute to maintain a healthy balance in nature.

iii) Trees keep the delicate ecological balance of the soil; the falling leaves provide humus, the nutrients of growth which fertilise the soil which is very important for agriculture. It is thought that in the mountains and the hills, at least 65% of the area must be under tree cover to retain the fragile top soil.

iv) Trees prevent soil erosion and protect the soil from the extremes of heavy rain and strong winds, and prevent land-slides in the hilly areas.

v) Trees provide cool belts in hot climates; it is estimated that the strips of 50 to 500 metres wide forest can reduce temperature by 3° to 5°C.

Hence, the extensive use of forest resources without proper afforestation will automatically undermine the stability of the ecology.

Some studies have been taken up to study some of these aspects by the life scientists. But the study of ecology in relation to human society in general and economic development in particular has not attracted the attention of the economists as it should have. The present study is a modest attempt to focus attention on this aspect of the problem.

Objectives of the study

The present study constitutes the second part of a larger study. The two parts or the stages of the study are as follows:

i) Patterns and growth of consumption of forest-based commodities, and

ii) Levels and patterns of production required to maintain such levels and patterns of consumption through time, and the determination of the implications of these patterns and levels of production on ecological balance.

The first part has already been taken care of by another researcher[2] of this Department. According to the study thirty-five forest-based commodities constitute the major items of private consumption. These thirty-five commodities are as follows:

1. Almirah made of wood,
2. Almirah made of mixed variety,
3. Chair made of wood,
4. Chair made of cane,
5. Chair made of mixed variety,
6. Table made of wood,
7. Table made of cane,
8. Table made of mixed variety,
9. Bed made of wood,

10. Fancy article made of wood,

11. Fancy article made of cane,

12. Fancy article made of bamboo,

13. Stools, benches, desks made of wood,

14. Stools, benches, desks made of cane,

15. Stools, benches, desks made of mixed variety,

16. Coach, sofa made of wood,

17. Coach, sofa made of cane,

18. Coach, sofa made of mixed variety,

19. Bookrack made of wood,

20. Bookrack made of cane,

21. Bookrack made of mixed variety,

22. Hanger made of wood,

23. Alna made of wood,

24. Firewood for cooking,

25. Charcoal for cooking,

26. Free dry branches, wasted articles for cooking,

27. Wood collected from forest for cooking,

28. Match-box,

29. Fuel for heating rooms,

30. Sports goods made of wood,

31. Sports goods made of cane,

32. Sports goods made of bamboo,

33. Sports goods made of mixed variety,

34. Broom made of bamboo,

35. Broom other than bamboo.

The study of the levels and patterns of consumption of these commodities is based on the data that have been generated by a special sample survey conducted for the purpose. The study has helped in identifying the determinants of the levels and patterns of consumption of these goods. These results have furnished us the base for the second stage of the study.

The major objectives of the present study are as follows:

a) To estimate total consumption of these thirty-five commodities in the State of Meghalaya in the base year of 1984-85.

b) To project the demand for consumption for these goods for the target year of 1989-90 which coincides with the last year of the Seventh Five Year Plan.

c) To estimate the levels and patterns of production of these thirty-five commodities that will be required to meet the specified patterns and levels of demand both in the base and target years.

d) To determine the likely impact of these patterns and levels of production upon ecological balance, especially deforestation.

Hypotheses of the study

We may formulate two plausible hypotheses which can be taken to be each other's alternative:

1) The patterns of consumption of forest-based products correspond to the current levels and patterns of production of these goods.

2) Alternatively, the levels and patterns of output of forest-based products at any point of time are determined by the levels and patterns of the consumption.

3) An associated hypothesis will then be if current trends of the growth of consumption continues for a reasonably long period of time, a major portion of the forest area will be deforested unless these trends are reversed or remedial measures are initiated simultaneously. It may also imply that the levels and patterns of both consumption and production of forest produce may not correspond to the optimum levels and patterns that are compatible with ecological equilibrium. The continuation of current developmental trends will, therefore, further accentuate the ecological disequilibrium and the discordance between ecology and economic development.

Chapter Scheme

Keeping in view the above objectives and hypotheses of the study the dissertation has been organised into the following chapters:

First chapter is the introductory chapter where we have introduced the problem undertaken for study.

For our study, it is essential to understand the concept of 'ecological balance'. Therefore, the second chapter has been devoted for discussing the meaning and nature of balance in economics and in ecology. From this we have made an attempt to specify the nature of 'ecological balance'.

Chapter-III is devoted to the estimation of consumption-levels of the thirty-five forest-based commodities in the state of Meghalaya in the base year. We have also discussed the precision of our estimates and problems thereof.

Chapter-IV discussed the projected levels of consumption upto the target year.

Chapter-V discusses the determination of the levels and patterns of production to match the estimated levels of consumption.

Chapter-VI discusses the implications of the projected levels and patterns of production of forest-based industries for the ecological-balance. A part of the chapter attempts to depict briefly the forest-ecology of Meghalaya.

Chapter-VII is the concluding chapter where we discuss the major findings of the study and suggest some policy measures to tackle the problem of ecological-imbalances in Meghalaya.

NOTES

1 The term economic development is used interchangeably with such terms as economic growth and economic progress. But economists have made some technical distinctions among them.

Conceptually, the developmental processes are classified into two categories:

i) Factor multiplication process, and

ii) Factor transformation process.

Under the first process, increased quantities of productive resources are used in the production processes without therebeing any improvements in the quality of the resources and the methods and techniques of production. Consequently, the output per unit of resource inputs does not change though the total output increases.

Under the second process both the quality of resources and the methods and techniques of production show marked improvements which raise both production and productivity.

The process of factor multiplication is known as the economic progress, whereas, the process of factor transformation is known as the economic growth. In practice, two types of processes often intermingle.

Absorption of factor transformation process, i.e., technological-changes, necessitates drastic changes in organizational and institutional set up. This process of overall change in socio-economic milieu may be defined as economic development.

2 Roy, D.C. - Economic-Development, Consumption Patterns and their Impact upon Ecological Balance with Special Reference to Forest-Based Industries (A Case Study of Shillong City). An unpublished M.Phil Dissertation submitted to the North-Eastern Hill University, Shillong, 1986.

CHAPTER - II

ECONOMIC EQUILIBRIUM AND ECOLOGICAL BALANCE

2.1 "The study of any problem in economics, whatsoever its nature, ... is a study of equilibrium, with a view to equilibrium ... Whenever we make a statement of a theory or a principle, we always relate our conclusions to the position of equilibrium ...[1]. Thus, it is customary that we first state the conditions of equilibrium and then proceed to find out the difference between the actual conditions and the conditions that are associated with the equilibrium state. Therefore, it is natural that while making a study of the problem of "Levels and Patterns of Production of Forest-Based Industries and their Impact upon Ecological Balance" we shall start by making an attempt to understand the concept of 'ecological balance' and the conditions that are expected to be there when the ecology is in equilibrium.

Since our study relates to ecological aspect of economic system or environmental economics as it is called by most of the authors our approach will be to discuss first (i) what does 'ecology' mean to us, (ii) what are the links between economics and ecology, and then (iii) to discuss the meaning and nature of 'balance' in economics and ecology respectively.

2.2 Ecology

The term 'ecology' appears to have first been used in the middle of the nineteenth century by a German biologist Ernst Haeckel when he tried to give contents to the term as follows:

"By ecology we mean the body of knowledge concerning the economy of nature -- the investigation of the total relations of the animal both to its inorganic and to its organic environment including, above all, its friendly and inimical relations with those animals and plants with which it comes directly or indirectly into contact".[2]

The definition has been modified subsequently a bit, and today, it is thought that ecology refers to that branch of study in biology which deals with relationships of all organisms (not only animals) to one another and to their surroundings.

Webster's Third New International Dictionary gives three meanings of ecology:

1) A branch of science concerned with the inter-relationships of organisms and their environment;
2) The totality or the pattern of relations between organisms and their environment;
3) Human ecology, a branch of sociology that studies the relationship between human community and its environment.

To be specific, the first definition relates to the work of professional ecologists who try to understand through the observations and experiments in the laboratory the laws that govern the interactions of living and non-living organisms with their environment.

The second definition indicates a more general use of the term as 'the ecology of Khasi pine', etc.

The third definition describes the totality of the relationship between human community and its environment. It is in this sense that we use the term for our purpose. This is so, because the study of 'environmental economics' is a branch of the study of applied human ecology, i.e., economics and ecology.

2.3 Economics and Ecology

Some of the environmental economists like Matthew Edel[3] think that population growth is the first ecological problem to concern economists when in the late eighteenth century a British economist, Thomas Robert Malthus, called attention to the conflict between expanding population and the capability of the earth to supply food to sustain that population, But in the course of gradual development, it has been discovered that the population increases faster than the total resource requirements, and not just food, that can be produced and recycled thereby causing serious environmental damage. Hence, it is felt that the time has come for man to manage rationally his own numbers as well as the resources on which he depends. Thus, the management of ecosystem and applied human ecology become new ventures that require merging of a host of disciplines. Therefore, like experts in other disciplines of Sociology, Anthropology, Geography, etc., economists have also developed interest in finding the links between the two sciences of 'economics' and 'ecology'.

D.W. Pearce[4] says that part of the function of investigating the links between ecology and economics is to see what common grounds the two disciplines have and to discover the contrasts, incompatibilities and inconsistencies that exist between the approaches of the two.

Edel's[5] book 'Economics and the Environment' is partly an attempt in this direction. He explains in the first chapter that the book explores the relations between two systems dealing with the interconnected phenomena. One deals with the economy, a social institution by which human beings determine who will do what work, what they will produce, how they will produce it, and who will consume what and how much. The other is the ecosystem, consisting of the relationships between organisms and their environments. These are the relationships that are subject to physical, chemical and biological laws. But there are three similarities. Firstly, just as economics studies flows of resources and products, ecology deals with flows of energy and nutrients. Secondly, both study the equilibrating mechanisms of these flows. Thirdly, both economics and ecology consider the growth and evolution of their respective systems through time.

The two sciences, however, differ in one important matter of emphasis. The system that economists consider reflects directly the consequences of deliberate human decisions -- both in the determination of actions within the framework of the given system, in the choice of the basic institutions that constitute the system, as well as in the choice of the system itself. This makes economics to be the science of choice making, as the choices concern the patterns of allocation of scarce resources among competing ends as well as the choices between ends themselves. It studies economic institutions and their effects on choice making behavioural patterns at a given point of time and it also evaluates the appropriateness of the institutional set up itself to the chosen goals and the developmental processes in operation through time. Consequently, changes in the institutional structures also furnish an interesting area of study.

Ecology has been less concerned with deliberate choice, but recently it has directed its attention to the issues of the decay and survival which have been ignored for long by economists. It has been realised that intereactions between the economic activities and ecosystems have endangered the very survival of the ecosystems and therefore, the study of these inter-relations can no more be ignored.

An interesting point to be noted is that both the words 'economics' and 'ecology' have the same root 'oikos' a Greek word that refers to 'house' or 'households'. Thus, it may be taken to indicate interlinkages between the two disciplines although the strength of these linkages seems to have been realised only recently when it has become painfully evident that the most pressing problems like scarcities of resources, particularly non-renewable ones, and environmental pollution are, to a great extent, caused by economic development. It is this realisation which has opened up new vistas of inter-disciplinary approaches to the problems common to both economics and ecology, in general, and the limits to growth set by ecological balances and the consequences of developmental processes to the ecosystem. Ecosystem is both a constraining and the facilitating factor of economic development. Investigation of such inter-relations has led to the birth of a new branch of economics which is defined by Prof. Prakash as 'econology'[6] -- the study of ecological aspects of an economic system'. The present study has also been inspired by the curiousity to discover and discern some aspects of the inter-relations between economic development and ecological balance. For an understanding of this aspect, it is essential to know the meaning of the term 'balance'.

2.4 a) Meaning and Nature of 'Balance' in Economics

The term 'balance' may also be called 'equilibrium' which is the term commonly used in economics. The term 'equilibrium' is derived from the Latin word 'aequilibrium' meaning 'equal balance'. The use of this term in economics has been imported from mechanics. In mechanics and other physical sciences, the term is used to denote a state of balance in which opposing forces or tendencies neutralise each other so that the object under consideration comes to a position of rest -- the position in which it does not move in space. The attainment of the state of rest where there is no movement in space at all is meaningful in physical sciences, which study the behaviour of matter or lifeless objects. But if all movements come to a stand still, the economic system would collapse. In economics, we study the equilibrium of human behaviour and those entities with which human beings are closely related. Thus, we study the equilibrium of such activities as production, consumption, export, import, demand and supply etc.. The primary and the ultimate objective of these studies is equilibrium of man and the equilibrium of man is the equilibrium of mind. But while studying the equilibrium of mind we have to keep in view that the mind bears a definite relationship to environment. Hence, we conclude, since economics relates to the study of human behaviour and we expect every individual to behave rationally, equilibrium can best be defined here as a situation where the most desired position of the operating forces is reached under given circumstances. Thus a person is in equilibrium when he regards his actual behaviour as the best possible under given circumstances and feels no urge to change his behaviour as long as circumstances remain unchanged. For example, a consumer is in equilibrium when he maximizes his satisfaction or utility, given his tastes, level of income and prices of the commodities, etc.. But this is only one aspect of economic equilibrium which is necessarily the equilibrium of human mind and can better be called <u>micro-economic equilibrium</u>. We can think of other aspects of economic equilibrium of aggregate quantities and aggregate entities which do not include human mind. For example, we can think of equilibrium in terms of equality between aggregate savings and aggregate investment at a given level of national income. This type of equilibrium is referred to as <u>macro-economic equilibrium</u>.

There are several ways of expressing the equilibrium of economic quantities. A firm is in equilibrium when i) its marginal cost equals marginal revenue, ii) its output tends neither to increase nor decrease, iii) all possibilities of maximizing profit have been exhausted, and iv) flow of resources into it per unit of time remains constant.

Professor Mehta considers that the last way of defining equilibrium of a production unit is the best since it brings the meaning of equilibrium in conformity with its meaning in mathematics. He says, 'a production unit is said to be in equilibrium when it shows no tendency to expansion or contraction within a period of time under consideration'.[7] Thus, according to him time element is very important in equilibrium analysis.

Another point to be noted is that equilibrium can be single point equilibrium or multiple points equilibrium. If the operating forces acting in opposite directions intersect each other only at one point, we get single-point equilibrium and if they intersect at more than one point, we get multiple points equilibrium.

There has been a criticism that equilibrium can never be achieved in real life. Hence, it is hypothetical and imaginary. But "... this criticism misses the real point" that "... although equilibrium does not exist in life, yet it can always be well utilised since we always need some ideal scale for comparative purposes."[8]

Moreover, equilibrium is not so unrealistic and imaginative as it is thought to be. As a matter of fact, it can and it often is achieved but for a moment. It is not able to persist for long as conditions undergo changes very quickly.

Besides, in real world, there is always a tendency towards equilibrium. The idea of equilirbium become clearer when we explain its different varieties.

2.4 b) Types of Economic Equilibrium

Economists divide equilibrium broadly into two categories, viz., (i) static-equilibrium and (ii) dynamic equilibrium. Again, these two terms 'static' and 'dynamic' have been borrowed from mechanics.

In mechanics, "static' implies a position of rest or absence of movement. But, economic static presupposes that the manner in which economic unit functions is the same as it functioned in the past and it will function similarly in the future. Thus, static equilibrium, in economics, is that equilibrium which maintains itself outside the period of time under consideration. Thus, in physical sciences, static equilibrium is characterised by absence of movement; in economics, it is characterised by the absence of change, that is, absence of growth or decay. In Professor Hicks' version, the static economy is a timeless economy in which various phenomena and their effects are analysed without reference to time,

But, static analysis has only a limited scope to deal with real life economic problems. Because, it assumes away time whereas, economic changes take place through time rather at every moment of time. Therefore, we need to introduce economic dynamics. In economics, 'dynamics' refers to the study of economic change. The economic unit may undergo change with respect to matter, space and time. For example, in the process of manufacture, the matter may undergo change. The process of transportation relates to change in apace and the process of stocking relates to change in time.

Economic dynamics, however, refers to the last type of change, i.e., change in time. Unlike physical sciences economic analysis deals with the magnitude and the direction of change through time in operating forces or agents under consideration.

While the economy is in the process of change through time, the economic variables may change in two ways. One way is that as the time element has undergone a change, the economy also changes but its patterns and rates do not change. Thus the values of the economic variables will move at the same constant rates. The second way is that the economy may evolve through time and change both its patterns and rates so that the economic variables are non-stationary through time. This latter type of change relates to 'economic dynamics'. Economic dynamics takes us closer to reality. Here we take into account changes, lags, sequences, cumulative magnitudes and even expectations.

Professor Mehta considers that an economic equilibrium is reached when no further adjustment between the opposite forces is possible within the period of time under consideration and all adjustments that could be made have already been completed. He said that this period of time "in limiting cases may contract to a point of time or extend to eternity. In the former case, all situations of necessity become positions of (dynamic) equilibrium. In the latter ...., equilibrium and static equilibrium become identical terms".[9]

Thus, dynamic equilibrium is a short period equilibrium which does not maintain itself in the next short period, as further adjustments will be required to be made outside the period under consideration. Dynamic equilibrium is thus a moving equilibrium, and the moment it is established it is disturbed, then again established and again disturbed, and so on.

