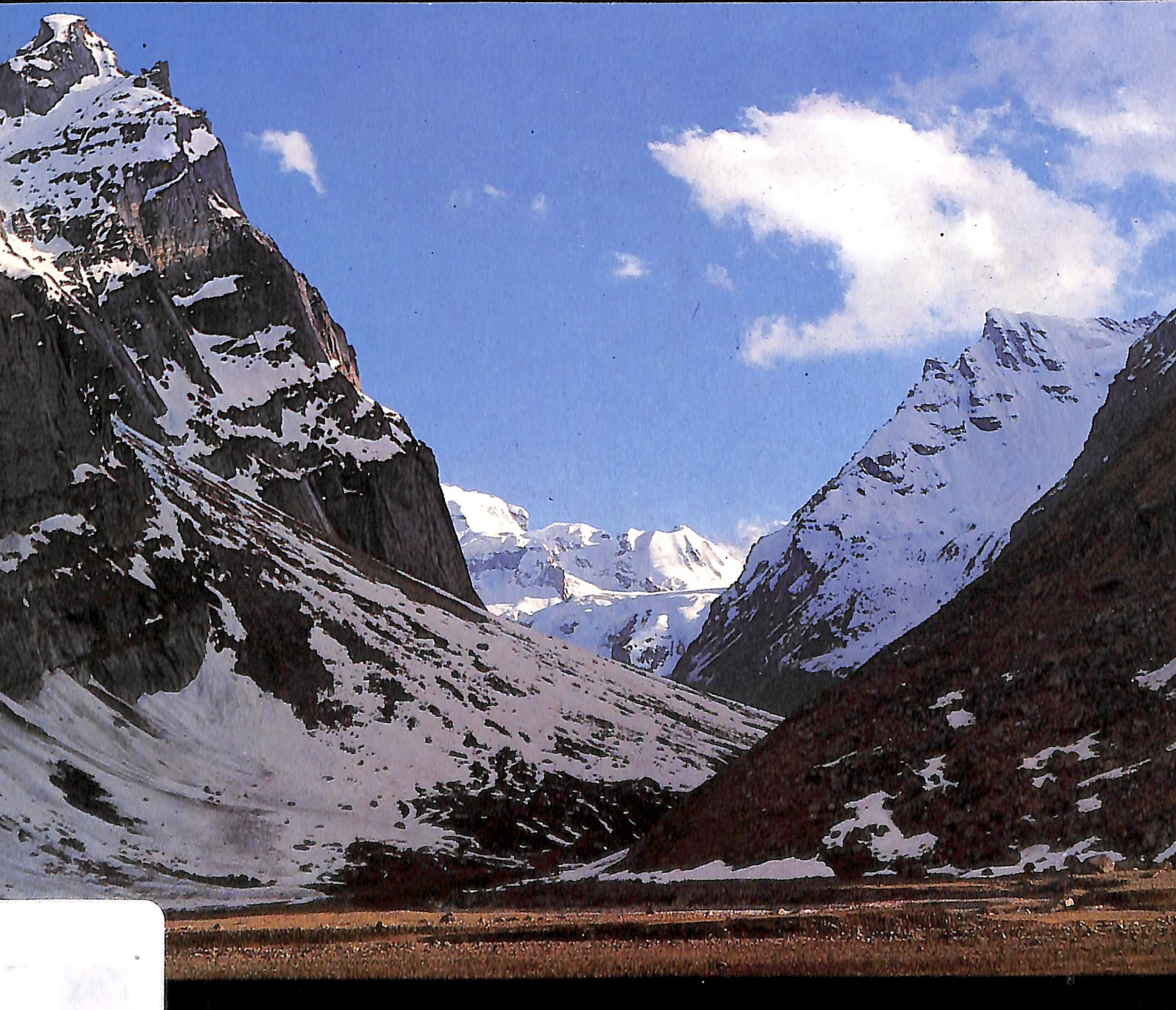
ENCYCLOPAEDIA OF HIMALAYAS



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ENCYCLOPAEDIA
OF
HIMALAYAS

Vol. 2
Eastern Himalayas

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PREFACE

World renowned 'Himalayas' are not only a great mountain range having the privilege Highest Peaks in the world.

A barrier to snowy winds from Mongolia and middle Asia to the south Asia, many great rivers originate from the Himalayas. A legendary range in Ancient Indian literature—many myths, realities and maxims are associated with Himalayas.