Professor Boulding thinks that apart from static and dynamic aspects of equilibrium, another aspect which he calls expectational equilibrium is very important in modern theory. According to his idea, expectational equilibrium is a condition in which the expectations of various organisms of society are mutually compatible and are fulfilled. But, the expectations of different persons may be contradictory. Besides, there is uncertainty which makes the concept of expectational equilibrium not a 'point' but a 'cloud' shading away into varying degrees of disappointment.

There are other varieties of equilibrium, viz., stable, unstable, neutral, and stock and flow equilibrium, etc..

Under stable equilibrium the operating forces concerned after having been disturbed tend to resume original position. The convergent type of cobweb model is associated with the stable equilibrium.

Again, if the small disturbance calls out further disturbing forces which act in a cumulative manner to drive the system away from its initial position, it is unstable equilibrium. A divergent cobweb system is associated with this type of equilibrium.

If, however, the initial position of equilibrium is disturbed, both the forces of disturbance bring it to the new position of equilibrium where the system comes to rest, then this becomes the case of neutral equilibrium.

Economic equilibrium may also be distinguished into flow equilibrium and stock equilibrium. Flow equilibrium of a firm may be defined as a position when there is no net inflow or net outflow of resources, i.e., when the flow of resources into it or out of it is constant over time. When flow equilibrium is there stock equilibrium will always be there. Because when value or amount of inflow is just equated to that of outflow, stock is not affected by inflow or outflow of resources and remains just as it is. It implies no change in stock.

Economic conclusions can also be arrived at any moment of time either by partial equilibrium analysis or by general equilibrium analysis. A number of forces always exert pressure on a particular phenomenon, though all of them are not equal in intensity. If we try to analyse all these forces, many complexities arise. To avoid these complexities, we can adopt partial equilibrium approach where we always take into account the most powerful forces and assume other things which have negligible effect remain the same for the time being.

In general equilibrium analysis, however, we take into account all the forces that might be exerting pressure on the given phenomenon, however insignificant some of them may be. Besides, equilibrium of all the phenomena is to hold simulataneously.

2.5 Ecological Equilibrium

From theoretical view point, ecological equilibrium may correspond to each variety of economic equilibrium. But a brief review of the available literature reveals that the term 'ecological-balance' lacks a conceptual base till date.

Some ecologists have discussed 'equilibrium level of population'. Accordingly, a particular species or population is in equilibrium when it reaches its maximum size which the environment can support. From this point of view one can infer that ecological system will be in equilibrium if all the existing species in that system have attained the optimum levels relative to their respective environs, so that the ecology of that particular ecosystem and the organisms belonging to it will be mutually balanced. Thus, ecological balance may be taken to be the case of general equilibrium. But in practice, it may be very difficult to find a general equilibrium solution of this type. This is so because, for determining whether a given population has attained precisely the optimum size which its e environment will just be able to support, one must first know all the direct and indirect relationships of this particular population with all other species in their surrounding environments. But it is neither possible to find out exactly how many species are there even in a small ecosystem nor is it possible to identify all the direct and indirect relationships of various organisms with each other in a universal set. Thus, the difficulty is not conceptual in nature. It rather impinges upon imperfect knowledge and inadequate information base. If these two limitations are overcome, the general equilibrium of ecosystem will be determinate. To the extent to which an ecosystem comprises of interdependent components it is the general equilibrium approach which is the most appropriate one.

Professor K.E. Boulding[10] attempts to develop the concept of ecological-balance from economic stand point. He considers that ecology is a term used in the biological sciences to describe a total system of inter-related population of different species. "Such a system of inter-related populations" he says "is called an ecosystem". He also considers that the first principle of an ecosystem is that everything depends on everything else, and the first theorem, therefore, is that the ecological-equilibrium may be possible only if all individual parts of this system are in equilibrium simultaneously. According to him ecology is in equilibrium when each species of the ecosystem finds that the level of population size of all other species is such that its own population will neither increase nor decrease. Again, he said "A forest is in static equilibrium when tree sprouts grow and die but where the composition of the forest as a whole remains unchanged".

But surprisingly, Boulding postulates a partial equilibrium function by supposing that there is an ecosystem with n populations with sizes

$$X_1, X_2, \ldots\ldots\ldots\ldots\ldots X_n$$

where

$$X_i = F_i\ (X_1, X_2, \ldots\ldots, X_{i-1}, X_{i+1}, \ldots\ldots, X_n)$$

This function is interpreted as follows:
given the sizes of all other populations except one under consideration, there will be a unique equilibrium size of the excepted population. If an equilibrium of this type is to be achieved in the real world, a set of real and positive values have to be found for n unknowns which will satisfy the ith equation. But in the partial case, n-1 will be given exogeneously.

He theorizes that if we have a set of species for which there is no equilibrium solution, then some of the other species will die out or new species will come in until there is an ecological equilibrium. It implies that for equilibrium, it is essential that all species are in equilibrium simultaneously.

Boulding has distinguished three cases of ecological-equilibrium:

i) Mutual competition,

ii) Mutual co-operation, and

iii) Predation or parasitism.

Assuming that there are only two species, if increase in the population of either species diminishes the population of the other, then this is the case of mutual-competition.

In the second case, increase (or decrease) in the population of either species diminishes (or increases) the population of the other.

In the third case, the first population is co-operative with the second but the second is competitive with the first.

Under the conditions of mutual co-operation, he has discussed a very curious case which may be considered to be of special interest to us. The case is that, two species are so co-operative that both of them may expand indefinitely or at least to very high levels before an equilibrium is reached. He says that cases of this sort are virtually unknown in the biosphere, but in the social system some relationships of this kind may exist between man and his artifacts. By artifacts he means those populations in man's environment which he himself creates. This fact, he says, explains in large part why the human population has expanded so persistently over the course of human history without showing any sign of reaching an equilibrium level.

But he says that equilibrium in human population growth will be reached, either,

i) if, man's artifacts become less friendly to his increase, which is feared to be happening now with the development of nuclear weapons and pollutions, etc., or,

ii) if, the earth becomes so overcrowded that man becomes disorganised and loses his capacity for making further artifacts.

However, so far man has not lost this capacity. Therefore, the problem arises from the first possibility which concerns us more in the present day time. But, at the same time the possibility of earth becoming very much overcrowded in near future is also not completely ruled out.

On the whole, Boulding's analysis is interesting. But it is difficult to specify exactly and precisely all the parameters along with their separate magnitudes and mutual interralations that are associated with the equilibrium condition even conceptually according to such criteria. It becomes even more difficult when we try to find the exact situation of ecological-balance in reality. Viewed so, the analysis loses its relevance.

It is not possible to establish a partial equilibrium function for a particular population as Boulding envisages because it is not possible to determine all the n unknowns for the given populations even for a small ecosystem.

Besides, he emphasizes that there is a tendency in the ecosystem to achieve equilibrium through dying out or coming in of some of the species and therefore, ecological balance is a case of stable equilibrium.

But, the death rates and birth rates of various populations not only differ from species to species and from time to time but these are also uncertain. Therefore, for a short period of time ecological-equilibrium may better be described as dynamic and neutral in nature whereas for a long or unlimited period of time it may tend to be unstable.

Besides, human population constitutes one of the n species in the ecosystem. Ecological-equilibrium cannot be reached until this particular species has reached its equilbrium level. Thus, the concept of 'ecological-balance' becomes more confusing to the mind and the problem arises -- whether it is good to achieve and maintain ecological-balance or it is always desirable that the ecosystem remains in disequilibrium. According to Boulding, it follows that as long as human population does not reach its equilibrium, disequilibrium of the human ecology will be worth for mankind.

A number of ferocious animal species that existed in ancient times no more exist now. Some more animal species as well as plant species also have been becoming extint day by day. At the same time, some new species are coming into the system for the first time. Can we, therefore, conclude from this fact that the need for stable ecological-balance has been automatically throwing some species out of the ecosystem and also bringing in some of the new species? Or, is this process itself has been leading to dynamism and unstability of ecological-equilibrium that throws us into the problem of environmental crisis?

As a matter of fact, ecology is a vast subject requiring knowledge and expertise in more than one fields. Therefore, any study relating to ecology necessarily has to be a multi-disciplinary in nature. Leaving aside all the vast and complex facets when we come to the point of view of environmental economics, we restrict ourselves to a particular aspect of ecology, i.e., man and nature -- which concerns us most. Hence, ecological-balance in our view refers to the balance between man's activities and needs, and the beauties and munificence of nature.

Thus, ecological-balance from our view point may be described as a situation where human population exist among others as one of the species and for its existence the act of consumption and production are carried out by extracting resources from nature upto the point at which human population themselves will not feel disturbed and endangered resulting from the changes in their surrounding environment caused by their own activities. Thus, the act of maximum consumption and hence, maximum production which leads towards maximum material welfare must be delimited at that point at which such acts of production and consumption will not inflict irreparable damage upon their surrounding environment in the short or the long run.

However, if the man-induced changes for carrying out the production and consumption activities adversely affect some species of the surrounding environment with which human beings do not have any direct or indirect positive relationship then this may not be taken to lead to ecological-imbalance.

The whole idea can be interpreted as follows:

Let us assume that there are i different types of species, where, i = 1,2, ..., T, ..., n and T-th species represents human population. Thus, number of species except human population is n-1. There also exist, say, j different types of relationships among these n species and j = 1,2,.... .., m. Now, the T-th species, i.e., human population does not have relationship with each and every other ith species. Let us assume that it has some relationships with L species out of n-1 species. Now, the T-th species will use up these L species as a medium for its survival and development, As a result some changes in the surrounding environment will be brought about. These changes are aimed at the welfare of only the T-th species. As a result, it may affect some other species adversely. Now, if these changes in the composition of L species adversely affect (n-1)-L species, i.e., with which T-th species does not have any relation, then this will not disturb the balance between man and nature or rather will help in achieving it. However, if changes in L species adversely affect the growth of some or all of the L species themselves, then this will lead towards imbalances in human ecology as such changes in its turn will adversely affect growth of T-th species. But, there remains a problem. Out of the (n-1)-L species some may have relationships with some of the L species. As a result, when those species which are related to any of the L species are adversely affected it will have some negative effects on L species and consequently on T-th species thereby leading to man-nature imbalances.

Therefore, it appears that the whole concept of 'ecological-balance' depends on the various relationships that exist among various species in an ecosystem. Hence, until and unless all these direct and indirect relationships -- j=1,2, ...,m, are identified it is difficult to describe an exact and precise situation of ecological-balance.

However, human beings carry with consumption and production activities by neglecting the adverse effects on ecology if they happen to be insignificant. Hence, we find that to start some production activities in some project, first the project evaluation is done and if it is found that the positive effects of production are greater than the negative effects that it induces, i.e., the benefits derived from the production outweigh the benefits lost then the project is started as human beings cannot avoid losing some benefits to achieve greater benefits. But, in course of time it may happen and at present in many cases have been happening that benefits lost outweigh benefits gained and therefore, we are faced with the problems of various kinds of environmental crisis.

Actually, this worldwide environmental-crisis or ecological-imbalances are caused by three factors:

i) a fast growing human population,

ii) increasing number of human wants and requirements of current wants to be satisfied at higher levels which require extraction of natural resources, and,

iii) Environmental pollution:

All these are inter-linked. Because, a fast growing population necessitates and induces faster developmental activities which require a faster extraction of natural resources. As a result, there arise the possibilities of

i) natural resources falling short in near future for further developmental activities and also

ii) the possibility that the capacity of recycling the wastes (produced through production and consumption) gets reduced. Hence, as these wastes accumulate in the biosphere they bring about adverse if not lethal effects on various organisms.

However, as a measuring rod of ecological-balance for our purpose we follow the National Forest Policy of 1952, according to which in the hilly areas as in the Khasi-Jaintia Hills, at least 60% of the land should be under forests to maintain an ideal ecological-balance although one does not know on what basis this percentage was determined to be ideal. It is also not discussed anywhere in the policy issue.

NOTES

1 Prakash, S., A Manuscript on 'Equilibrium'.

2 As quoted by Kormondy, E.J. - Concepts of Ecology, 1969. Englewood Cliffs, New Jersy, Prentice Hall Inc. Page viii.

3 Edel, Matthew, Economics and the Environment, 1973, Prentice Hall Inc., Englewood Cliffs, New Jersy, Chap.2.

4 Pearce, D.W., Environmental Economics, 1977. Longman Inc., New York, page 31.

5 Edel, Matthew, Op cit., Chap. 1.

6 A new terminology which has been derived by merging the two words 'Economics' and 'Ecology', Prakash, S.

7 Mehta, J.K., Studies in Advance Economic Theory, 1957, S. Chand and Co., Ltd., New Delhi, Chap. 2.

8 Prakash, S. op cit.

9 Mehta, op cit., ch. 2.

10 Boulding, K.E., Economics As a Science, 1970, Tata McGraw Hill Publishing Co. Ltd., Bombay, ch. 2.

CHAPTER - III

ESTIMATED BASE YEAR CONSUMPTION LEVELS

3.1 Consumer's decisions at any given point of time are threefold:

a) whether to consume a given good at a given point of time,

b) if one decides to consume the good, then the next decision relating to the quality or the brand of the good is to be taken if several options are available, and,

c) lastly, the quantity of consumption has to be decided.

Given the price of the chosen brand of the good under consideration, the last decision determines total expenditure to be incurred on the consumption of the good.

The factors which affect the first decision determine the number of consumers of a given good at a given point of time as well as the number of those who will not consume it. The factors which affect the second and third decisions will determine the levels of the consumption of the given good. These two groups of factors will together determine the levels and patterns of consumption of the various goods at any given point of time.

Thus, the estimation of the levels of consumption involves two steps-

i) Estimation of the number of consumers or consuming households for a given good, and

ii) Estimation of the levels and patterns of consumption.

However, in our case, the models for both of the estimations above have already been developed by the researcher mentioned earlier in the introductory chapter. So the parameter in terms of which the number of consuming households and the levels of their consumption are determined happen to be given to us. We will use these parameters for blowing up the sample consumption levels in the base year from which the levels of consumption for the subsequent years will then be determined. But before we do that, it is proper to discuss the methodology employed for determining these parameters.

3.2 Estimation of the Number of Consumers : A Review

3.2 a) Data Base: The objective of the study of the above said researcher was to estimate the levels and the patterns of consumption of the forest-based commodities. For this purpose, the city of Shillong which is the capital of Meghalaya has been selected for sampling as the area of the study on the following considerations:

The city of Shillong includes - Shillong Municipal area, Nongthymmai, Mawlai, Pynthorumkhrah, Shillong Cantonment and Madanrting. The population[1] of the individual units of the Shillong city are as follows:

Table 3.1

Area	Population
1. Shillong Municipality	1,09,244
2. Nongthymmai	21,558
3. Mawlai	20,405
4. Pynthorumkhrah	10,711
5. Shillong Cantonment	6,620
6. Madanrting	6,165
Total	1,74,703

Thus, greater Shillong is a conglomerate of the city of Shillong, townships and the villages on the periphery. Out of a total population of 13,35,819 of the State of Meghalaya, Shillong, accounts for as much as 1,74,703. Thus, the population of Shillong constitutes 13.08% of the total population of the State. On the one hand, the greater Shillong includes the most modernised, developed and the oldest urban centre of the state, on the other hand, it also includes rural areas. Thus, it represents a certain traits of both the rurality and the urbanity though the villages on the periphery may be relatively more developed and modernised, especially in comparison to the very remote areas. Being the oldest and the most developed city of the State, Shillong is a highly cosmopolitan area both in its demographic structure and outlook. The population may be classified according to levels of income into three distinct groups of the higher income group, the middle income group and the low income group. But there is no objective method of determining the cut off points for these groups. The range of incomes of these groups may therefore be quite arbitrary. The levels and patterns of consumption differ from one income group to another. The differential consumption behaviour across the socio-economic groups which are broadly related to income levels can conveniently be brought out by the study of these three groups.

The study is based on primary data regarding consumption collected through a sample survey of the households from Shillong during the late 1984 and early 1985. It is worth-mentioning that the households have been considered to be the better sample units[2] than the individual consuming units as the consumption decisions for both the durable and non-durable commodities are taken by the family for the family as a whole. But once purchased, the durable goods are used by all the members of the family over a period of time.

As can be seen from the table 3.1, total population of the Shillong Municipal area alone is 1,09,244 which consist of 21,289 households according to the 1981 census. Of the total households, 106 households were selected for the sample survey through stratified systematic sampling. Due to the non-response either because of the non-availability of the respondents or their refusal to give interview, informations could be collected only for 98 households. Thus 8 households remained in the group of non-response (the questionnaire for household survey is reproduced in the appendix-1).

All the households are not the consumers of all the commodities under consideration. Whether a particular household is the consumer or the non-consumer of a given good, depends on the income and the preferences of the household and the price of the commodity. Other factors, such as, size of the family, social status of the family, educational status, occupation, habits and tastes, etc. also affect the consumption decisions. Some of these factors are interrelated among themselves and some of the factors are qualitative in nature. It is neither feasible nor is it desirable to include all the factors that may be envisaged to affect the levels and patterns of consumption. Besides, the influence of the most of the economic factors may be captured by income. Therefore, it has been assumed that the income is the factor that exercises the most decisive influence upon the decisions of a household whether to purchase a given commodity at a given price at a given point of time. Of course, the decision at a given point of time is with reference to the price that prevails in the market at the given instant. But price variations will have to be taken into account if the changes in consumption through time are to be considered.

3.2 b) Models for Estimating the Number of Consuming Households

Two mathematical models have been developed for estimating the number of eonsuming households for each income group separately for each commodity.

Model-I : Probability Regression Model:

The first model is probability regression analysis. For each commodity, the total sample of 98 households has been divided into a number of income groups. The probability of a household belonging to a given income group being a consumer of a given commodity has been estimated separately. The total number of income groups for each commodity has been obtained by dividing the range of income by the price of the given commodity. This has been preferred to the conventional method of dividing the sample arbitrarily into income groups. As price differs sharply from one commodity to another, price itself has been used to divide the income range for obtaining income groups for different commodities. The probability of a household belonging to K-th income group being a consumer of a good has been calculated as follows:

$$P_{ik} = \frac{C_{ik}}{C_k} \quad \ldots\ldots\ldots \quad (3.1)$$

where C_{ik} is the number of households in K-th income group who are the consumers of i-th good, and C_k is the total number of households in the K-th income group.

Naturally, $P_{ik} + Q_{ik} = 1$
where, Q_{ik} is the probability of a household of K-th income group not being a consumer of the i-th item.

In order to calculate the number of income groups, implicit price has been used as the diviser.

The formula for calculating the implicit price is as follows:

$$\text{Implicit Price} = \frac{V_i}{Q_i}, i = 1,2, \ldots, n$$

where, Q_i is the quantity purchased and V_i is the money value of commodity i.

Now,

Range = Maximum Income - Minimum Income.

So,

$$\text{Number of groups (N)} = \frac{\text{Range}}{\text{Implicit Price.}}$$

It is interesting to note that both the size and number of these groups vary from one commodity to another because of the very approach of calculation. This approach comprises two steps: 1) the range of income is determined by the usual method of taking the difference between the highest income of the sample households and the corresponding lowest income, and 2) the income range has then been divided by the implicit price of the particular commodity. The rationale is that whether a particular durable consumer good is purchased or not purchased by any household is determined mainly by two factors: the price of the commodity and the level of income of the household. Higher the price of a commodity lower is the probability of its being purchased by the people belonging to lower income group. Alternatively, higher the level of income, greater is the probability of a household to be the consumer of those goods whose prices are high. As income differs from one household to another, probability of consumption varies across the households. Again, as income of the given household varies, its probability of consumption also changes with time. As the household moves from the lower to the higher income level, it may tend to be transferred from the non-consumer to the group of consumers of a given good. Hence, for evaluating the influence of these two factors (i.e., price and income) a frequency distribution according to the levels of income has been prepared for each commodity. The frequencies of households in each income group are subdivided into two categories -- consumers and non-consumers for each commodity. This information has then been used to estimate the probability of a household in each income group as being a consumer or non-consumer of the given good. Such frequency distributions have been prepared for each of the 35 commodities separately.

Obviously, these probabilities have been calculated on the basis of the data collected through the sample survey of 98 households. But for projecting the number of consumers and non-consumers in a given income-group at some future date, there are two possible courses of action open to one. One may assume that the probability of being a consumer or non-consumer remains constant through time. This implies that the factors that governed the consumers' decision to consume or not to consume the given good in the past would not change at all. But the factors like, price, income, education etc. do change in the course of development of an economy. The pattern of income distribution also does not remain constant through time in an economy that is growing rapidly. Therefore, the assumption of constancy of the probability of being a consumer or non-consumer does not appear to be an appropriate one. If this assumption is relaxed, then one has to know as to what are the factors that determine the consumers decisions to purchase or not to purchase a given good. As a first approximation, we postulate that income is the only factor that exercises the most decisive influence upon the decisions of a household whether to purchase the given commodity at a given price at a given point of time. Therefore, the probability of consumption has been treated as a function of income. The influence of income on the consumption probability has been estimated from the following regression model:

$$P_{ik} = a_0 + a_1 Y_k + U_i , \quad \begin{matrix} i = 1, \ldots, n \\ K = 1, \ldots, m \end{matrix} \qquad (3.2)$$

where, P_{ik} is the probability of consumption of i-th item by a given household of the K-th income group,

Y_k is the average income of the K-th group,

U_i is the stochastic disturbance term, and,

a_0 and a_1 are the intercept and slope parameters which have been estimated by the Ordinary Least Square Method. Therefore, all the usual assumptions of OLS are made here also.

Model-II : Logit Analysis

Logit analysis has also been used as an alternative to the probability regression model in order to test the hypothesis that the logit of the ratio of consumers to the probability of non-consumers of different commodities is a function of income of the households. The logit function[3] may be specified as:

$$\log \frac{P_a}{1-P_a} = b_0 + b_1 \log X_a \quad \ldots\ldots \qquad (3.3)$$

where, P_a is the probability of a household of the a-th income income group being a consumer,

X_a is the average income of the a-th group.

b_1 is the income elasticity of the ratio of consumers to non-consumers of a particular durable good.

The left hand side of equation (3.3) is known as the logit of the variable.

The functional equations estimated from both the probability regression model and the logit model for all the thirty-five commodities are reported below:

1.1 $P = 0.189122 - .000516\ Y$ $\quad R^2=0.526369$
$t \qquad (-7.37944)$

1.2 $\log \frac{P_a}{1-P_a} = -1.43388 + 0.003768\ X_a$ $\quad R^2=0.006193$
$(-0.4878)\quad(.7814)$

2.1 $P = 0.252474 + .000231\ Y$ $\quad R^2=0.598672$
$t \qquad (4.0508)$

2.2 $\log \frac{P_a}{1-P_a} = -15.141 + .009088\ X_a$ $\quad R^2=0.082008$
$t \qquad (-7.8949)\quad(2.95882)$

3.1 $P = 0.95156 - .000008\ Y$ $\quad R^2=.000923$
$t \qquad (-0.288835)$

3.2 $\log \frac{P_a}{1-P_a} = 12.6412 - .000859\ X_a$ $\quad R^2=.001471$
$t \qquad (8.9419)\quad(-0.37984)$

4.1 $P = 0.65173 + .000069\ Y$ $\quad R^2=0.014401$
$t \qquad (0.920568)$

4.2 $\log \frac{P_a}{1-P_a} = -2.76402 + .003015\ X_a$ $\quad R^2=0.004183$
$t \qquad (-0.941887)\quad(0.641577)$

5.1 $P = -0.031533 + .000006\ Y$ $\quad R^2=0.649973$
$t \qquad (5.93983)$

5.2 $\log \frac{P_a}{1-P_a} = -12.3397 + .008102\ X_a$ $\quad R^2=0.044545$
$t \qquad (-5.21356)\quad(2.13751)$

6.1 $P = 0.869144 + .000101\ Y$ $\quad R^2=0.141138$
$t \qquad (3.8028)$

6.2 $\log \frac{P_a}{1-P_a} = 10.1344 + .002672\ X_a$ $\quad R^2=0.010878$
$t \qquad (6.30662)\quad(1.03814)$

7.1 $P = 0.164871 + .000425\ Y$ $\quad R^2=0.224437$
$t \qquad (2.5799)$

7.2 $\log \frac{P_a}{1-P_a} = -9.66998 + .0053017\ X_a$ $\quad R^2=0.16899$
$t \qquad (-3.79128)\quad(1.29792)$

8.1 $P = 0.1272 + 5.54132\ Y$ $R^2=0.8278$
t (8.20371)

8.2 $\log \frac{P_a}{1-P_a} = -13.2083 + .007627\ X_a$ $R^2=0.046358$
t (-6.0531) (2.18263)

9.1 $P = 0.999038 - .0000502\ Y$ $R^2=0.200562$
t (-4.8303)

9.2 $\log \frac{P_a}{1-P_a} = 14.7805 - .003209\ X_a$ $R^2=0.039661$
t (14.837) (-2.01174)

10.1 $P = 0.701798 + .000078\ Y$ $R^2=0.013728$
t (0.943849)

10.2 $\log \frac{P_a}{1-P_a} = 4.50858 - .000004\ X_a$ $R^2=0.001038$
t (1.60518) (-0.100411)

11.1 $P = 0.637887 + .000152\ Y$ $R^2=0.0734676$
t (2.25272)

11.2 $\log \frac{P_a}{1-P_a} = 6.03296 - .002197\ X_a$ $R^2=0.002506$
t (2.18283) (-0.49627)

12.1 $P = 0.614781 + .0014142\ Y$ $R^2=0.083108$
t (2.31253)

12.2 $\log \frac{P_a}{1-P_a} = 2.93642 + .000866\ X_a$ $R^2=0.000364$
t (1.02665) (0.189175)

13.1 $P = 0.345597 + .000102\ Y$ $R^2=0.052233$
t (1.32799)

13.2 $\log \frac{P_a}{1-P_a} = -1.66587 - .0046318\ X$ $R^2=0.018186$
(-0.596301) (-1.03524)

14.1 $P = .005098 + .000347\ Y$ $R^2=0.324312$
t (1.95954)

14.2 $\log \frac{P_a}{1-P_a} = -11.0674 + .000138\ X_a$ $\qquad R^2=0.002456$

$t \qquad (6.19582) \quad (0.048429)$

15.1 $P = 0.24567 + .000244\ Y$ $\qquad R^2=0.255364$

$t \qquad (2.86889)$

15.2 $\log \frac{P_a}{1-P_a} = -4.1422 + .004237\ X_a$ $\qquad R^2=0.010525$

$t \qquad (-1.59833) \quad (1.02095)$

16.1 $P = -0.041194 + .000462\ Y$ $\qquad R^2=0.505635$

$t \qquad (4.11446)$

16.2 $\log \frac{P_a}{1-P_a} = -12.9132 + .006064\ X_a$ $\qquad R^2=0.032404$

$t \qquad (-6.17867) \quad (1.89159)$

17.1 $P = 0.224408 + .000116\ Y$ $\qquad R^2=0.066683$

$t \qquad (1.25373)$

17.2 $\log \frac{P_a}{1-P_a} = -7.08501 - .000426\ X_a$ $\qquad R^2=.000115$

$t \qquad (-2.8331) \quad (-0.106496)$

18.1 $P = -0.084197 + .000390\ Y$ $\qquad R^2=0.785403$

$t \qquad (5.06154)$

18.2 $\log \frac{P_a}{1-P_a} = -14.4871 + .005334\ X_a$ $\qquad R^2=0.043525$

$t \qquad (-9.18645) \quad (2.11177)$

19.1 $P = 0.325153 - .000096\ Y$ $\qquad R^2=0.025738$

(-6.70163)

19.2 $\log \frac{P_a}{1-P_a} = -7.55184 - .001633\ X_a$ $\qquad R^2=0.001959$

$(-3.24682) \quad (-0.438398)$

20.1 $P = 0.149892 + .000096\ Y$ $\qquad R^2=0.101439$

$t \qquad (1.16391)$

20.2 $\log \frac{P_a}{1-P_a} = -11.573 + .003119\ X_a$ $\qquad R^2=0.009112$

$(-5.64268) \quad (0.949252)$

21.1 $P = -.093461 + .000572\ Y$ $R^2=0.753129$
t (6.29754)

21.2 $\log \frac{P_a}{1-P_a} = -10.7586 + .002147\ X_a$ $R^2=0.004077$
t (5.08428) (0.63401)

22.1 $P = 0.146447 + .000339\ Y$ $R^2=0.387555$
t (3.73112)

22.2 $\log \frac{P_a}{1-P_a} = -8.61247 + .002867\ X_a$ $R^2=0.005097$
t (-3.40946) (0.708593)

23.1 $P = 0.471501 - .0000297\ Y$ $R^2=0.010237$
t (-0.601196)

23.2 $\log \frac{P_a}{1-P_a} = -2.45945 - .001135\ X_a$ $R^2=0.0006218$
t (-0.85738) (-0.247001)

24.1 $P = 1.06712 - .001249\ Y$ $R^2=0.772423$
t (-11.5052)

24.2 $\log \frac{P_a}{1-P_a} = 7.33691 - 0.018965\ X_a$ $R^2=0.173713$
t (2.81287) (-4.53903)

25.1 $P = 0.406063 + 0.000157\ Y$ $R^2=0.058707$
t (1.55961)

25.2 $\log \frac{P_a}{1-P_a} = 0.462653 - 0.006454\ X_a$ $R^2=0.020114$
t (0.162881) (-1.41833)

26.1 $P = 0.275658 - 0.000312\ Y$ $R^2=0.528317$
t (-2.890009)

26.2 $\log \frac{P_a}{1-P_a} = -11.4736 - 0.002206\ X_a$ $R^2=0.014255$
t (-9.91732) (-1.19044)

27.1 $P = 0.155612 - 0.000199\ Y$ $R^2=0.291975$
t (-6.29194)

27.2 $\log \frac{P_a}{1-P_a} = -9.82091 - 0.0047003\, X_a$ $R^2=0.052315$
t (-7.78508) (-2.32596)

28.1 $P = 1.0829 - 0.000189\, Y$ $R^2=0.169804$
t (-4.43118)

28.2 $\log \frac{P_a}{1-P_a} = 13.1718 - 0.003882\, X_a$ $R^2=0.018865$
t (7.4595) (1.37265)

29.2 $\log \frac{P_a}{1-P_a} = 6.49894 + 0.003122\, X_a$ $R^2=0.00688$
t (2.7457) (0.823977)

30.1 $P = 0.21146 + 0.000109\, Y$ $R^2=0.10667$
t (1.50623)

30.2 $\log \frac{P_a}{1-P_a} = -8.01429 + 0.000007\, X_a$ $R^2=0.000372$
(-3.2021) (0.190684)

31.1 $P = -0.007078 + 0.000338\, Y$ $R^2=0.22787$
t (1.437)

31.2 $\log \frac{P_a}{1-P_a} = -14.6991 + 0.005684\, X_a$ $R^2=0.04947$
(-9.33703) (2.25711)

32.1 $P = 0.330172 - 0.0000196\, Y$ $R^2=0.005599$
t (-0.3899)

32.2 $\log \frac{P_a}{1-P_a} = -13.9435 + 0.004859\, X_a$ $R^2=0.032464$
t (-8.33476) (1.89334)

33.1 $P = 0.073505 + 0.000284\, Y$ $R^2=0.403437$
t (3.07697)

33.2 $\log \frac{P_a}{1-P_a} = -11.8566 - 0.000994\, X_a$ $R^2=0.0023319$
t (-9.14184) (-0.478664)

34.1 $P = 0.330122 - 0.0000196\, Y$ $R^2=0.005599$
t (-0.3899)

34.2 $\log \frac{P_a}{1-P_a} = 4.3924 - 0.002241\, X_a$ $R^2=0.002755$
t (1.63294) (-0.520325)

35.1 $P = 0.822854 + 0.000207\ Y$ $R^2=0.398551$

t (7.67958)

35.2 $\log \frac{P_a}{1-P_a} = 8.24016 + 0.00663\ X_a$ $R^2=0.075715$

t (5.63968) (2.8334)

A comparison of the results of both the models reveals that the results of probability regression model is more satisfactory than those of the Logit analysis. In both the models, income has been considered as explanatory variable and it is found that for 29 commodities in the first model and 18 commodities in the second model, the levels and patterns of probability of consumer has been explained by the level of income of consuming household. So income has rightly been chosen for predicting the level of consumer probability in our model. However, the coefficients of income (according to the probability regression model) are not significant for the following six commodities:

1. Chair made of wood,
2. Chair made of cane,
3. Fancy articles made of wood,
4. Alna made of wood,
5. Sports goods made of bamboo,
6. Broom made of bamboo.

This implies that, this model is not capable of explaining the changes in the consumption probabilities of these commodities. There may be two reasons for this:

i) Either, there are some economic factors other than income that determine the consumption probability of these commodities, or,

ii) the consumption of these goods are universally prevalent in the sample irrespective of the levels of income of the households with the result that consumption probabilities do not vary sufficiently between the different income groups.

Since the probability regression model fits the data better than the logit model, we have chosen the results of this model for projecting the probability of a household of a given income group being a consumer or non-consumer of a specified good in the target year. The projection of the levels and patterns of income distribution becomes a prerequisite for the forecasting of consumption probability. For this, the Pareto Income Distribution is fitted to the primary data relating to the income-levels of the sampled households.

According to the Pareto Law of Income Distribution,[4] the cumulative frequency distribution curve of persons earning more than the particular amount of income takes the shape of a hyperbola:

$$N(Y) = AY^{-B}$$

The simplest way of demonstrating it is to plot N(Y) against Y on the graph paper with a logarithmic scale on either axis, and to see whether the plotted points lie on the straight line:

$$\log N(Y) = \log A - B \log Y \qquad (3.4)$$

where, N(Y) is the number of households having an income level of $\geqslant$ Y,

A and B are the parameters of the distribution.

By definition, N(Y) decreases monotonically with the increasing Y.

The Pareto law is usually assumed to represent the distribution of incomes or other economic phenomena at upper levels as it does not graduate the distribution of low income values well.

The parameter A may then be defined as $A = {Y_0}^B$, where, Y_0 is some low level of income above which the Pareto Law graduates the rest of this distribution. The value of the Pareto's constant B is regarded as a measure of the inequality of income; a high value of B corresponds to a steeper decline of N(Y) with increasing Y, and hence, to a greater degree of income inequality.

The Paretian frequency function is

$$N(Y) = \frac{B}{Y_0} \left(\frac{Y_0}{Y}\right)^{B+1}$$

This function holds for $Y > Y_0$. If $Y \leqslant Y_0$, the frequency is assumed to be zero. The cumulative function is then

$$N(Y) = \left(\frac{Y_0}{Y}\right)^B \text{ for } Y > Y_0.$$

If Y_0 is arbitrarily selected as some low value of income such as the modal value, or some other a priori value, the distrubution then depends on only one parameter, B.