The present work in four volumes is encyclopaedic in nature which elaborately discusses all the major aspects viz. Geography, Economy, Fauna and Flora, Tourism, species, history and culture etc. Based on authoritative information, the four volumes, are grouped as follows:

- Understanding Himalayas
- Eastern Himalayas
- Eastern Himalayas
- Central Himalayas
- Western Himalayas.

I am thankful to all the learned authors and scientists whose writings are cited or substantially made use of in the present encyclopaedia. I am also grateful to Mr. J. L. Kumar, Managing Director, Anmol Publications Pvt. Ltd., New Delhi for undertaking the publication of this project.

This work will prove a standard reference for the students, scholars and teachers in the field of geography, economics, environment, and sociology of the Himalayan regions.

—Kadambari Sharma

Ecology and Environment

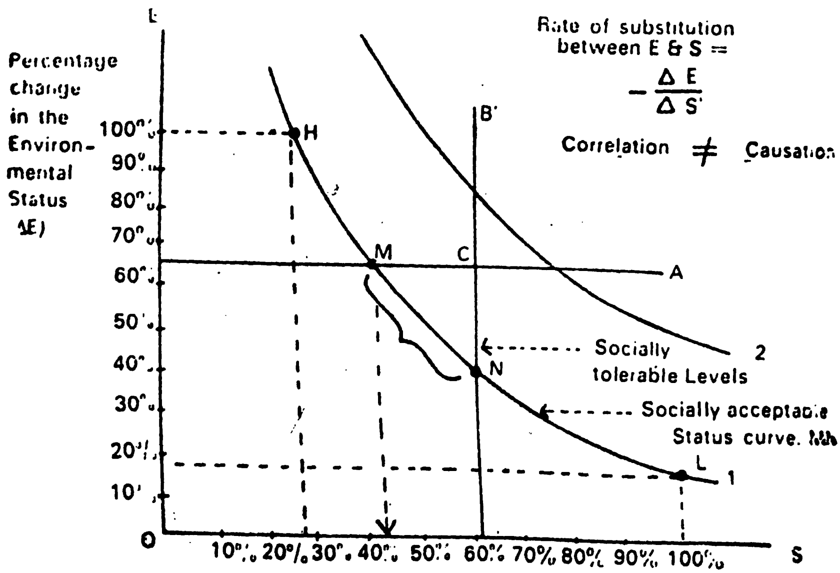
1

Ecology and Environment

The word 'environment' is frequently used with a vagueness matched only by the vehemence of zeal with which it is invoked. This chapter attempts to explain the ecological balance in hilly regions with the aid of a two-dimensional diagram. The vertical axis represents, all the constituents of the environment such as the air, water, soil, plants and trees, animals, scenic beauty and all types of natural resources; they keep on interacting with each other to maintain the ecological balance. The horizontal axis shows, the socio-economic status of the people and their production and consumption activities, social conditions, cultural conditions, all visual features of main-made objects enhancing their quality of life. In general, this axis represents 'development' which is a dynamic process and one in which there is no recognized end point. The more technologically advanced countries or regions seek new techniques for improving their resource utilization or for enhancing the conditions of the environment in which human beings live. Less advanced countries or regions attempt to attain levels of economic well-being which the more advanced nations have achieved. Thus the categories of developed and developing countries have no relevance in this analysis due tot he fact that all are developing at different rates and from differing historical levels of achievement. Such development with a view to meeting the socio-economic needs implies that man must use nature in the process of development. This, in turn, does cause certain changes in environment. If these changes are not properly adjusted to preserve the harmony of nature and the ecological balance, man faces twin risks: increasing cost of development and imbalances which have severe repercussions on his living conditions. Thus the diagram is based on a hypothesis of negative correlation. The environmental status and the socio-economic status of the people living in an environment go in the opposite direction. This article describes how a "trade-off" between the two is justified from the practical standpoint. A 100% change in the environmental status implies a perfect ecological balance and a 100% change in the socio-economic status may mean a mass consumption stage where all man-made visible objects enable the people to meet all sorts of basic needs of food, energy, water, health, education, communication, clothing, recreation and shelter. An attempt has been made to explain the implications of a "trade-off" between the two within a socially tolerable level without affecting them badly; and to show how policy-makers' preferences may influence the attainable combinations. In analytical framework, the term "status" does not have any class connotation; it simply implies a desirable quality of life.