The estimated Pareto Distribution for our sample is as follows:

$$\log N(Y) = 7.42993 - 1.8051 \log Y$$

It is observed that the value of individual χ^2 for an income level of less than Rs. 1000/- ranges from 87.70 to 2.94, whereas, the estimated value of χ^2 for all the 98 households is as high as 476.34.

This implies that the Pareto Distribution fits our data for the higher income levels. But, this is the inherent feature of this distribution.

Now assuming that the income distribution of the State follows the pattern of the same Pareto law, we convert the sample number of households in each income bracket into the number of households for the State as a whole. This has been done as follows:

Total population in the given year is divided by the average size of the households* for deriving the total number of households:

$$\frac{n_t}{S_n} = N_t \qquad (3.5)$$

* The method of determining the average size of the households has been discussed in detail in the next chapter.

where, n_t is the total population in year t and S_n is the average household size. Then, the projected net domestic product is allocated among these households, households in each income group, N_{kt}, being determined according to the Pareto Law of Distribution. For this purpose, we have made use of the 7th five year plan's[5] projection of the State Domestic Product and the level of population for the State of Meghalaya.

The estimated average income of each income group has then been used to estimate the probability of consumption, P_{ik}, given the estimated values of a_0 and a_1 of model (3.2). Total number of consuming households of i-th good at t-th time is then given by $\sum_k P_{ik} N_{kt}$. Thus estimated, the total number of consuming households in the base year (1984-85) for each of the thirty five commodities are shown in Table 3.2.

Twenty-nine commodities out of the thirty-five goods studied are durable goods. The remaining six commodities are fuel goods, and hence, are non-durables. Thus, the estimated number of the consuming households as above for the 29 durable goods does not imply that the commodities have been purchased by them in the base year itself. For the time being, we are interested in finding out the number of households who consume these goods irrespective of the date on which the goods have been purchased. Through the questionnaire that had been canvassed we have found out the date of purchase of the goods, Table-3.2

Sl. No.	Commodities	Total number of consuming households
1.	Almirah made of wood	146950
2.	Almirah made of mixed variety	37458
3.	Chair made of wood	265087
4.	Chair made of cane	129662
5.	Chair made of mixed variety	60509
6.	Table made of wood	262205
7.	Table made of cane	72034
8.	Table made of mixed variety	48701
9.	Bed made of wood	273815
10.	Fancy article made of wood	184408
11.	Fancy article made of cane	190171
12.	Fancy article made of bamboo	175764
13.	Stools, benches, desks made of wood	97967
14.	Stools, benches, desks made of cane	28814
15.	Stools, etc. made of mixed variety	74916
16.	Coach, sofa made of wood	34576
17.	Coach, sofa made of cane	66272
18.	Coach, sofa made of mixed variety	23051
19.	Bookrack made of wood	54746
20.	Bookrack made of cane	40339
21.	Bookrack made of mixed variety	43221
22.	Hanger made of wood	69153
23.	Alna made of wood	106611
24.	Firewood for cooking	109492
25.	Charcoal for cooking	112374
26.	Free dry branches etc. for cooking	11539
27.	Wood collected from forest for cooking	14407
28.	Match Box	259324
29.	Fuel for heating rooms	24747
30.	Sports goods made of wood	63390
31.	Sports goods made of cane	20169
32.	Sports goods made of bamboo	25932
33.	Sports goods made of mixed variety	17288
34.	Broom made of bamboo	83560
35.	Broom other than bamboo	27719

the purchase price and the income of the consumers during the period in which the good has been purchased.

The income elasticity of the consumption probability for the probability regression model is calculated as follows:

$$e_w = a_1 \quad \frac{\bar{Y}}{\bar{P}} \qquad (3.6)$$

where, a_1 is the slope coefficient of the regression of consumption probability on income,

$\bar{Y}$ denotes the average income of the consuming households belonging to the given income groups, and $\bar{P}$ denotes the probability of the consuming households.

This elasticity can be defined as the ratio of the proportionate change in the probability of consumption to the proportionate change in income per consuming unit. These income elasticities of consumption probability are reported in Appendix-II.

3.3 Model for Estimating the Levels and Patterns of Consumption:

The levels and patterns of consumption decisions are greatly influenced by the price of the good and the consumer's income. Generally, an increase in income induces consumption to increase. As against this, a decrease in income induces consumption to decrease. Thus, consumption and income are directly related. The quantum of change in consumption of a good induced by a change in the income may be defined as income effect. Similarly, a change in the price also affects consumption. But unlike income, generally the relation between price and consumption is inverse. The change in consumption in response to a change in price may be defined as price effect. Conventionally these two effects (price effect and income effect) are measured through the price elasticity and income elasticity. These two elasticities determine the patterns of consumption, given the levels of income and price and the changes therein.

The elasticities for all the thirty-five commodities under consideration have been estimated from constant elasticity function which is as follows:

$$\log E_{ijt} = b_0 + b_1 \log P_{it} + b_2 \log Y_{jt} + V_{it} \qquad (3.7)$$

where, E_{ijt} is the average expenditure on good i by households belonging to j-th income group at t-th time period; P_{it} is the price of the i-th good at the t-th period; and Y_{jt} is the average income of the households belonging to j-th income group at t-th time period; V_{it} is the disturbance term, and b_0, b_1, b_2 etc. are the parameters; b_0 represents autonomous consumption, b_1 is the price elasticity and b_2 is the income elasticity.

Given the data relating to prices, income and expenditure in the base period, elasticity co-efficients may be estimated from the model. The model may also be adopted for the projecting or the forecasting of the consumption levels. Given the price and income elasticities, E_{ijt} may be estimated from the function by substituting the projected values of P_{it} and Y_{jt} for different values of t. The advantages of adopting log-linear model of this type are:

i) At each point of the demand curve, the elasticity remains the same;

ii) Logarithmic transformation of the linear function offers distinct technical advantages in regression analysis, especially if the heteroskedasticity happens to be present.[6]

iii) If the non-linearities affect the variate values and their inter-relations, log transformation of the data takes their care.

iv) Then, the change instead of the absolute variate values are related functionally. The constant elasticities are estimated at the average levels of the changes.

The estimated functions of the constant price and income elasticities of consumption for each of the 35 commodities are reported below:

1. $\log E_1 = 0.177673 + 1.05381 \log P_1 - 0.110992 \log Y_1$

t (0.900421) (26.2246) (-1.69296)

$R^2=0.93128$

2. $\log E_2 = 2.72705 - 0.299774 \log P_2 + 0.490753 \log Y_2$

t (-2.23531) (2.83412)

$R^2=0.419968$

3. $\log E_3 = -0.353088 + 1.3166 \log P_3 + 0.074654 \log Y_3$

t (-0.99487) (9.10242) (0.602804)

$R^2 = 0.513786$

4. $\log E_4 = 0.182495 + 0.881897 \log P_4 + 0.153442 \log Y_4$

t (0.188402) (2.20067) (0.768696)

$R^2 = 0.103539$

5. $\log E_5 = 0.004516 + 1.05884 \log P_5 + 0.068069 \log Y_5$

t (.0045008) (2.12546) (0.233247)

$R^2 = 0.222534$

6. $\log E_6 = 0.214325 + 1.12955 \log P_6 - 0.089279 \log Y_6$

t (0.751785) (10.9851) (-0.790669)

$R^2 = 0.607605$

7. $\log E_7 = 1.10632 + 0.717346 \log P_7 - 0.176514 \log Y_7$

t (1.23789) (2.20933) (-0.854827)

$R^2 = 0.196879$

8. $\log E_8 = -0.244385 + 1.08112 \log P_8 + 0.0227661 \log Y_8$

t (-0.852824) (5.05987) (0.165849)

$R^2 = 0.603875$

9. $\log E_9 = 0.921387 + 1.23387 \log P_9 - 0.390305 \log Y_9$

t (3.09594) (15.99) (-3.48733)

$R^2 = 0.731505$

10. $\log E_{10} = 1.7258 + 0.776516 \log P_{10} - 0.396668 \log Y_{10}$

t (3.52833) (5.382) (-2.00877)

$R^2 = 0.312203$

11. $\log E_{11} = 0.204254 + 0.611391 \log P_{11} + 0.229462 \log Y_{11}$

t (0.38229) (3.8806) (1.16386)

$R^2 = 0.212658$

12. $$\log E_{12} = 0.683167 + 0.655708 \log P_{12} - 0.03632 \log Y_{12}$$
$$t \quad (1.55159) \quad (4.96428) \quad (-0.236173)$$
$$R^2 = 0.288093$$

13. $$\log E_{13} = -1.19333 + 1.25656 \log P_{13} + 0.337425 \log Y_{13}$$
$$t \quad (-2.94617) \quad (8.66486) \quad (2.37013)$$
$$R^2 = 0.728659$$

14. $$\log E_{14} = -0.706055 + 1.27045 \log P_{14} + 0.17511 \log Y_{14}$$
$$t \quad (-0.601881) \quad (4.32129) \quad (0.461115)$$
$$R^2 = 0.656271$$

15. $$\log E_{15} = 0.151978 + 1.15544 \log P_{15} - 0.126953 \log Y_{15}$$
$$t \quad (0.957095) \quad (20.7962) \quad (-1.83086)$$
$$R^2 = 0.953778)$$

16. $$\log E_{16} = -.000061 + 1.00002 \log P_{16} + .0000153\ Y_{16}$$
$$t \quad (-0.53136) \quad (30280.3) \quad (0.502868)$$
$$R^2 = 1$$

17. $$\log E_{17} = .000244 + .999878 \log P_{17} + .000008 \log Y_{17}$$
$$t \quad (3123.28) \quad (0.052251)$$
$$R^2 = .999998$$

18. $$\log E_{18} = .000122 + 1.00003 \log P_{18} + 0 \log Y_{18}$$
$$t \quad (39266.60) \quad (0.00000)$$
$$R^2 = 1$$

19. $$\log E_{19} = 0.804138 + 1.10982 \log P_{19} - 0.329346 \log Y_{19}$$
$$t \quad (1.61519) \quad (9.00297) \quad (-1.73079)$$
$$R^2 = 0.810994$$

20. $$\log E_{20} = 0.00002 + 1.00002 \log P_{20} + .000007 \log Y_{20}$$
$$t \quad (12841.40) \quad (0.000581)$$
$$R^2 = .99725$$

21. $\log E_{21} = -0.0000305 + 0.99996 \log P_{21} + .0000076 \log Y_{21}$

t (-0.54553) (43367.9) (0.36449)

$R^2 = 0.99875$

22. $\log E_{22} = 0.42896 + 0.742241 \log P_{22} + 0.015564 \log Y_{22}$

t (0.68886) (1.30654) (0.064132)

$R^2 = 0.07971$

23. $\log E_{23} = -0.367127 + 1.19736 \log P_{23} - 0.009323 \log Y_{23}$

t (-1.31505) (14.3209) (-0.100106)

$R^2 = 0.846622$

24. $\log E_{24} = 3.27295 - 0.924805 \log P_{24} - 0.125885 \log Y_{24}$

t (1.78767) (-0.747957) (-0.484119)

$R^2 = 0.0198408$

25. $\log E_{25} = 3.60797 - 6.3064 \log P_{25} - 0.094711 \log Y_{25}$

t (2.57507) (-1.61374) (-0.319969)

$R^2 = 0.066555$

26. $\log E_{26} = 6.62209 - 3.8208 \log P_{26} - 0.01984 \log Y_{26}$

t (100.772) (-78.4982) (-2.39079)

$R^2 = 0.999353$

27. $\log E_{27} = 5.50781 - 2.70605 \log P_{27} - 0.068420 \log Y_{27}$

t (1.16969) (-0.914221) (-0.95614)

$R^2 = 0.147779$

28. $\log E_{28} = 0.922455 - 0.287674 \log P_{28} + 0.05848 \log Y_{28}$

t (1.84914) (-0.57869) (0.501317)

$R^2 = 0.005391)$

29. $\log E_{29} = 0.8125 + 2.5 \log P_{29} - 0.10836 Y_{29}$

t (0.03026)(0.02803) (-0.66457)

$R^2 = 0.091556$

30. $\log E_{30} = -0.469727 + 1.3594 \log P_{30} + 0.145416 \log Y_{30}$
t (-0.970049) (10.5135) (0.868098)
$R^2 = 0.83404$

31. $\log E_{31} = -0.142822 + 0.613884 \log P_{31} + 0.243576 \log Y_{31}$
t (-0.10345) (1.07299) (0.552762)
$R^2 = 0.159776$

32. $\log E_{32} = -1.24634 + 1.10932 \log P_{32} + 0.44567 \log Y_{32}$
t (-2.03981) (5.06501) (2.02687)
$R^2 = 0.794573$

33. $\log E_{33} = 0.542603 + 1.3327 \log P_{33} - 0.148927 \log Y_{33}$
t (0.454899) (3.30365) (0.26957)
$R^2 = 0.804773$

34. $\log E_{34} = 0.113335 + 1.52766 \log P_{34} - 0.096746 \log Y_{34}$
t (0.39579) (5.1314) (-0.94821)
$R^2 = 0.47903$

35. $\log E_{35} = 0.387848 + 1.19029 \log P_{35} - 0.074245 \log Y_{35}$
t (0.43416) (4.33726) (-0.808316)
$R^2 = 0.178318$

The t-values show that the price elasticities of the consumption expenditure of 30 commodities are statistically significant. As against this, the income elasticities of the consumption expenditure of 10 commodities only are significant. It is interesting to note that the income has emerged as the significant determinant of the consumption probability of 29 goods for the probability regression model, whereas, it is found to be the major determinant of the per household consumption expenditure of only 10 goods according to the log-linear model.

Given the prices of the commodities, average income-level and the estimated number of consuming households, the total consumption expenditure on the i-th good will be given by

$$E_{it} = \sum_k P_{ik} N_{kt} E_{ik} \qquad (3.8)$$

$$= \sum E_{ik} N_{ikt}$$

where, E_{ik} is the expenditure on i-th good per unit of consuming household of the k-th income group.

The levels of consumption expenditure E_{it} of 35 commodities are reported in table 3.3.

NOTES

1 Government of Meghalaya, Directorate of Census Operation, Shillong, 1985.

2 Cherinichovsky, Dov, in his "The Economic Theory of Household and Impact Management of Nutrition and Related Health Programs, World Book reprint series, No.121, Washington, Page 228, says "The household ... is the basic socio-economic unit that makes most decisions about investment in human being and about consumption".

3 For details, see, Theil, H., Principles of Econometrics, John Wiley and Sons Inc., New York, page 632.

4 For details, see, Cramer, J.S., Empirical Econometrics, North-Holland Publishing Co., Amsterdam, page 52.

5 Government of Meghalaya, Seventh Five Year Plan 1985-90 and Annual Plan 1985-86, Draft Proposals Vol. I.

6 Op. cit., Cramer, J.S. Empirical Econometrics, page 31.

Table 3.3

Levels of Consumption Expenditure (in Rs.)

Sl. no. of commodities	Total consumption Expenditure	Sl. no. of commodities	Total consumption Expenditure
1	92582909	19	2959568
2	59111724	20	1322715
3	77227796	21	2312323
4	29885804	22	524179
5	28560248	23	11016115
6	55896862	24	53962037
7	7238696	25	82945497
8	34312777	26	1625644
9	67637781	27	1679548
10	5202149	28	23743705
11	8126006	29	3848653
12	4506589	30	1490283
13	25463583	31	359009
14	1593990	32	609921
15	20852869	33	904849
16	14266058	34	760360
17	45100084	35	488931
18	15345281		

CHAPTER - IV

PROJECTION OF THE LEVELS OF CONSUMPTION

4.1 The projecting of the future values or the forecasting as it is called, refers to the "prediction of values of certain variables outside the available sample of data -- typically, the prediction for other times or places".[1] Thus, given the observed values of the variables, X_1, X_2 ...., X_n at time t, the problem of forecasting is to predict the values of the X_i's for some future date t + m or even for the past that has not been observed, t-m. The time interval represented by m is called the forecast horizon.

4.2 Methods of Forecasting

There are various approaches to the forecasting. Expert opinion refers to the traditional approach to the forecasting. Accordingly, the forecasting is done on the basis of the informed judgement of the expert(s) acquainted with the phenomenon in question.

A modern variant of the method of expert opinion is the Delphi Method according to which the judgements of a panel of experts are put together in order to obtain forecasts. Each of the experts is consulted and then their forecasts are presented in summary statistical form to all.

A more formal approach is Persistence Forecasting which is based on the assumption of the future replicating the past or present in some important respects. The future may replicate the past in three ways:

1) The present value of the variable may remain invariant through time;
2) The direction and the quantum of the change in the future variate values will be the same as in the past;
3) The variable will change at the same rate at which it had changed in the past. The deceleration/acceleration of the rate is also included in it.

The third approach is more popular. This approach is also more scientific than the other two.

Another approach to the forecasting is the method of using the leading indicators. To use this approach, a forecast of y is based on another variable x, which is the leading indicator; and where y at time t depends on x at time t-1.

The forecasts may be short-term forecasts or the long-term forecasts. By the long-term forecasts we refer to those for which the forecast horizon exceeds some prespecified level. The long-term forecasts may also be obtained by developing a succession of short-term forecasts.

4.3 As already stated in the introductory chapter, the target year or the forecasting horizon, in our case, extends upto the year 1989-90 which may be considered to be the short-term forecast.

However, the forecasting of any variable is done on the basis of the present value(s) of the variable(s). Thus, in order to project the levels of consumption of the thirty-five forest-based commodities under consideration upto the year 1989-90, the first task is to estimate the levels of consumption of these commodities in the base year of 1984-85. However, this has been done as discussed in the earlier chapter III. These estimated base year levels and patterns of consumption constitute the present values for our purpose.