Readers may note that the correlation implies in the following diagram is in the statistical sense and does not signify any causation. It just shows the degree of association between the natural environment and the socio-economic conditions of the people living in the whole set of surrounding conditions. The "status" curve is asymptotic; it comes closer to the axis, but never touches it. Suppose, it touches the horizontal axis, then, it means "Zero" environmental status. This complete "annihilation" is avoided by the realistic asymptotic curve. This article also examines the ideal goal of positive correlation between the two under the assumptions of new technologies and interaction of variables affecting the aggregative values represented by the two axes. 'Percentage changes' are not calculated, but they are left to the preferences and computations by appropriate policy-makers. Conclusions are drawn concerning short-term and long-term policy measures.

Hypothesis and implications



Percentage change in the socioeconomic change

There is an imperative need for a trade-off between the environmental status and the socio-economic status of the people living in hill areas, in order to escape the ecological boomerang. Concerning ecological balances and survival thresholds, a pertinent observation made by a group of ecologists is worth-quoting: "Any ecosystem, no matter how resilient, can be pushed to a 'point of no return' or, more exactly, to a threshold beyond which limiting factors become so severely operative that recovery, in periods meaningful in the human time-scale becomes impossible".

Two status curves are imposed on lines AA' and BB', which depict the socially tolerable levels as specified by the preference of policy-makers. Any status curve, for example, No. 1 which passes within rectangle OACB represents an obtainable combination of environmental status and socio-economic status lying within the socially tolerable level. If the applicable status curve passes outside the rectangle, so called dilemma model is present—in which none of the available combination of environmental status and socio-economic status is socially acceptable. One must choose between them. Therefore, the choice is obviously in favour of No. 1 status curve.

Let us explain the hypothesis of inverse relationship between the environmental status and the socio-economic status implicit in the diagram. Suppose our goal is to achieve 100% environmental status, then we get a point H, but corresponding to this point we obtain a low socio-economic status. On the other hand, suppose our objective is to attain 100% socio-economic status at point L implying complete eradication of poverty, solution of unemployment, under-employment problems and perfect parity in living standards in a mass consumption stage, then, corresponding to this point we face a low percentage change in the environmental status.

When the status curve is used for policy formulation purposes, its slope and position were of vital concern—its slope yields the rate at which the socio-economic status can be traded-off against the environmental status, its position gives us the initial magnitudes of relationships between socio-economic and environmental aspects.

The variables which are affecting the environmental status curve emanate from the socio-economic spheres. Thus, there is an interaction giving rise to key factors of ecological degradation. In many parts of the hill regions, population growth has now exceeded the carrying capacity of the traditionally used land. It has caused overstocking of grazing lands and ever-increasing need for new agricultural and pastoral land. A direct consequence of the demographic pressure is that forested upper slopes which used to protect the lower slopes from excessive erosion are being altered by clearing for cultivation, grazing, lopping of leaves and twigs for fodder, collection of firewood, and timber production. Excessive deforestation and unscientific use of mountain slopes trigger acute problems: widespread erosion, landslides and resulting massive soil impoverishment and soil losses. Thus the result is obvious in hill regions: there has been a rapidly deteriorating physical and biological environment causing diminishing agricultural yields. These problems are aggravated by the less favourable conditions for plant growth at high altitudes. In many areas of hilly regions there is a lack of adequate technical equipment, and existing facilities for marketing are sub-optimal from the point of view of farmers' needs in areas of intensive cultivation.

Environmental problems confronted by the highlands have harmful effects on the lower valleys and lowland areas, such as silting, flooding causing loss of crops and human suffering. The unsatisfactory conditions of life in the highlands and the lack of alternative employment opportunities lead to influx of people to the lowlands and tot he urban areas. There are serious repercussions of this migration on the urban environment. The consequence is the aggravated housing, employment and under-employment problems in urban and lowland areas.

At the present time, there is a danger that the ecological balance in the Himalayan region will be irreversibly ruptured. The goal for the future must be to develop a new balance—a new pattern of man-environment relationship which will be consistent with the revolution of rising expectations and the socio-economic needs of the people. The existing wide spread poverty in urban and rural areas must be eradicated. Development of the hilly regions of Darjeeling thus poses a dilemma. Developmental efforts must necessarily involve the exploitation of the available resources, yet the fragility of the Himalayan ecosystem makes it imperative that these resources should be exploited in an ecologically sound manner which will preserve the productivity of the system for future generations. What is needed is the rational management of natural resources—mainly land use patterns and forest resources. The task for evolving economic and social conditions, especially, through education, and new attitudes to the short-run goal of profit maximization that characterizes the managerial behaviour and systematic community action. This goal should be attained subject to certain constraints as in a hill region composed of different ethnic and cultural groups, there is often resistance of change.