As has been discussed in the earlier chapter, the most important factors, among others, that determine the levels of consumption of a product at a given point of time, are

i) the existing number of households;

ii) the levels and patterns of income distribution of these households; and

iii) the product prices.

Hence, in order to project the levels of consumption, we first project the number of the households, their income distribution and the prices of the products.

4.4 For projecting the number of households and their income distribution, we have taken the Seventh Five Year Plan's[2] projection of the State Domestic Product (as is done in the draft proposal) for the State of Meghalaya as the base. However, the Draft Plan proposals contain neither the number of households nor levels and patterns of income distribution among these households. The plan contains only the total population and the State Domestric Product both of which have been projected yearwise upto the year 1989-90.

So far as the population is concerned, it is stated that, "For the purpose of the plan, it is expected that the growth rate of the past decade would, at least remain constant". The population of the State for 1984-85 has been estimated to be 14.94 lakhs which is expected to rise to about 17.17 lakhs by the end of the Seventh Plan on the basis of the 1971-81 decadal growth rate of 32.08%.

This projected population has been converted into the number of the households as follows:

The estimated total population has been projected according to the age and sex structure.[3] For this, the single-year age and sex distribution of 1981 census has been taken as base. The age and sex structure of the population in 1981 has been as follows:

$$\begin{aligned} P^o_1 &= P^{om}_1 + P^{of}_1 \\ P^o_2 &= P^{om}_2 + P^{of}_2 \\ &\vdots \\ P^o_k &= P^{om}_k + P^{of}_k \end{aligned} \qquad (4.1)$$

where, P stands for population; the subscripts 1, 2, ..., k refer to age-group; superscript o refers to the base year; and m and f denote male and female respectively. K goes from 0 to 100. As in the cesus report, it is assumed that no one survives after 100 years of age.

Children born in the base year will belong to the first age group in the next year. But all of them do not survive. Hence, let us denote the birth rate by b and survival rate by s = 1-d, where, d represents death-rate.

Thus, age and sex specific population of the base year gets converted into the age and sex specified population of the next year:

$$
\begin{aligned}
P_1^1 &= s^m b^m P^{om} + s^f b^f P^{of} \\
P_2^1 &= s_1^m P^{om} + s_1^f P_1^{of} \\
P_3^1 &= s_2^m P_2^{om} + s_2^f P_2^{of} \\
&\vdots \\
P_k^1 &= s_{k-1}^m P_{k-1}^{om} + s_{k-1}^f P_{k-1}^{of}
\end{aligned}
\qquad (4.2)
$$

where, P_o^m and P_o^f in the first row denote total male population and total female population in the base year. Similar projection has been done for sucessive years upto 1990.

Obviously, the death, and hence, the survival rates have been postulated to differ both across the age and sex The mortality rate is high among the infants and reaches to peak at the old age. It is also a little higher for the males than the females in all age-groups and almost everywhere in the world.

But the 1981 census report provides neither the age and sex wise death rates nor the birth rates. It reports only the standard death rate and the standard birth rate which are some kind of average of the total birth and death rates over the decade of 1971-81. The population growth rate used for the population projection in the Seventh Plan's draft proposals is also based on the average birth and death rates of 1971-81.

Since the age and sex specific death rates or birth are not available, we have assumed that these rates are the same in all age and sex groups.

The projected age and sex structure of the population has then been converted into the number of the consuming unit by using the 'adult equivalent scale'[4], which has been formulated by the National Council of Applied Economic Research. This has been done because it is the number of consuming units rather than the number of persons which affects the levels and patterns of consumption.

The adult equivalent scale is as follows:

Sl. No.	Age and Sex of consumer unit	Weight
1	Male above 14 years	1.0 c.u.
2	Female above 14 years	0.8 c.u.
3	Children between 10 to 14 years	0.8 c.u.
4	Children between 1 to 10 years	0.7 c.u.
5	Children below 1 year	0.0 c.u.

The calculated total number of consuming units according to the 1981 census report were 1078777.6 and the total number of households was 255935. On an average, the number of the consuming unit per household was 4.215. Assuming that this average size of the households remain the same for the successive years for which projection has been done, we con convert the projected number of the consuming units for each year into number of households.

4.5 For projection of income levels also the Seventh Five Year Plan's Projection of State Domestic Product has been used as the base. The Plan does not give the income-level as such. It gives the State Domestic Product that has been projected yearwise upto the year 1989-90. Given these projected State Domestic Product, the estimated Pareto Distribution of Income (as is discussed in chapter-III) and the projected number of households, we project the pattern of income distribution and the levels of income upto the target year 1989-90. The projected income per household in each income bracket has then been used to estimate the probability of a household in a given bracket being a consumer. The projected income per household and the parameters of the equation (3.2) together furnish the estimates of the probabilities of the consuming households across the income groups of different goods.

Then, the multiplication of the number of the total households in each income-group by the respective probabilities yield the projected number of the consuming households for each of the products. The number of the consuming households projected thus have been aggregated over income-groups for each year separately. These projected aggregated number of consuming households for each good and for each of the projected years are reported in table 4.1.

As has already been stated in the earlier chapter (Ch. III), 29 out of the 35 commodities are durable goods. Hence, the estimated total number of consuming households in 1984-85 for any of these commodities, will not purchase the commodity again and again in the projected successive years of 1985-86, 1986-87, 1987-88, 1988-89 and 1989-90. The level of consumption expenditure on any commodity denotes that expenditure which is incurred to make new purchases of the commodity in that year. We assume that the new purchases of

Table 4.1

Projected Total Number of Consuming Households

Sl. no. of commodities	1985-86	1986-87	1987-88	1988-89	1989-90
1	147504	148046	148667	149270	149851
2	39959	42623	45489	48540	51788
3	272413	279917	287777	295815	304029
4	133705	137861	142221	146697	151290
5	66687	73490	81029	89327	98461
6	270038	278079	286509	295152	304006
7	70981	69936	68943	67954	66969
8	54760	61568	69258	77897	87600
9	281147	288649	296505	304530	312723
10	189968	195677	201663	207802	214093
11	196288	202583	209189	215978	222953
12	181432	187266	193388	199681	206146
13	101262	104659	108226	111898	115676
14	31393	34200	37277	40626	44268
15	78249	81723	85396	89221	93202
16	39021	44033	49715	56121	63343
17	68830	71481	74272	77161	80150
18	27887	33735	40831	49411	59787
19	56893	59118	61462	63890	66403
20	42114	43962	45915	47948	50063
21	47623	52470	57840	63750	70253
22	73325	77742	82467	87467	92756
23	109382	112215	115181	118208	121295
24	106133	102868	99755	96722	93766
25	116351	120458	124775	129227	133818
26	11073	10625	10200	9791	9397
27	14064	13727	13406	13090	12780
28	265483	271763	278338	285029	291835
29	232605	240715	249238	258025	267079
30	65834	68367	71034	73794	76649
31	23537	27464	32062	37426	43679
32	29543	33654	38357	43710	49803
33	18871	20597	22492	24559	26811
34	85770	88031	90398	92815	95282
35	28620	29548	30522	31523	32552

the durable commodities are made by the new consumers of the commodities in the projected years. For this purpose, we assume that the increased number of consuming households in each year are the new consumers or purchasers of the commodities in that year. Hence, we find the projected number of new consuming households or purchasing households for 29 durable goods as follows:

$$N_{pit} = N_{cit} - N_{cit-1} \tag{4.3}$$

where, N_{pit} is the number of purchasing households of the i-th commodity in t-th year, N_{cit} and N_{cit-1} are the estimated total number of consuming households of i-th commodity in t-th year and t-1 year respectively. Thus derived, the estimated total number of purchasing households are reported in table 4.2.

4.6 In order to find out the projected levels of consumption expenditure, we are required to project the prices of the products as well. For this purpose, we have collected information about the prices through a primary survey of the various selling units of the respective commodities for the years 1984-85 and 1985-86. But, the prices of the same commodity, say, Almirah made of wood, have been found to be differing depending on the variations in size as well as the quality of wood used in its production. In order to overcome the first difficulty, we have collected the

Table 4.2

Projected Number of Purchasing Households

Sl. No. of commodities	1985-86	1986-87	1987-88	1988-89	1989-
1	554	542	621	603	581
2	2501	2664	2866	3051	3248
3	7326	7504	7860	8038	8214
4	4043	4156	4360	4476	4593
5	6178	6803	7539	8298	9134
6	7833	8041	8430	8643	8854
7	1053	1045	993	989	985
8	619	688	769	863	973
9	7332	7502	7856	8025	8193
10	5560	5709	5986	6139	6291
11	6117	6295	6606	6789	6975
12	5668	5834	6122	6293	6465
13	3295	3397	3567	3672	3778
14	2579	2807	3077	3349	3642
15	3333	3474	3673	3825	3981
16	4445	5012	5682	6406	7222
17	2558	2651	2791	2889	2989
18	4836	5848	7096	8580	10376
19	2147	2225	2344	2428	2513
20	1775	1848	1953	2033	2115
21	4403	4847	5370	5910	6503
22	4172	4417	4725	5000	5289
23	2771	2833	2966	3027	3087
24	-	-	-	-	-
25	-	-	-	-	-
26	-	-	-	-	-
27	-	-	-	-	-
28	-	-	-	-	-
29	-	-	-	-	-
30	2444	2533	2667	2760	2855
31	3368	3927	4598	5364	6253
32	3611	4111	4703	5353	6093
33	1583	1726	1895	2067	2252
34	2210	2261	2367	2417	2467
35	4901	4928	4974	5001	5029

price information for the commodities on an average standard size. In order to overcome the second difficulty, we have taken the weighted averages of the prices which have been calculated as follows:

$$\bar{P}_i = \frac{\sum P_{iq} X_{iq}}{\sum X_i} \qquad (4.4)$$

where, $\bar{P}_i$ is the weighted average of the price of i-th commodity, P_{iq} is the price of the i-th commodity made of q-th variety of wood, X_{iq} is the weight eattached to the i-th commodity made of q-th variety of wood, and

$$X_{iq} = \frac{m_{iq}}{M_i} \qquad (4.5)$$

where, m_{iq} is the money value of the total number of i-th commodity made of q-th variety of wood and M_i is the total money value of all the i-th commodity.

Thus, depending on the weighted average of prices of both the observed years (1984-85 and 1985-86) we have projected the prices yearwise upto 1989-90. For this purpose of projection, we have assumed that the prices of various products change at the same rates at which they have changed during the years actually observed.

Now, using the projected prices and income we project the consumption expenditure incurred on various commodities by adopting the log-linear model (3.7). However, the estimated parameters of the model have been assumed to remain constant.

We adopt equation (3.8) of the earlier chapter to arrive at the levels of total consumption expenditure for each of the commodities. The projected levels of consumption expenditure on the commodities corresponding to the number of consuming households of 6 non-durable commodities as in table 4.1 and the number of purchasing households of 29 durable goods as in table 4.2 are reported in table 4.3.

NOTES

1 Intriligator, M.D., Econometric Model, Techniques, and Applications, Prentice Hall of India Private Ltd., 1980, page 509.

2 Government of Meghalaya, "Seventh Five Year Plan 1985-90 and Annual Plan 1985-86' Draft Proposals, Vol. I.

3 For details of the model see Prakash, S., "Projection of Occupational-Educational Structure of Manpower", Arthanijnana, March, 1971.

4 National Council of Applied Economic Research, New Delhi, All India Rural Household Survey, Vol. I, page 53.

Table 4.3

Projected Levels of Consumption Expenditure (in Rs.)

Sl. no. of commodities	1985-86	1986-87	1987-88	1988-89	1989-90
1	350383	344398	396720	387524	375820
2	4111369	4545317	5059851	5558647	6092795
3	2464320	2715172	2969508	3249603	3789447
4	984915	1068882	1182694	1279509	1382723
5	2973966	3338300	3769425	4225922	4736618
6	1707907	1795314	1924063	2028685	2132752
7	107743	109014	105735	107583	109562
8	4328126	4929741	5643768	6425343	7312860
9	1807998	1853594	1949702	2004886	2064144
10	159072	165846	175270	182257	194014
11	279241	306565	342719	374753	409153
12	151336	162185	177354	189923	203324
13	893802	959245	1046344	1116876	1189730
14	153399	179283	210805	245884	286334
15	927941	968273	1025722	1070962	1118265
16	1872367	2155310	2494512	2871105	3304498
17	1791956	1911716	2071815	2207601	2351177
18	2740609	3330027	4063312	4932985	5990791
19	115981	120417	127326	132593	138215
20	60510	65512	71968	77884	84240
21	239435	267991	301848	337757	377824
22	32250	34806	38036	41050	44269
23	297495	316191	342662	361969	382047
24	48065513	44500697	41250684	38267092	2959255
25	85154970	87466963	89957784	92547208	95240947
26	21314	22253	25855	28812	31709
27	38631	34229	31068	29161	26195
28	24594345	25469628	26353042	27225970	28121221
29	10050862	11609684	13351680	15401512	17811499
30	61980	69252	78516	87409	97213
31	63824	79051	98167	121334	149634
32	93742	117369	147204	183287	227695
33	86020	97502	111388	126521	143655
34	10321	10875	11717	12327	12952
35	8145	8612	9282	9790	10352

CHAPTER - V

DETERMINATION OF THE LEVELS OF PRODUCTION

5.1 In economics, production is understood as the transformation of inputs through technical processes into output. By inputs we refer to the resources that are used in the production processes, and by outputs we refer to the goods and services that result from the completion of these processes. The technological inter-relations between inputs and outputs that are functional in nature are known as production functions. The production function shows the maximum amount of output that can be produced from a given set of inputs used with a given technology. Alternatively, it may refer to the minimum quantities of inputs that are required to produce a given quantity of output.

A very advanced method of expressing the functional relationships between inputs and output has been developed and introduced by Wassily W. Leontief in 1936 which is known as Input-Output system. The input-output system refers to a general equilibrium solution for all the sectors existing in a given economy. The basic idea is that the sectors are interdependent. A proportion of the total outputs of the different sectors flow as inputs into other sectors of the economy.

For determining the levels and patterns of production of forest-based industries, we have preferred the use of the input-output model. Hence, it is essential that we discuss first the basic features of an input-output system. Then we may highlight the particular version of the model that we have developed for our purposes.

5.2. a) The Basic Input-Output System : A Resume[1]

Let there be only two producing sectors in an economy: 1) agriculture and 2) industry. Then in the tabular form we shall have the following

Table 5.1

A Basic Input-Output Table

Industries To → From ↓	Intermediate Demand		Final Demand	Total Demand
	Agriculture	Industry		
Agriculture	X_{11}	X_{12}	f_1	X_1
Industry	X_{21}	X_{22}	f_2	X_2
Primary Input	X_{01}	X_{02}		X_0

In this table X_{ij}'s refer to the output of i-th industry going to j-th industry as input where i=1,2, and j=1,2. f_i's are the final demands for the i-th products.
X_i's refer to the Gross-Output of i-th sector,
X_0 is the total supply of labour in the economy,
X_{0j}'s refer to the quantity of labour required by the j-th sector.

Rowwise addition of the intermediate demand, i.e. X_{ij}'s, and the final demand f_i gives the corresponding gross output X_i.

Thus, we have:

$$X_1 = X_{11} + X_{12} + f_1 \quad (5.1.1)$$

$$X_2 = X_{21} + X_{22} + f_2 \quad (5.1.2)$$

$$X_0 = X_{01} + X_{02} \quad (5.1.3)$$

These are known as the balance equations of the soctors. The balance equation reveals that the total output of any industry gets completely exhausted in meeting the two types of demand - intermediate demand and final demand. The intermediate demand refers to those quantities of various goods and services produced by the different sectors of the economy that are required to be used in the production processes of the economy. As against this, the final-demand component of total demand refers to that component of the demand which is used to satisfy direct consumption needs of the private individuals/ households and the government; investment requirements and lastly, net foreign trade, i.e., imports minus exports.

Looking at the table columnwise, we obtain the input structure of each of the industries. When columnwise entries for a particular industry are divided by the gross-output figure of the corresponding industry we get the input-coefficients of that industry. Thus, denoting the input-coefficient of the i-th product in the j-th sector by a_{ij} we have $a_{ij} = \frac{X_{ij}}{X_j}$ (5.1.4)

Relation (5.1.4) can be rewritten as

$$X_{ij} = a_{ij} X_j \qquad (5.1.5)$$

Now, putting relation (5.1.5) in (5.1.1) and (5.1.2) we get

$$\begin{aligned} X_1 &= a_{11}X_1 + a_{12} X_2 + f_1 \\ X_2 &= a_{21}X_1 + a_{22} X_2 + f_2 \end{aligned} \qquad (5.1.6)$$

or $\quad (1-a_{11}) X_1 - a_{12} X_2 = f_1$

and $\quad -a_{21} X_1 + (1-a_{22})X_2 = f_2 \qquad (5.1.7)$

Putting equation system (5.1.7) in matrix form we get

$$\begin{bmatrix} 1-a_{11} & -a_{12} \\ -a_{21} & 1-a_{22} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} f_1 \\ f_2 \end{bmatrix} \qquad (5.1.8)$$

or, $$\left\{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}\right\} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} f_1 \\ f_2 \end{bmatrix}$$

or, $\quad (I - A)X = F \qquad (5.1.9)$

or, $\quad (I - A)^{-1}F = X \qquad (5.1.10)$

As can be seen, in relations (5.1.9) or (5.1.10), 'A' denotes the matrix of the input coefficients, 'I' is the identity matrix, 'X' is the vector of gross outputs, and 'F' is the vector of final demands. These equations are defined as the structural relations.