The ecological and developmental problems of hill regions transcend political or administrative boundaries. They are delimited to a large extent by watershed and river systems. Join action is necessary to deal effectively with the destructive forces of nature and to optimally use the resources available to the private and public sectors for economic development, for example, for hydroelectric power production. The physical and biological complementarity of the highlands and lowlands in the Himalayan and sub-Himalayan regions is another factor for bilateral and multilateral endeavours. Simultaneously, regional exchange of goods and people must need developmental efforts and socio-cultural values of the hill regions must be preserved and enriched.

Without an integrated approach to the development of hill regions the dilemma posed in the diagram concerning the status curves will persist. Unplanned and lopsided changes in the socio-economic status, though apparently in the positive way, will lead to the loss of environmental status in a region or in a country. In a region or a country facing a critical demographic pressure on land and other resources and a temptation to maximize short-run gains in every sphere of activity, the development dilemma posed in the diagrammatic illustration and outlines above-reconciling socio-economic needs with those of maintaining biological productivity—will seldom be solved by developmental efforts in the slow planning process. "Integral" approach are the key words in the developmental planning; but "differentiations" on all fronts, economic and social, are not taken into consideration, and it is out of these "differentiations" that the "integral" development will take place. *Pari passu* with the alarming population growth and mounting socio-economic needs,/the integrated development is slow enough to justify the rationale undertrying the negative correlation between the two: the percentage change in the environmental status and the percentage change in the socio-economic status, as specified in the diagrammatic model.

As the sectoral or isolated measures at the local level can not effectively solve the development dilemma-outlined above, what is fundamentally needed is an integrated approach to development taking into account all the factors interlinked in the concept of development spelled out in the resolution of the United Nations General Assembly proclaiming the beginning of the Second United Nations Development Decade on January 1, 1971. The principal objectives of development as stressed in the United Nations proclamation are (i) a minimum standard of living consistent with human dignity; (ii) sustained improvement in the well-being of the individual; (iii) sharing of benefits by all; (iv) more equitable distribution of income and wealth; (v) a greater degree of income security; (vi) expansion and improvement of education, health, nutrition, housing and social welfare; and (vii) the safeguarding of the environment. The interlinking of factors connected with these objectives will solve the dilemma. These interlinked factors are more critically involved in the functioning of the man-environment system of the Himalayas. This integrated approach should be adopted for the speedy development of rural areas as well as for regional and national planning. There should be proper link between the rural development and urban areas. Policies for energy, transport, construction, industry, marketing and commerce should not be framed in isolation. Social issues such as education, public health and population policy imperatives should be duly considered. In particular, if the population policy and strategy are not properly framed, the dilemma or conflict implicit in the diagrammatic model of inverse relationships between socio-economic and environmental aspects will persist.

The current status

The environmental status of the Darjeeling hills can be revealed by the following sentences.

"Although the Centre provides special financial assistance for the hills, there is no sign of an integrated approach for the development of such areas in Darjeeling district. As in other parts of the Himalayas, the Darjeeling hills have certain peculiar agro-ecological and socio-cultural features which have to be taken into account while formulating development programmes. But the concept of development without destruction which necessary for the conservation and utilization of resources, has not yet taken root. The region, therefore, finds itself in the quandary of a dwindling resource base and mounting poverty, a grim situation that affects people in the plains of North Bengal as well.

Forest constitute the lifeblood of the people in the hills. They check soil erosion, prevent rivers and streams from drying up, protect wild life and vegetation, regulate precipitation patterns and safeguard the lifestyle and culture of the people. Removal of forest cover has led to considerable denudation through loss of the top soil and landslides, making several areas in the Darjeeling hills uninhabitable."

The quantum of annual soil loss in the Darjeeling hills is not known, but a study in Nepal showed that the river Karnali brought 75 million cubic metres of solid materials down every year into the Ganga basin. Deforestation and the lack of adequate conservation measures is probably responsible for the Ambotay landslide in Kurseong, covering more than 25 acres. It is feared that this landslide, which started in 1968 and is said to be one of the biggest in Asia, may engulf Kurseong town if effective measures are not taken. The Darjeeling hills harbour a rich variety of flora and fauna. A local botanist found more than 1,138 different plant species in the 15 kms between Lebong and Tiger Hill; 27 per cent of India's bird life can also be found in Darjeeling. It is the only one of West Bengal's 16 districts which has all three kinds of flora and fauna—tropical, temperate and alpine Unfortunately, the indiscriminate felling of trees destroyed many species even before they were properly observed. Wiping out of unstudied flora and fauna for short-term commercial gains has dealt a severe blow to scientific research. The clearing of these natural forests causes even greatest concern because not much is known about the long-term ecological damage.

Conservation means not only preservation and protection of the environment, but also safeguarding the region against dangers such as soil erosion, landslides, floods, desertification, drying up of spring water and pollution of land, water and air. More than 70 per cent of the natural forest in the Darjeeling hills have already been wiped out.

The forest policy in this area does not seem to be geared to true development. By and large, it is directed towards restructuring the vegetation through the introduction of quick-growing exotic species without paying the slightest attention to the undesirable impact of such practice. In this process, the lifestyle of the "target groups", whose economic regeneration is the avowed goal of the Five-Year Plans, has been undermined.

A rational forest policy would have concentrated on effective conservation in catchment areas, including the dense forests of Takdah and Tiger Hill, and protection of the inaccessible natural sanctuary and watershed of the Takdah range. This also applies to wild life in the Rembick, Duteriah, Palmajua, Dooars, Lava, Najok and Mahanadi sanctuaries where conditions are shocking.

The entire Himalayas being geologically young, the Darjeeling hills are prone to erosion. They need to be clothed with forests, and this is where forestry programmes worth being called "scientific" have a role to play. "The Forest Corporation says that the denudation of an acre of forest should cause no worry for another acre of plantation will come up. But this does not take into account the bio-economic deprivation caused to the environment as a whole."

Owing to considerable variations in Darjeeling's altitude, topography, climatic and edaphic conditions, the approach has to be different in different areas. A scientific forest policy should be one in which (i) a total stock taking of the flora and fauna of an area is undertaken before deforestation; (ii) steps are taken top protect the natural habitat of the flora and fauna; (iii) a pedological analysis is carried out to determine whether deforestation can cause soil erosion or land slides; (iv) no tree felling is allowed in *jhoras* and catchment areas or in and around wild life sanctuaries; (v) no villages are allowed in the middle of the forests; (vi) national parks and sanctuaries are established for the conservation and preservation of the flora and fauna in each altitudinal zone for the purpose of public recreation, scientific study and research; (vii) a forest research institute is established to cope with the problems of forest development peculiar to the region with reference to the region's socio-economic and environmental needs.

Just because a natural forest has become mature, it does not mean that it should be felled for commercial gain while ignoring the ecosystem. There is a limit to human interference in the evolutionary process of natural environment. Because of indiscriminate felling, two other ecological problems may appear in the Darjeeling hills: the pollution of air and drying up of water resources. A new phenomenon in plant-animal relationship has been noticed: due to want of normal food, Himalayan black bears have now started feeding on the resinous sap of Cryptomeria Japonica trees which succumb eventually. A huge pile of timber from such trees was recently seen at the jorebungalow forest office. One can only guess the fate of other faunal life due to the loss of their natural habitat and food.

While the National Forest Policy prescribes minimum requirement of 60 per cent of the total geographical area of the hills as forests, the present standing forests in Darjeeling hardly constitute 15 to 20 per cent. The forest coverage of West Bengal and India is equally low. This being so, the forests of Darjeeling, which comprises less than three per cent of West Bengal's area, should not have been unscientifically felled at all. The need now is to conserve the little that is left.

Our forest wealth has suffered due to the failure of afforestation, which may be attributed to shortage of manpower for adequate planting, lack of effective and persistent supervision of saplings lack of cattle pounds to arrest uncontrolled grazing, lack of appropriate punitive measures for offenders, lack of forest protection forces to keep round-the-clock vigil at all strategic points and, lastly, not taking enlightened public opinion into account.

Tea garden forests in the Darjeeling hills have vanished altogether. By providing necessary incentives, each tea garden should be asked to revive its erstwhile forests. The situation is such that even shade trees—*Albizza* or *Crotolaria*—have disappeared from most gardens. Bamboos could be planted on steep hills to cater to urgent needs.

The future of hill regions will depend on the health of its soils. "Save the oil" is an important slogan, but "save the soil" is of equal importance. The area under forest, cinchona and tea gardens comprises 66% of the total area, the area under roads, buildings and uncultivable waste is 40,598 hectares, i.e. 18% of the total area and the agricultural sector uses the remaining land, i.e., 16% of the geographical area. As percentage of land area for agricultural operations cannot be increased in hilly regions, there has been influx of rural people to urban areas as well as encroachment of forest lands. Currently, 15 to 20 per cent of the labour force in tea gardens being unemployed due to the demographic pressures and sickness of industry have further aggravated the problem. Generally, the density of population per sq. km. is less in hill areas in comparison to the State of West Bengal, but if only cultivated land is taken into consideration there is a heavy pressure of population on land. There are 1371 people per hectare of such land in comparison to 840 for the rest of the State. The effects of this high density are reflected in the following chart.