It is obvious from the above that once we have the matrix A and the vector X we can easily obtain the vector F which gives the amount of each commodity available for final use. Similarly, when A and F are given, we could solve for X. While such a result would be just tautological for the year for which the table is constructed, it would be substantive when we have to compute such vector(s) for some future period. This, of course, assumes matrix-A to remain the same. This defines the static input-output system.

Besides, it is worth-mentioning that the implicit assumption characterising equation (5.1.3) is that no labour is required to produce labour. Because, there is no production process by means of which labour is produced in the requisite quantities for meeting inter-industry demand for it. It is given and fixed from outside. Hence, the economy is dependent upon the outside world for meeting its labour requirements. Thus, since the labour sector is treated exogenously, the system becomes an open input-output system.

However, there may also be closed input-output system. In the closed system, the labour sector is endogenised and is regarded as a production sector, the output of which is labour and its inputs are the quantities of consumption of goods and services. Thus, in the closed-system, when the household sector is endogenised, the final-demand vector need not be treated separately.

The input-output system may also be dynamic in nature. In the static system, we are concerned exclusively with the current or flow requirements of the production. But every industry requires some stocks also to carry on productive activity. These stocks may be of various forms, such as, buildings, machinery and other fixed assets, stocks of raw materials, finished goods, goods in the process of production etc.. Hence, in order to obtain a complete picture of the productive process one should incorporate these stocks also in the analysis. The information pertaining to these stocks at any point of time can also be put in a tabular form analogous to the current flow matrix as follows:

Table-5.2

Industries To → From ↓	Stock requirement	
	Agriculture	Industry
Agriculture	s_{11}	s_{12}
Industry	s_{21}	s_{22}

where, s_{ij} represents total stocks of i-th product held by j-th sector. Thus, while each column represents a vector of stocks, held by the given industry, each row shows the amount of particular commodity held by the various industries at a given moment. Dividing these entries by the yearly output of the relevant industry we obtain a capital-coefficient matrix. Let us call it B. Thus, we have,

$$B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

where, $b_{ij} = \frac{s_{ij}}{X_j}$, $i,j = 1,2$.

Although the 'B' matrix is obtained by the operation similar to the one by which 'A' was obtained, the 'B' matrix differs from 'A' in that it involves an additional time dimension. The output in the denominator and the stocks in the numerator relate to different points of time.

An implicit assumption in the system described by (5.1.9) or (5.1.10) is that the necessary stock requirements are automatically met. Such an assumption is justifiable if our requirement to produce the gross output vector X is less than or equal to the capacity available in each industry. If, however, the X vector needs more stocks than are available, then the additional capacity should have been created earlier. This would mean the inclusion of investment, which was considered as one of the constituents of final use, within the model.

If the additional capacity required is given by the vector ΔX then the stock requirement of the various commodities will be given by $B\Delta X$. With this, equation (5.1.9) will be

$$(I-A)X = C + B\Delta X \qquad (5.1.11)$$

where, C is the vector of final demand excluding investment requirements. (5.1.11) can also be written as

$$X - AX - B\Delta X = C \qquad (5.1.12)$$

If we define the rate of growth of the output of the i-th commodity as

$$g_i = \frac{\Delta X_i}{X_i}$$

then, $\Delta X = GX$ (5.1.13)

where, G is a diagonal matrix of growth rates having g_i in the -i-th row and the i-th column. Using (5.1.13) we write equation (5.1.12) as

$$(I-A-BG)X = F \quad (5.1.14)$$

or, $$X = (I-A-BG)^{-1} F \quad (5.1.15)$$

or, $$X = \left[I-BG(I-A)^{-1}\right]^{-1} (I-A)^{-1} F$$

This system is known as the Leontief Dynamic Input-Output System.

5.2.b) Nature of the Production Function Implicit in the Input-Output System

The Leontief system directly tell us nothing about the production processes that are at work to turn out outputs X_1 and X_2. But certain properties of the production processes are deducible from the information contained in Table-5.1 or in the balance equations. It is clear that the agricultural sector produces only agricultural goods whereas industrial sector produces only manufactured goods. Agricultural goods can not be produced in the industrial sector or vice-versa. This implies that there is no joint production. Besides, it can also be inferred that the process to produce agricultural goods uses X_{11} units of agricultural goods, X_{21} units of industrial goods and X_{01} units of labour to produce X_1 units of output. Similarly, industrial sector uses X_{12}, X_{22} and X_{02} units of agricultural goods, industrial goods and labour respectively to produce X_2 units of manufactured goods. Thus, there is one and only one production process to produce each of the two goods. It is, therefore, inferred that for producing any given good, there exists one and only one production process. In other words, there is one to one correspondence between the number of goods produced in the economy, number of sectors into which the economy is classified, and the number of processes that are available to produce these goods in the economy.

But we cannot discover the pattern of responsiveness of the various inputs used in the production processes if the scale of output is changed. This difficulty has been easily solved by Leontief who assumes the constant returns to scale. This implies that the inputs get multiplied by the same scalar by which the output is multiplied. Hence, the production function is linearly homogeneous of degree zero.

Leontief has assumed not only constant returns to scale but he also made a far stronger assumption of the fixity of these coefficients. He also assumed the usual property of the convexity possessed by the isognants. It implies the assumption of generalised diminishing returns.

The above assumptions are combined with the assumption that each production process requires a certain minimum amount of each of the commodity and primary factor inputs in order to produce a specified amount of output of the given good. Its implication is that there are other production processes in existence which need more inputs than the p rocesses in use. The rationality and motivation of earning maximum profits always induce the producers to adopt only that technique of production which is the most efficient one of all. But various techniques of production embody combinations of labour and capital and also other inputs in different proportions. It is as if producers were substituting one factor for another while they choose one technique in preference to others. But the substitution choice is exercisable only before the selection of a given technique. Once the selection is done, the factor proportions become fixed and no substitution can then take place between one factor and another. Thus, production coefficients become fixed for any scale of output once the technology has been chosen, and the chosen technology remains invariant by assumption.

5.3 The Model

In order to determine the levels of production of the thirty-five forest-based commodities to match with the estimated levels of consumption, we have adopted the following input-output model:

$$\left[\frac{X_f}{X_n}\right] = \left[\begin{array}{c|c} (I-A_{ff}) & -A_{fn} \\ \hline -A_{nf} & (I-A_{nn}) \end{array}\right]^{-1} \left[\frac{F_f}{F_n}\right] \qquad (5.2.1)$$

where, the subscript f refers to forest-based sectors and n refers to non-forest-based sectors.

As can be seen the economy has been partitioned into two segments:

i) forest-based sectors, and

ii) non-forest-based sectors.

By applying the Frobenius-Schur's formula for the inversion of partitioned matrices this system can be solved as follows:

$$\left[\frac{X_f}{X_n}\right] = \left[\begin{array}{c|c} R + R_2MR_1 & R_2M \\ \hline MR_1 & M \end{array}\right] \left[\frac{F_f}{F_n}\right] \qquad (5.2.2)$$

where, $R = (I-A_{ff})^{-1}$

$R_1 = A_{nf}(I-A_{ff})^{-1}$

$R_2 = (I-A_{ff})^{-1} A_{fn}$, and,

$$M = \left[I - \left\{(I-A_{nn})^{-1}A_{nf}\right\}\left\{(I-A_{ff})^{-1} A_{fn}\right\}\right]^{-1} (I-A_{nn})^{-1}$$

Solving for the levels of outputs we have

$$X_f = \left[R + R_2MR_1 \;\middle|\; R_2M\right] \cdot \left[F_f \;\middle|\; F_n\right]' \qquad (5.2.3)$$

and

$$X_n = \left[MR_1 \;\middle|\; M\right] \cdot \left[F_f \;\middle|\; F_n\right] \qquad (5.2.4)$$

However, our interest lies in determining X_f rather than X_n.

5.4 Data base and the Methodology

In order to determine the levels of production of the forest-based sector by using the above model it is required that we have to have an input-output system for the economy as a whole where both the forest-based and the non-forest-based sectors are considered. Hence, either we adopt an input-output table which is readily available, or, we prepare one.

Our study relates to the economy of the State of Meghalaya for which we do not have a readily available input-output table, nor, the limited time period allow us to go for the preparation of such a table for the State of Meghalaya. Hence, we have made use of the latest national level input-output table (60 x 60) prepared by the Central Statistical Organisation at 1973-74 prices.[3]

We assume that the economy of Meghalaya also consists of the same 60 sectors. These 60 sectors are, however, divided into two groups - (i) forest-based sectors, and (ii) non-forest based sectors. Under the first group, we include those sectors which produce the thirty-five forest-based commodities under consideration.

According to the definitions of sectors as specified in the national table our thirty-five commodities are produced by the following three sectors:

i) Forestry and logging - This sector produces five commodities (Com. no. 24, 25, 26, 27, & 29).

ii) Wood and Wood Products except Furniture - Eleven commodities are produced by this sector. (The commodities are - Com. no. 10, 11, 12, 22, 28, 30, 31, 32, 33, 34, 35).

iii) Furniture and Fixture - This sector produces 19 commodities (Com. no. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 21 & 23).

Thus, these three sectors constitute our forest-based sectors and the remaining 57 sectors constitute the non-forest based sectors.

Accordingly, our partitioned input-coefficient matrices will be of the following orders:

A_{ff} is 3 x 3; A_{fn} is 3 x 57;
A_{nf} is 57 x 3 and A_{nn} is 57 x 57.

We derive the final demands for our three forest-based sectors by aggregating the levels of consumption of the thirty five forest-based commodities according to the sectoral classification described above. Thus, we have the following

$$F_{dft} = \sum_{i=1}^{m} C_{idt} \qquad (5.3.1)$$

where, F_{dft} is the final demand of the d-th forest-based sector at t-th time, C_{idt} is the level of consumption of i-th commodity produced by d-th sector at t-th time and 1, ..., m, refer to the commodities produced by the d-th sector.

However, our purpose is to estimate the impact of production levels of forest-based commodities on deforestation. Therefore, we are not interested in finding the output levels of the non-forest-based sectors. Hence, we assume that the final demands for the products of these sectors to be zero.

So far as the input structure of the sectors are concerned we have assumed the a_{ij}'s of the non-forest-based sectors at the level of the state to be the same as they are for the national economy. But we replace the input-coefficients of the forest-based industries of the national economy by the state level input-coefficients. This implies that the input-structure of the non-forest-based sectors are assumed to be the same at the state and the national levels, whereas, the input-structure of the forest-based sectors at the level of the state is assumed to be different from the national input structure.

For determining the input-coefficients of the forest based sectors of the state economy we have collected data from the production units of each of the thirty-five forest-based commodities.

Nineteen out of the thirty-five commodities fall in the category of furniture, and, therefore, are assumed to be produced by the firms that produce furniture. According to the Directorate of Industries, Meghalaya, there are 41 registered units in the state which produce furniture. Out of these, 22 firms are located in the capital city of Shillong. Shillong is, thus, chosen to be the sample unit for collecting the information about input-structure of these 19 commodities. We have, conducted a primary survey of all these 22 furniture producing firms. The questionnaire used in this survey is reproduced in the Appendix-III. The input-requirements and the total outputs of all the 22 firms have been aggregated to find the input-coefficients of the sector -- furniture and fixture.

Of the remaining 16 commodities, the following two are not produced in the state-:

i) Match-box, and

ii) Sports-goods made of mixed variety.

For the rest of the commodities, as the production units are scattered throughout the state and excepting only one or two units most of the firms are located outside the capital city of Shillong we found it difficult to conduct the sample survey of all the units producing each of the 14 commodities. However, the necessary information about the input-structure of these commodities has been collected from the following three official sources:

i) Directorate of Industries, Meghalaya,

ii) Meghalaya Small-Scale and Village Industries Board; and

iii) Forest Department of Meghalaya.

The input-coefficients of the two sectors - forestry and logging, and, wood and wood products except furniture, have been calculated on the basis of the data provided by these three sources.

The three forest-based sectors draw their inputs from 21 out of the 60 sectors into which the economy has been divided. Therefore, the inputs supplied by the other 39 sectors to the three forest-based sectors are zero.

The input-coefficients of the forest-based sectors derived thus give us the matrices A_{ff} and A_{nf}. Therefore, we replace the national matrices by these modified partitioned input-coefficient matrices A_{ff} and A_{nf} which have been prepared by us for the state.

Given all the terms on the right hand side of equation (5.2.1), we can solve for the levels of outputs of forest based sectors with the equation system (5.2.2) and (5.2.3).

But, in order to find M in (5.2.2) or (5.2.3) we need to find out the following inverse:

$$\left[I - \left\{(I-A_{nn})^{-1} A_{nf}\right\} \left\{(I-A_{ff})^{-1} A_{fn}\right\}\right]^{-1}$$

This, in our case, is the inverse of a matrix of the order 57 x 57 corresponding to the 57 non-forest-based sectors. The inversion of such a big matrix is not possible without a powerful computer. As a first approximation, therefore, we have aggregated the gross outputs and the input-requirements of the 57 non-forest-based sectors into one. From this, we have derived the input-coefficients of the non-forest-based sector. Similarly, we also aggregate 57 rows of the matrix A_{nf} prepared at the state-level into 1 row. As a result of these aggregations, the order of the matrix A_{ff} remains the same as it was, i.e., 3x3. But, the orders of the other matrices change as follows:

A_{fn} becomes 3x1,
A_{nf} becomes 1x3,
and A_{nn} becomes 1x1.

Thus, 57 non-forest-based sectors merge into one and our economy now consists of altogether four sectors out of which three are forest-based sectors and one is non-forest-based sector. Now, the system becomes handy and we can readily calculate M and consequently, X_f.

Empirical Findings

The estimated yearwise final demands for the forest-based goods are given by the following vectors:

	1985-86	1986-87
	143277345	143582995
	859911	954561
	27930222	30973697

1987-88	1988-89	1989-90
144565844	146221613	142650947
1078265	1202130	1348606
34757680	38623318	43219838

It is worthnoting that these final demands for the forest-based goods refer to only private consumption.

The following is the partitioned input-coefficient matrix for our generalised four-sectors economy:

'A'

$$\left[\begin{array}{ccc|c} .414051 & .374273 & .303579 & .004001 \\ .013579 & .1631517 & .000013 & .003269 \\ .000034 & .000008 & .027080 & .003091 \\ \hline .033698 & .191451 & .127304 & .369871 \end{array}\right]$$

Assuming that this input-coefficient matrix remains the same, and given the yearwise final demand vectors the solution for X_f yield the following yearwise gross output vectors:

$$\underline{1985\text{-}86}\quad \begin{bmatrix} 263018000 \\ 5379455 \\ 28785298 \end{bmatrix} \qquad \underline{1986\text{-}87}\quad \begin{bmatrix} 265263000 \\ 5532090 \\ 31916102 \end{bmatrix}$$

$$\underline{1987\text{-}88}\quad \begin{bmatrix} 269102000 \\ 5746329 \\ 35808901 \end{bmatrix} \qquad \underline{1988\text{-}89}\quad \begin{bmatrix} 274146000 \\ 5980666 \\ 39785948 \end{bmatrix} \qquad \underline{1989\text{-}90}\quad \begin{bmatrix} 279213000 \\ 6243024 \\ 44514735 \end{bmatrix}$$

These yearwise total gross outputs of the three sectors are then disaggregated into thirty-three commodities (since 2 commodities are not produced in the state) by assuming that their proportions in the total final demands and hence, outputs are the same as in the base year. The gross outputs of commodities thus derived are reported in Table 5.5.

Notes

1. This section is prepared on the basis of the following references:

   i) Bharadwaj, R. and Mathur, P.N. - "The Input-Output Economics - A Resume", Economic Analysis in Input-Output Research Association, Poona, 1967.

   ii) Bez, K. - Introduction to Input-Output Techniques. Goel Publishing House, Meerut. 1983. Chap.-1.

   iii) Prakash, S. - Leontief open and closed input-output models, A paper presented in Refresher Course in Quantitative Economics. 26th Nov. to 16th Dec. 1984, NEHU, Shillong.

2. Milana, C., Direct and Indirect Requirements for Gross Output in Input. Output Analysis. Metroeconomica, October 1985 vol. XXXVII, no.3, pp.285.

3. Input-Output Transactions Table. 1973-74. National Accounts Statistics. Central Statistical Organization. Deptt. of Statistics. Ministry of Planning, Govt. of India, September 1981.

Table 5.5

Projected Levels of Production (in Rs.)