The hill soils are mostly light in texture and acidic in nature, porous and therefore water procolates down rapidly. 90% of the high annual rainfall (3000 mm) is received by the hilly region during the period between May to September. The excessive runoff water causes soil erosion and loss of fertile lands, drastic reduction of fertility and productivity. Thus the problem of improving the socio-economic conditions of 80% of farmers who are small, marginal and share-croppers is interlinked with the environmental status of hiss regions.

Reduction of the pressure on land will be decisive in solving the problems of the hilly regions. This can be optimally achieved by integrating measures for diversification of land use practices such as horticulture and sericulture with others for creating alternative sources of income not directly based on land exploitation, e.g. cottage industry and tourism.

The planning and developmental-efforts in hill areas should be undertaken with caution with a view to transforming the rural economy. In this context the following sentences are quoted from an international report: "Development planning should also take into account the available know-how and the adaptation of technologies from abroad with great care. Tropical mountain countries are particularly vulnerable in this respect, as witnessed by many mountain ecosystems ravaged or abandoned because they are not suited to development programmes based on technologies and management practices derived mainly from lowland and urbanized situation".

Possible consequences in hill areas

Nature of crops planted

Cash Crops (20% of the total)		Subsistence Crops (80% of the total)	
↓	↓	↓	↓
low man/land ratio	high man/land ratio	low man/land ratio	high man/land ratio
↓	↓	↓	↓
No serious problems	Complex problems	subsistence farming carrying capacity not exceeded	subsistence farming carrying capacity exceeded
		Population can survive	1. Out migration to urban areas survive 2. Deterioration of resource base 3. Population vulnerable to malnutrition

How is the dilemma posted by the negative correlation between the proportionate change in the environmental status and the corresponding proportionate change in the socio-economic status in a region or in a country be solved? Who will compute such critical "percentage changes"? Are such calculations possible? Is the diagrammatic model operationally meaningful? Answers to these questions are attempted in the following paragraphs.

With alarming population growth in a country that makes developmental efforts in the existing state of technologies, the dilemma will remain unsolved. So long, for example, alternatives to the firewood needs of the people causing pressures on forest resources are not possible. So long, problems of poverty, unemployment and underemployment, poor health, inadequate housing and nutrition remain unsolved, the negatively sloped "status" curves illustrated in the diagram cannot be reversed, i.e., transformation into a positively sloped curve. The implications are simple. For the former type of "status" curve, more environmental status implies less socio-economic status and the latter indicates the improvement of both the environmental status and the socio-economic status simultaneously. The ideal for the survival of mankind is the coordinated human action to transform in the long run the negative correlation into a positive correlation, so long such transformation is not possible in the absence of suitable technologies and human will, a trade-off is necessary: a combination of a certain percentage of the socio-economic status and a certain percentage of the environmental status within the socially tolerable level.

Such aggregative quantification is possible to get the results related to socio-economic and environmental variables within a certain range. Peskin has recommended a set of ideas for an integration between national accounting and the environment on the and hand, and the economic budget in the fiscal year and the environment, on the other. If the general taxation, direct and indirect, industrial licensing, cess of levies imposed by public authorities, the allocation of government budgets are related to the environment, a good starting point will be made for a desirable trade-off between environmental status and the socio-economic status. One important policy initiative adopted by the Government of India is worth mentioning here. This is concerned with tax incentives for agencies working in the field of natural resource conservation. The Government allows accelerated depreciation at the rate of 30% of the capital costs for equipment used in pollution control energy saving devices for conservation of natural resources. No doubt, systematic cost-benefit analysis must be undertaken for integrating the budgets of public authorities with the environment.

In a democratic set up, who will determine the desirable or optimal percentage change in the environmental status and combine it with the ideal percentage change in socio-economic status of the people for a "trade off"? Such "trade-off" or optimal combination of the two within a socially tolerable level will first of all depend upon policy-makers. Since ecology is an integrating science, the policy-making body concerned with the hill regions will include both longer-term and short-term members and consultants from a wide range of professions and disciplines including:

1. resource managers (ecologists, economists, planners).
2. forestry scientists (with biological higher training, forest engineering and afforestation experience).
3. agronomist-livestock specialists (with agricultural and grassland ecological training and with experience in both extensive and intensive livestock systems).
4. applies physical geographers, pedologists, hydrologists
5. social scientists and social workers with community development training and experience.
6. specialists in regional science (industrialization, trade, commerce).
7. engineers (traffic, construction, energy).
8. architects (housing, urban renewal).
9. information and communication specialists.
10. documentalists.
11. administrators.

Trade-off and social choice

The policy-makers with a view to effecting a "trade-off" must adhere to certain rules of collective choice mechanism. Kenneth Arrow, the eminent mathematical economist, pioneered the modern study of collective choice processes, and established a set of properties of the social choice mechanism.

These properties are:

1. Collective rationality. In any given set of individual preferences the social preferences are derivable from the individual preferences.
2. Pareto principle. If alternative A is preferred to alternative B by every single individual, then the social ordering ranks A above B.
3. Independence of irrelevant alternatives. The social choices made from any environment depend only on the preferences of individuals with respect to the alternatives in that environment.

According to Arrow, no mechanism can be devised that consistently meet all the above properties. This is his famous "impossibility theorem". However, the representative government with a two-party system can provide a means of going from individual choice to social choices in a way that satisfies Arrow's conditions. The legislative bodies based on the principles of representative government must, in the last analysis, review critically the competitive price system that provides signals for resource allocation; because it is the resource allocation that affects the environment, beneficially or adversely.

In the man-environment system if the vicious circles are turned into virtuous circle, new technologies are adopted for productive efficiency, growth of renewable resources is speedy enough to account for rapid population growth, public goods are more in number, distributive justice is quickly administered along with the desirable growth rate of the economy, the spread of environmental education is rapid, and the alarming population growth is checked, the assumption of hypothesized negative correlation in the diagram may be rejected. A positively sloped status curve will then be the ideal situation where the socio-economic status will improve along with the betterment of the environmental status. However, this ideal situation is extremely desirable, but in the light of realism and relevance today, it may not be attainable. Policy-makers concerned with environmental preservations and betterment as well as with higher living standards of the people must seek a solution in terms of a "trade-off" between a certain percentage change in the environmental status and a corresponding percentage change in the socio-economic status of the people, within a socially tolerable level. It is the significant task of the policy makers to determine the "socially tolerable level" within which the optimal combination of the two aggregative variables posited in the diagram will lie. In this a number of variables, including natural resources, capital investment, pollution, population and the quality of life, are linked by assumed relationship, and, sounding a note of pessimism, the model discussed by the authors generate basic scenario characterized by drastic declines in population (in the Malthusian sense), the economy and the quality of life. "Within a socially tolerable level" implies the country's search for suitable technologies and techniques to tackle economic and environmental problems simultaneously. But, in this context, questions such as: Is technological progress limitless? Can human institutions cope with new technology? Can people in hill areas, or, man kind in general, converge monotonically towards an economic and environmental state in which human life is both pleasant and more or less indefinitely viable? These are open questions. Probably, uncertainties are so great that it is difficult to give a clear cut answer to these questions. But one clear signal is there: if we fail to bring population under control, rapidly, very rapidly, future problems of environmental and socio-economic nature may be totally insoluble. In this case there may be parallel shifting of the "status" curve in the diagram, not upward, but downward, towards the origin. If we do succeed in reversing this trend, there is a CHANCE.

With reference to the diagrammatic illustration of the negative correlation between the socio-economic status and the environmental status, let us conclude by quoting Eckhom, an eminent ecologist whose ideas about the Himalayas are pertinent. He observes: "Based on available knowledge, it is no exaggeration to suggest that many mountain regions could pass a point of no return within the next two or three decades. They could become locked in a downward spiral from which there is no escape, a chain of ecological reactions that will permanently reduce their capacity to support human life.....This possibility is very real, but it is not inevitable. There is no major mountain problem for which technological solutions are not already known. If the existing negative trends are not abruptly reversed within the coming decades, it will be because human institutions have failed to adapt themselves to environmental necessity."

CONSERVATION: There is so much of mingling of the dominant component of different types of vegetation in North-eastern Himalaya that neither the correct classification is feasible nor the zonation of the vegetation is perceptible in many places. The phytogeographical studies have brought to light the presence of many typical tropical elements although neither the altitude nor the latitude as a rule permits their occurrence. Presence of many primitive plants, several rare and curious plants, enormous genetic variability of cultivated plants, many instances of alien elements and endemic species, confers this region the status of a natural 'Germ Plasm Bank'.