Sl. No.	1985-86	1986-87	1987-88	1988-89	1989-90
1	361110	354877	408718	399189	387080
2	4237231	4683612	5212779	5725972	6275337
3	2539765	2797785	3059319	3347423	3902982
4	1015068	1101404	1218464	1318024	1424150
5	3065014	3739872	3883429	4353129	4878531
6	1760194	1849938	1982255	2089753	2196651
7	111042	112331	108933	110821	112844
8	4460630	5079733	5814459	6618757	7531958
9	1863349	1908961	2008669	2065236	2125987
10	995127	961149	934055	906739	898139
11	1746884	1776675	1826430	1864418	1894068
12	946732	939931	945161	944878	941236
13	921165	988431	1077990	1150496	1225375
14	158095	184738	217181	253285	294913
15	956349	997734	1056744	1103200	1151767
16	1929689	2220887	2569957	2957530	3403503
17	1846816	1969882	2134475	2274054	2421629
18	2824512	3431346	4186204	5081476	6170279
19	119532	124081	131177	136584	142356
20	62362	67505	74145	80228	86764
21	246765	276145	310977	347924	389144
22	201750	201716	202703	204226	204932
23	306603	325811	353025	372865	393493
24	88235342	82213567	76786508	71745989	65415589
25	156321000	161592000	167452000	173514000	180103000
26	39127	41112	48129	54019	62066
27	70917	63237	57832	54674	51272
28					
29	18450677	21448508	24853626	28875900	33682143
30	387736	401345	418430	434865	450022
31	399272	458134	523155	603644	692692
32	586434	680203	784485	911863	1054055
33					
34	64566	63025	62443	61327	59958
35	50954	49910	49466	48706	47922

CHAPTER - VI

ECOLOGICAL IMPLICATIONS OF THE LEVELS OF PRODUCTION

6.1 The levels and patterns of production of the forèst-based industries, like any other industry, are determined by the levels and patterns of the demands for their products. Higher the demand for the forest-based commodities, higher will be the levels of their production. The basic inputs of forest-based sectors are various kinds of forest resources, e.g., wood, bamboo, canes, etc.. Hence, the higher levels of production in these sectors require greater quantity of forest resources to be used as the inputs in their production processes. This, in its turn, requires a faster rate of deforestation. Since, forest plays an important role in maintaining the ecological-balance, a faster rate of deforestation will hamper the stability of the ecology.

Thus, estimation of the ecological impact of the levels and patterns of production of the forest-based industries involves the following steps:

i) Estimation of the levels and patterns of demand for the forest-based commodities;

ii) Estimation of the levels and patterns of production to match that level of demand as in (i) above;

iii) Estimation of the area required to be deforested to meet the demands to produce that level of output as in (ii) above; and,

iv) Estimation of the impact of this deforestation on ecological-balance.

The levels and patterns of consumption of forest-based commodities and the corresponding levels of production have been estimated as discussed earlier.

In the present chapter, we shall discuss how the area required to be deforested to meet the demands to produce the estimated levels of output is determined. We shall also discuss the ecological impact of this deforestation.

6.2 Estimation of the Area required to be deforested:

6.2 a) Methodology and Data-base:

In order to determine the area required to be deforested, first we have converted the yearwise estimated levels of outputs in money terms into quantity terms as follows:

$$X_{irt} = \frac{X_{imt}}{\bar{P}_{it}} \qquad (6.1)$$

where, X_{irt} refers to the total output of commodity i in quantity terms at t-th time;

X_{imt} refers to the estimated total output of commodity i in money terms at t-th time.

These X_{imt}'s are reported in table 5.5.

$\bar{P}_{it}$ denotes the projected prices of i-th item at t-th time as is done in section 4.6 of chapter IV.

We have the data about how much of wood, or for that matter, any other forest-product is required to produce 1 unit of each of the 35 commodities under study. Therefore, we can find out the total wood requirements to produce X_{irt} as:

$$W_i = X_{irt} \, w_i \qquad (6.2)$$

where, W_i denotes the total wood requirements to produce i-th commodity, and,

w_i denotes the wood requirement per unit of commodity i.

Therefore, total quantity of wood required to meet the input demands of the forest-based sectors will be given by $\sum_i W_i$.

But, all the commodities, say, Almirahs made of wood, are not produced out of a single variety of wood. Given the available qualities of wood in a particular region, the qualities of wood used in producing particular units of the commodities differ according to the variations in consumers' choice and demand. Therefore, we are required to distinguish between the wooden varieties as the average wood-yield per tree for different varieties of trees are different. Hence, the number of trees required to be cut will also be different even for the same quantity of wood requirements. Accordingly, the required area to be deforested will also differ.

Therefore, we have found the requirements of different varieties of wood separately. This we have done as follows:

At our sample-level, we have the data about how many of the i-th commodity are made of the q-th variety of wood. From this, we find the proportion of i-th commodity made of q-th variety of wood as:

$$K_{iq} = \frac{n_{iq}}{N_i} \qquad (6.3)$$

where, n_{iq} is the number of i-th commodity made of q-th variety of wood; and N_i is the total number of i-th commodity produced. Now, we assume that these proportions of i-th commodity made of q-th variety of wood (i.e., K_{iq}'s) in the sample level total outputs remain the same for the output-levels of the State as a whole in the base year as well as for the estimated levels of outputs in the projected years. Thus, by denoting the number of i-th commodities made of q-th variety of wood by N_{iqt} we have

$$N_{iqt} = K_{iq}X_{irt} \qquad (6.4)$$

Now, the equation system (6.2) gets generalised as

$$W_{iq} = N_{iqt}w_{iq} \qquad (6.5)$$

where, W_{iq} denotes the total wood requirement of q-th variety for producing i-th commodity, and w_{iq} refers to the per unit wood requirement for i-th commodity made of q-th variety of wood.

Total wood requirements of q-th variety for producing all the forest-based commodities will be given by $\sum_i W_{iq}$.

This can be converted into the number of trees of q-th variety required to be felled if the average wood-yield per tree is known. Hence, these informations about the approximate quantity of wood yielded by an average tree for each of the q-th variety of trees have been collected from the Forest Department of Meghalaya. With the help of these informations we have found

$$Z_q = \frac{\sum_i W_{iq}}{Y_q} \qquad (6.6)$$

where, Z_q denotes the number of trees of q-th variety required to be felled, and Y_q is the wood-yield per q-th variety of tree.

The required area to be deforested to meet the demand for Z_q is, then, given by

$$Q_q = \frac{Z_q}{S_q} \qquad (6.7)$$

where, S_q denotes the approximate number of trees of q-th variety grown per sq. km. of area. The data relating to S_q have also been collected from the Forest Department of Meghalaya.

The total area required to be deforested has, then, been found as $\sum Q_q$.

6.2 b) Empirical Findings:

The total requirements of various varieties of forest-products, $\sum_i W_{iq}$, obtained according to the methodology discussed above are reported in Table 6.1 and 6.2 below:

Table 6.1

Wood Requirements

	Trade Name	Scientific Name	Quantity (in cu. ft)
1.	Pine	Pinus kesiya	807644
2.	Sal	Shorea robusta	118772
3.	Teak	Tectona grandis	349272
4.	Tita-Chap	Michelia champaca	197699
5.	Poma	Cedrela Toona	139566
6.	Gamari	Gmelina aroborea	44541
7.	Khokan	Duabanga Sonneratioides	66203
8.	Siris	Albizzia stipulata	443443
9.	Jaman	Eugenia jambolana	260561
10.	Haldu	Adina cardifolia	106849
11.	Mundani	Acrocarpus fraxinifolius	2224
12.	Chaplash	Artocarpus chaplasha	1374
13.	Simul	Bombax ceiba	1593

Table 6.2

Requirements of other Forest Products

	Products	Quantity (in ton.)
1.	Bamboo	227
2.	Cane	89
3.	Broomsticks	1139

In order to meet these requirements of forest-products, the estimated total forest area that will be required to be deforested, ΣQ_q, during the forecast horizon of 5 years, is 476 sq. km. approximately.

6.3 Ecological-Impact of Deforestation in Meghalaya:

Meghalaya forest is a genetic treasury of the plants and animals. The variety of vegetation ranging from sub-temperate to tropical is due to diverse topography, variation in rainfall and differential climate of the state.

Although rainfall is assured, it differs in intensity and quantity from region to region and from altitude to altitude. As variations in rainfall are considerable even in comparatively small areas they cause noticeable effects on distribution of plant and floral species. The plant and floral species of the state is, therefore, extremely varied. The Khasi and Jaintia Hills differ from the Garo Hills in not having the characteristic grass vegetation.

In the upper hill regions from 1500 mts. and above from sea level especially in the central plateau of Khasi Hills, coniferous pine vegetation are prominent. This extends further east upto Jowai and Passi in Jaintia Hills but the growth of the pine trees in the drier regions are stunted and cannot reach their normal heights. Oaks and rhododendrons on higher altitudes are common.

In the middle hill slopes between 900 mt. and 1200 mts. altitudes, temperate forests and grasslands abound. Vegetation in these altitudes differ according to the diversity of slopes found in different regions. In Garo Hills, over this altitude there are rich temperate forests where Poma, Lampati, Fir, Chilauni trees are found. In the Khasi Hills, over the same altitude, we find dense temperate forests in West Khasi Hills District. Among other trees, Laurel or Sinkoli trees which yield bay-leaf (Tezpatta), are found in abundance on the southern slope of the West-Khasi Hills, i.e., in Nongkhlaw region and below the Mawsynram and Cherra Plateau.

In the lower hill of the sub-tropical region, deciduous forests and grass-land occur in many places. Most of this region falls in Garo Hills.

The northern hills facing the Brahmaputra valley are clothed with tropical vegetation. In Garo Hills, the important trees are Sal, Gamari, Simul, Chaplash, Siris and Teak. The whole of the hills are covered with mixed evergreen and sal forests and bamboo jungles.

Meghalaya forest is also the abode of wild animals. Hamphanggiri, a place 10 km. off Balphakram in the East Garo Hills district is considered to be the centre of wild elephant population. Other wild animals found in the forests are tiger, bisons, hoolock, bears, barking dear, sambhars, leopards and slow loris. Apes, reptiles, monkeys, mammals and bird fauna are also common in Meghalaya forests.

The state has various species of bird fauna. In the higher altitudes, smaller birds, like fly-catcher, thrush, treepie, magpie, mininet, grey-til and backed til, hoopoe and wood-pecker are found.

In the lower altitude and in deeper forests, horn-bill, impeyon-pheasant, patridges, wood-cock, florican, barn-owl, maina, black drongo, whistling thrush and the Himalayan Great Barbet (Newool) are commonly found.

Meghalaya is also called the land of butterflies. Diverse climatic conditions, luxuriant vegetation, evergreen hills make the hills of Meghalaya the perfect breeding grounds of rare species of butterflies. Some 500 species of butter-flies are found in the state.

Therefore, cutting of trees and excessive extraction of natural forest resources will automatically hamper and endanger this genetic treasury of both plant and animal species.

Besides, reduce in the forest areas of a region implies:

i) decrease in the proportion of oxygen in the atmosphere of the region;

ii) increase in the temperature of the region; and

iii) losing the fertility of the soil as well as causing the soil erosion.

All these have serious implications on ecology in general, and on human ecology in particular.

However, according to the National Forest Policy of 1952, in the hilly areas as in the Khasi-Jaintia Hills, 60% of the total geographical area must be under forests. But, statistics of the Forest Department of the State shows that only 37.96% of the area are under forests. Thus, we presume that the ecology is already unbalanced. On the top of this, losing 476 sq. km. of forest area in 5 years to meet only the private consumption demands for commodities like, fuel, furniture, fancy article, brooms, etc., is by no means meagre.

We have not taken into account the Government consumption and export demand for forest-based commodities under this study. Besides, the most important sector, viz., construction, that requires huge amount of forest resources is also not taken into consideration. All these will be taken into account at a later stage of the study. But, even without doeing so, one can easily infer from this present study that if all these are taken into account the rate of deforestation will prove to be much higher which will have very serious implications for ecological-balance. Not only this, if this rate of deforestation is not matched by the implementation of the programme of afforestation then it will not take long for deforestation of even the total forest area of the state.

CHAPTER - VII

SUMMARY AND CONCLUSION

The major findings of the study may be summed up as follows:

The probability of being consumer or non-consumer of the commodities under study have been estimated with the help of the Probability Regression model where income has been used as explanatory variable. It is found that the pattern of consumption probabilities for 29 out of 35 commodities can be explained by the level of income of the consuming households. Hence, income has been used as an instrument for prediction of consumption probabilities of the forest-based commodities for the projected years.

The Pareto Law of Income Distribution has been used to project the level of income and it is found that for higher levels of income the distribution fits the data well.

A perusal of table 4.1 reveals that the projected total number of consuming households show positive growth rates for 32 commodities. For the remaining 3 commodities of (i) firewood for cooking; (ii) free dry branches, wasted articles for cooking and (iii) wood collected from forest for cooking, the number of consuming households show negative growth. The implication for this may be that some of the households have been substituting the consumption of firewood by charcoal or by other fuels like LPG, kerosine, electricity, etc..

For estimation of the levels and patterns of consumption of the forest-based commodities the Log-Linear model is adopted where price and income have been used as two explanatory variables. According to this model, the price elasticity of consumption expenditure shows that out of 35 commodities 29 are positively related with expenditure out of which 28 are significant statistically. Out of 6 negative price elasticity only 2 are significant statistically.

The income elasticity on consumption expenditure, on the other hand, shows only 18 commodities to be positively related. The coefficient of income is significant only in 3 cases. Out of the 17 negative income elasticities, the coefficient of income is significant only in 7 cases.

Given these price and income elasticities, and the projected levels of prices and income, the levels of consumption expenditure have been projected. The total consumption expenditure for two commodities have been found to be increasing at a diminishing rate, for 3 commodities the increase in consumption shows negative growth rate and for remaining 30 commodities ,the growth in consumption are positive and are increasing at an increasing rate.

For estimating the levels of production Input-Output model has been adopted. Given the projected levels of consumption for five years and the input coefficient matrix in the base year, we project the levels of production by assuming that the input-coefficients of the base year remain constant for the projected years. The results thus obtained show that the growth rate in the levels of production of our three sectors of i) forestry, ii) wood and wood products, and iii) furniture are 46.03%, 15.66% and 5.93% respectively. The corresponding growth rate in the levels of consumption expenditure were 20.75%, 4.87% and 5.92%. These growth rates have been calculated on the basis of base year levels of consumption and production.

These high rates of growth of consumption and even higher rates of growth of production of forest-based commodities are required to be checked in order to check the destruction of forest resources and maintenance of viable ecological balance. At the same time it is also necessary to adopt suitable policy measures of afforestation for maintenance of ecological balance. Hence, we may suggest some policy measures to be adopted as a part of ecological planning.

Policy measures

Some of the earlier environmentalists suggested for zero economic growth for maintenance of ecological balance. But, this is not feasible. Even to maintain the current level of growth, exploitation of the considerable amount of natural resources is needed. However, one can also suggest to prohibition of universal use of various forest-based products. But this is not feasible in a democratic country like India.

Hence, we suggest that the following policy measures must be considered for implementation:

i) strict policy must be adopted to control population growth, so that growing consumption demand gradually comes under control;

ii) prices of purely wooden products must be raised to a sufficiently high level and that of semi-wood and non-wood substitutes of these goods may be subsidized. This policy may automatically convert the wooden products into luxuries;

iii) for reducing the consumption of firewood, the wood saving improved chullas must be made popular among the common people;

iv) no forest-based industries should be permitted until and unless they are first cleared with regard to assured availability of the raw materials after meeting the bonafide needs of the local people;

v) social forestry and community forestry programmes should be made popular among the common mass;

vi) ornamental plants, which may not serve the purpose of usual consumption of wood but will help in maintaining ecological balance, may be planted at a large scale.

vii) research work for identifying fast growing species suitable for specific climatic conditions must be taken up.

For implementation of these policies, the sense of awareness regarding the importance of ecological-balance must be created among common people, by large publicity through radio, television. The Government organizations and educational institutions must take initiative to organise seminars and conferences to discuss the problem of environmental crisis and to find the solutions for it. Besides, importance of ecological balance may be made a compulsory course content right from school level.

However, we are happy that, ecological viability has been accepted as one of the important aspect of planning for growth of our country. The Government of India set up a Department of Environment in the Sixth Plan. The State and Union Territory Governments were also asked to set up structures which could act as focal points for environmental considerations in the state plans and most of the states have set up appropriate structures. A number of Ministries/ Departments of the Government of India now go into environmental considerations in some detail in their major developmental programmes. The centre has proposed to expand its afforestation programme five times during the Seventh Plan by undertaking five million of hectares per annum. The Seventh Five Year Plan approach paper contains a separate chapter on 'Environment and Ecology' which assumes proper management of environmental quality.

BIBLIOGRAPHY

Books

1. Atkinson, A.B., Economics of Inequality, Clarendon Press, Oxford, 1975.

2. Atkinson, A.B. (Ed.), The Personal Distribution of Incomes, George Allen and Unwin Ltd., 1976.

3. Bez, K., Introduction to Input-Output Techniques, Goel Publishing House, Meerut, 1983.

4. Boulding, K.E., Economics As a Science, Tata McGraw Hill Publishing Co. Ltd., Bombay, 1970.

5. Carter, A.P. and Brody, A. (Ed.), Applications of Input-Output Analysis, North-Holland Publishing Co., Amsterdam, 1972.

6. Gramer, J.S., Empirical Econometrics, North-Holland Publishing Co., Amsterdam, 1975.

7. Dasman, R.F., Milton, J.P. and Freeman, P.H., Ecological Principles for Economic Development, John Wiley and Sons Ltd., 1975.

8. Edel, Matthew, Economics and Environment, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1973.

9. Fox, K.A., Intermediate Economic Statistics, Wiley Eastern Private Ltd., New Delhi, 1972.

10. Gupta, S.P., Practical Statistics, S. Chand & Co. Ltd., New Delhi, 1979.

11. Hicks, J.R., Value and Capital, An Inquiry into Some Fundamental Principles of Economic Theory, The Clarendon Press, Oxford, 2nd Edition.

12. Intrilligator, M.D., Econometric Models, Techniques, and Applications, Prentice Hall of India Private Ltd., New Delhi, 1980.

13. Jaswal, I.J.S. (Ed.), Status of Ecology, Punjab Publishing House, Patiala, 1984.

14. Klein, L.R., An Introduction to Econometrics, Prentice-Hall of India Private Ltd., New Delhi, 1973.

15. Kormondy, E.J., Concepts of Ecology, 2nd Edition, Prentice-Hall of India Private Ltd., New Delhi, 1978.

16. Lecomber, R., Economic Growth Versus Environmental Quality, McMillan, 1975.

17. Lundholm, B. (Ed.), Ecology and the Less Developed Countries, Symposium in Stolckholm, 26.4.1971. Bulletins from the Ecological Research Committee-13.

18. Lydall, H.F., The Structure of Earnings, Oxford University Press, Oxford, 1968.

19. Marshall, A., Principles of Economics, The E.L.B.S. and McMillan and Co. Ltd., London, 1961.

20. Mathur, P.N. and Bharadwaj, R. (Ed.), Economics Analysis in Input-Output Frame-Work, Vol. I., Input-Output Research Association, Poona, 1967.

21. Mehta, J.K., Studies in Advance Economic Theory, S. Chand & Co. Ltd., New Delhi, 1957.

22. Odum, E.P., Fundamentals of Ecology, W.B. Saunders Co., Philadelphia, 1971.

23. Ophuls, W., Ecology and the Politics of Scarcity, W.H. Freemand and Co., San Francisco, 1977.

24. Pearce, D.W., Environmental Economics, Longman Inc., New York, 1977.

25. Prakash, S., Educational System of India, Concept Publishhing Co., Delhi, 1978,

26. Problems of Environmental Economics, Organization for Economic Co-operation and Development, Paris, 1972.

27. Rendall, F.J. and Wolf, D.M., Statistical Sources and Techniques, McGraw Hill Book Co. (UK) Ltd., 1983.

28. Rohrlich, G.F. (Ed.), Environmental Management: Economic and Social Dimensions, Ballinger Publishing Co. Cambridge, Massachusetts, 1976.

29. Sen, A.K., On Economic Inequality, Clarendon Press, Oxford, 1973.

30. Singh, J.P., Urban Land Use Planning in Hill Areas - A Case Study of Shillong, Inter India Publications, Delhi, 1980.

31. Theil, H., Principles of Econometrics, John Wiley and Sons Inc., New York, 1971.

32. Yamane, T., Mathematics of Economists, Prentice Hall of India Private Ltd., New Delhi, 1981.

Journals

1. Chandras, G.S. and Srivastava, S.S., Forestry Economics in India - Same Areas for Research, Arthavijnana Vol. 10, No.2 June 1968.

2. Chandras, G.S. and Muranjan, S.W., Intensification of forestry production through 'Area Selection', Arthanijnana, Vol. 10, No.2. 1968.

3. England, R.W., Production, Distribution and Environmental Quality, Kyklos, Vol. 39, 1986.

4. Colledge, R.G., Representing, Interpreting and Using Cognized Environment, The Regional Science Association Papers, Vol. 41, 1978.

5. Guha, R., Ecological Crisis and Ecological Movements: A Bourgeois Deviation? Economic and Political Weekly, December 25, 1982.

6. Kannan, K.P. and Mody, A., Environment and Development in India, Economic and Political Weekly, April 16, 1983.

7. Kulkarni, S., Towards a Social Forest Policy, Economic and Political Weekly, Feb. 5, 1983.

8. Milana, C., Direct and Indirect Requirements for Gross Output in Input-Output Analysis, Metroeconomica, Vol. XXXVII, no. 3, October, 1985.

9. Pandey, M.C., Role of Forests in Ecological-Balance, Journal of North-Eastern Council, Vol. VI, 1984.

10. Prakash, S., Educational Structure of Manpower, Arthani Arthanijnana, 1971.

11. Prakash, S. and Tripathi, I., Consumption Behaviour of Farmers in Punjab- A Case Study of Food Grains, The North-Eastern Hill University Journal of Social Sciences and Humanities, Vol. III, no.3. 1985.

12. Thage, B., Commodity Flow Systems and Construction of Input-Output Tables in Denmark, Denmark Statistics, 6 Kontor, 1986, No. 15.

13. Von Boventer, E., Urban Dynamics : Environmental Processes with Band Wagon Effects and Product Cycles, Papers of the Regional Science Association, Vol. 40, 1978.

14. White, M.J., On Pollution, Pigounian Taxes, and the Market for Land, The Regional Science Association Papers, Vol.41, 1978.

Government Publications

1. Government of Meghalaya - Seventh Five Year Plan 1985-90 and Annual Plan 1985-86, Draft Proposals, Vol. I.

2. Government of Meghalaya - Directorate of Census Operation, Shillong, 1985.

3. Government of Meghalaya - Performance Budget, 1982-83, 1983-84, Forest Department, Shillong.

4. Government of Meghalaya, Statistical Handbook - 1984, Directorate of Economics, Statistics and Evaluation, Shillong.

5. Government of India, Input-Output Transaction Tables, 1973-74, Central Statistical Organization, Department of Statistics, Ministry of Planning, September, 1981.

6. Government of India, The Seventh Five Year Plan 1985-90, Vol. II, Sectoral Programmes of Development, Ch.18, Planning Commission, New Delhi.

7. Manager of Publications, Delhi 1972, Indian Forest Utilization Vol. I and II, Editorial Board, Forest Research Institute, and Colleges, Dehra Dun.

8. North-Eastern Council, Basic Statistics, 1982, North Eastern Council Secretariate, Shillong.

Unpublished Papers and Theses

1. Dutta, B.B., Issues of Tribal Development in North-East India - A Case Study in the Khasi-Jaintia Tribal Setting, Unpublished, ZA paper presented in 'Symposium on Tribal Demography and Development' 1985.

2. Mathur, P.N., Techniques of Buildings Suitable for Hill Region, A Paper presented in the National Seminar on "Strategies of Development During the Seventh Five Year Plan" held in N.E.H.U., Shillong, 1984.

3. Mathur, P.N., Economics of Social Forestry, A Paper presented in the National Seminar on "Strategies of Development During Seventh Five Year Plan" held in N.E.H.U., Shillong, 1984.

4. Prakash, S., South-South Co-operation and Import-Substitution As a Strategy of Development of Developing Economies, A Paper presented in "Asian Symposium on the Green Book Contemporary Human Causes, New Delhi, 1984.

5. Prakash, S., Uses of Input-Output Economics, A Paper ppresented in Refresher Course in Quantitative Economics, N.E.H.U., Shillong, 1984.

6. Prakash, S., Leontief Open and Closed Static Input-Output Model, A .paper presented in Refresher Course in Quantitative Economics, N.E.H.U., Shillong, 1984.

7. Roy, D.C., Economic Development, Consumption Pattern and their Impact upon Ecological-Balance with Special reference to forest-based Industries, An unpublished M.Phil Thesis, submitted to the N.E.H.U. Shillong, 1986.

8. Tulasidhar, V.B., 'Impact Analysis of Indian Government Expenditure in a Semi-Closed Input-Output Frame-Work - Some Explorations' A Ph.D. thesis submitted to the Gujrat University, Ahmedabad, 1983.

APPENDICES

APPENDIX - I

CONSUMPTION AND INCOME SURVEY

Sector : A - Identification Particulars

1. Serial No. of Sample household :
2. Name of the locality :
3. Area :
4. House No. :
5. Name of the head of the household :
6. Religion: Tribe/Non-Tribe:
7. Name of the respondent:

Section B - Particulars of household members

Sl. No.	Relation ship with the house-hold head	Sex M/F	Age	Marital status	Education	*Primary occupation	Income From	
							primary occupation	Secondary occupation

*1. Self employmemt in small cottage or household industries

2. Petty business a trade
3. Artisan, Craftsman
4. Govt. Employee
5 (a) State Govt. (b) Central Govt. (c) Local Authority. (d) Public Sector Undertaking

1. Colee, Porter
2. Private employee
   a. In business
   b. In household work
   c. In private farm.

Section C : Household consumption expenditure

a) Consumption of durabl. forest-based products

Description of item	Year in which purchased	Quantity purchased	Money value	Total Consumption	
				Quantity	Money Value
1	2a)	2b)	2c)	3a)	3b)
1. Almirah					
1.1 Wood made					
1.2 Mixed					
2. Chair					
2.1 Wood made					
2.2 Cane made					
2.3 Mixed					
3. Table					
3.1 Wood made					
3.2 Cane made					
3.3 Mixed					
4. Bed					
4.1 Wood made					
4.2 Mixed					
5. Fancy article					
5.1 Wood made					
5.2 Cane made					
5.3 Bamboo made					
5.4 Mixed					
6. Stools, benches					
6.1 Wood made					
6.2 Cane made					
6.3 Mixed					
7. Coach & Sofa					
7.1 Wood made					
7.2 Cane made					
7.3 Bamboo made					
7.4 Mixed					

8. Book rack

8.1 Wood made
8.2 Cane made
8.3 Bamboo made
8.4 Mixed

9. Hanger

9.1 Wood made

10. Alna

10.1 Wood made
10.2 Cane made

11. Sports goods

11.1 Wood made
11.2 Cane made
11.3 Mixed
11.4 Bamboo made

12. Brooms

12.1 Made of bamboo
12.2 Other than bamboo

b) Consumption of fuel for cooking and ligating

1	2a)	2b)	2c)	3a)	3b)
1. Firewood					
2. Charcoal					
3. Free-dry branches					
4. Electricity					
5. Kerosine					
6. Matches					
7. Gas					
8. Wasted articles					

c) Consumption of fuel for heating

1. Charcoal
2. Fuel wood
3. Electricity
4. Wasted article

Appendix-II

The estimated income elasticity of consumption probability calculated from Probability Regression Model:

1. -2.339953
2. 3.790039
3. -0.017379
4. 0.327184
5. 7.227887
6. 0.199958
7. -4.129349
8. 9.3989171
9. -0.101344
10. 0.226821
11. 0.423116
12. 0.43106
13. 0.566197
14. 6.002553
15. 1.622415
16. 9.800179
17. 1.049499
18. 17.707173
19. 1.108297
20. 1.572846
21. 7.204897
22. 3.163317
23. -0.177675
24. -5.691276
25. 0.737024
26. -6.634424
27. -5.023978
28. -0.395670
29. 0.695125
30. 1.045281
31. 13.536567
32. 10.841208
33. 6.201591
34. -0.1330472
35. 0.457174

Appendix-III

Questionnaire for Production Survey

Section A : Identification Particulars

1. Serial number of the sample firm:
2. Name of the firm:
3. Name of the locality in which the firm:is situated:
4. Year in which the firm was established:

Section B : Particulars of Output

Sl. No.	Items produced	Size of the commodities	Variety of wood used in production	Output in physical Quantity per unit of output	Total Output produced		Selling price per unit (Rs.)
					Quantity	Value	

2. Whether the commodities are produced on the basis of demand. If yes, then, whether private consumption demand or Government demand or demand from other sources? If no, then for which prupose the commodities are produced?

Section C : Particulars of the materials consumed in the production process

	Materials consumed	Money Value	Quantity
a)	Basic materials		
b)	Chemical & auxiliary materials		

Materials consumed	Money value	Quantity
c) Packing materials		
d) Fuel, electricity, lubricants, etc.		
e) Materials consumed for repair and maintenance of building, machinery, etc.		
f) Others		

Section D : Investment Particulars

Total Investment	Fixed Capital			Working Capital			Rent paid	Interest paid	Wages & salaries paid
	Items	Quantity	Money value	Items	Quantity	Money value			

Section E : Gross Value of Output

1. Products and Bi-Products, total:
2. Stocks i) Opening stock -
   ii) Closing stock -
   ii Change in stock (i.e, ii) - i))
3. Work done for others: i) for customers -
   ii) for other firms -
4. Sale value of goods sold in the same condition as purchased -
5. Total :

Section F : Gross Value of Input

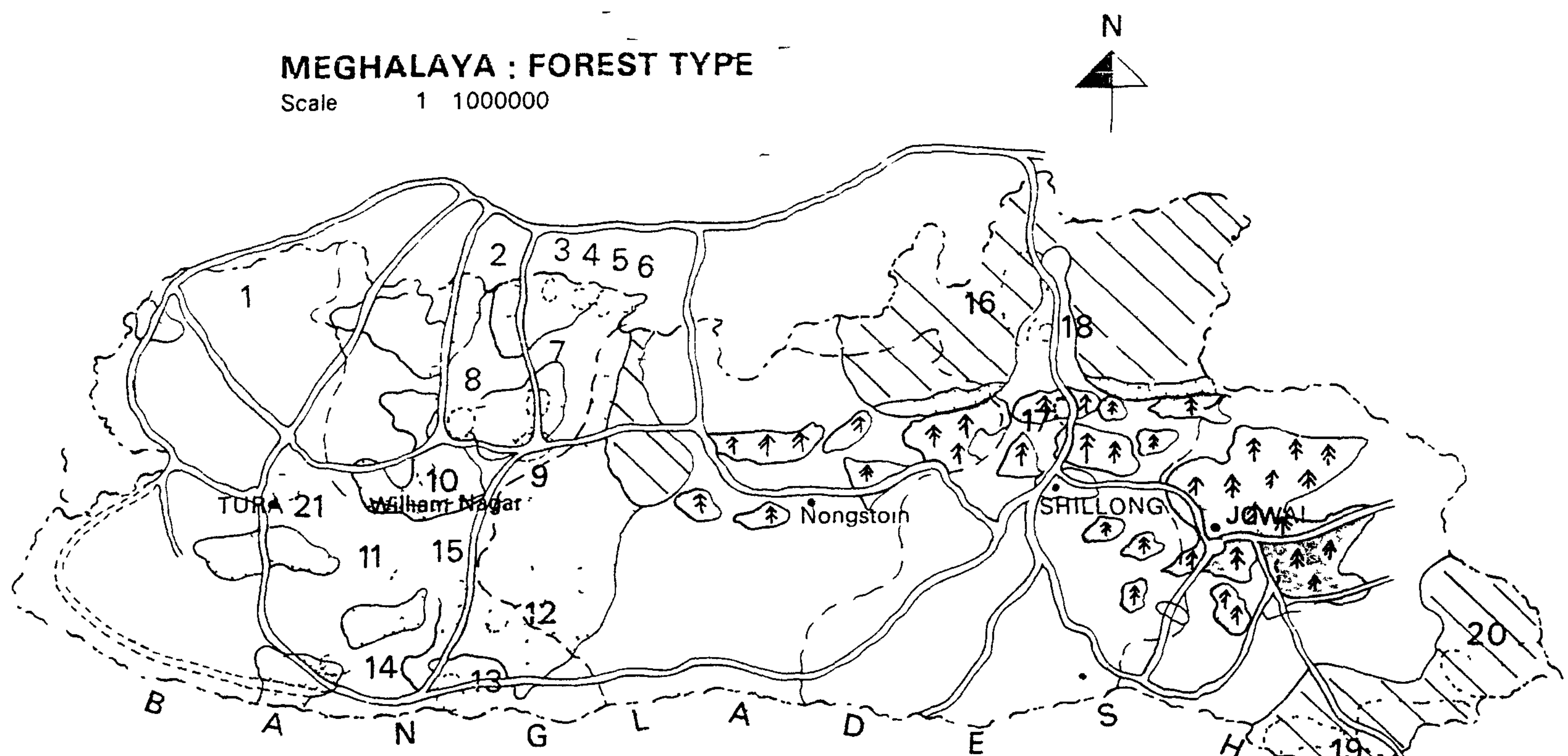
1. Total value of materials consumed :
2. Inward transport charges :
3. Non-industrial services purchased:
4. Purchase value of goods sold in the same condition as purchased:
5. Wages and salaries paid to the workers:
6. Total:

Section G: Value-added by Manufacture

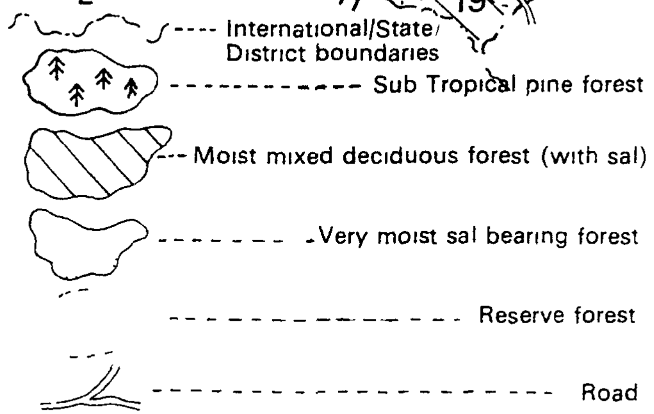
(Gross Value of output) - (Gross value of input)

MEGHALAYA : FOREST TYPE

Scale 1 1000000



1	Dibru hills	1502.194 Ha	12.	Siju	517 998 Ha
2	Chimabongshi	2258 15 ,,	13	Bagmara	4428 883 ,,
3	Dhima	1674 59 ,,	14.	Angratoli	3010 864 ,,
4	Dilma	·258 999 ,,	15	Rewak	647 5 ,,
5	Raja simla	1812 993 ,,	16	Nongkhyllem	12590 591 ,,
6	Ildek	258 999 ,,	17.	Raitkhwan	391 331 ,
7	Dambu	1812 999 ,,	18	Umsaw	43 706 ,
8	Songsak	2330 991 ,	19	Narpuh (bl 1 & 2)	16109 983 ,
9	Darugiri	1035 996 ,	20	Saipung	15035.299 ,,
10	Rongrenggiri	3625 986 ,	21	Tura Peak	418 631 ,
11.	Emanggiri	828 797 ,			



Source: Office of the Chief Conservator of Forest, Govt. of Meghalaya, Shillong.