Fortunately there is still much more area under the cover of virgin forest in this region compared to other parts of India, which can be conserved taking necessary steps according to the formula C = P + R. Belt Biosphere Conservation (B.B.C.) is the ideal form of preservation of virgin forests of this region.

The eastern Himalaya ranges stretching between 23-29° N. Lat form one of the richest abodes of botanical treasures, fostering about 17% of the total forest cover of our sub-continent. Fifty per cent of the total number of species of India hail from this region (ca 8,000) and also the genetic variability in a wide group of crop plants like Citrus, Banana, Coffee, Maize, Paddy, Oil seeds, Jute, Sugar-cane, etc., is enormous, which makes E. Himalaya a natural germ plasm bank. Besides, the origin of many cultivated plants has been (either primary or secondary) attributed to the N.E. Himalaya.

Hooker remarked that the vegetation of the Khasi hills, Meghalaya is "richest in India and probably in all Asia". This is true for the whole of N.E. India as well. There is so much mingling of the dominant components of different types of vegetation in this region that neither the correct classification is feasible nor zonation of vegetation is perceptible. Champion's classification does not hold good in many respects.

It is also interesting to record here that phytogeographical studies have brought to light the presence of many typical tropical elements, although, normally neither the altitude nor the latitude permit their occurrence. From an analysis of the distribution of the primitive plants, Takhthajan concluded that E. Himalaya forms a "cradle of many flowering plants" belonging to the genera like magnolia Linn., Michelia Linn., Tetracentron Oliv., betula Linn., Taxus Linn., Alnus Mill., Holboellia Wall., Exbucklandia R. W. Brown., etc.

Recent explorations by the Botanical Survey of India (B.S.I.) and other agencies have discovered more than 70 new species belonging to about 50 genera, not known to the botanical world hitherto. These include two new species of carnivorous plants.

Besides, there are many instances of discontinuous distributions of elements hitherto known regions like China, Burma, Indo-China, Thailand, Sri Lanka, Africa, etc. Examples are Nymphaea pygmaea Ait. (Siberia, N. China), Epipogium roseum Lindl. (W. Africa, Java, Australia), Polystachya concreta (Jacq) Garay at Sweet (Java, Africa, S. India), Dioscorea laurifolia Wall. (Penang Malaysia), Mitrastemon yamamotoi Makino (Japan, Sumatra), Illicium cambogianum Pierre (Southern Indo-China, Burma), Utricularia stanfieldii P. Taylor and U.pubescens Sm. (Africa).

Another interesting aspect of the plant wealth of this region is the presence of several curious and rare plants like insect catching pitcher plant Nepenthes Khasiana Hook. f.(Nepenthaceae), the rare root parasites like Sapria himalayana Griff. (Rafflesiaceae), Rhopalocnemes phalloides Jungh (Balanophoraceae), stem parasite like Korthasella opuntia Merr. (Viscaceae) and saprophyte, like Monotropa uniflora Linn. Hypopithys lanuginosa Nutt. (Monotropaceae), the shrubby gymnosperm Gnetum genmone Linn, etc.

Out of 151 species of Bamboos, 47 species have their concentration in this region alone. The eastern Himalaya as a whole is very prolific in the epiphytic as well as terrestrial orchids (700 to 1000) species. Many of them, species of 'Cymbidium' Sw., Dendrobium Sw., Paphiopedilum Pfitz., Vanda R. Br., Aerides Lour., etc., are of great horticultural value and some of them are the progenetors of the present day highly priced commercial hybrids. They richly deserve protection and regeneration applying the formula C = P + R (Conservation is equal to protection/preservation plus regeneration/ rehabilitation) for the future genetic engineering programmes. Even a single tree of the virgin forests of this region affords perch for more than 30 species of different genera of orchids (in S.india, one comes across only a few on a host despite of the high humidity) like Dendrobium eria Lindl., Bulbophyllum Thou., Coelogyne Lindl., Oberonia Lindl., Pholidota Lindl., Vanda, Otochilus Lindl., Cymbidium, etc. Still, there are vast areas (more than two third) of climax forest stands in this region which remain terra incognita botanically: others are under-explored, owing to the inaccessibility and inclemency of climatic conditions. Hence, when thoroughly botanised this region is bound to yield very many interesting findings.

The high incidence of taxa in the E. Himalayan region as compared to Western Ghats of peninsular India led to the hypothesis that "more dense and varied is the flora and vegetation of an area which experiences occasional earth termors". The E. Himalaya together with the adjoining region fall within the tremor belt. The pent up magenetic, electric and other invisible forms of energy of the subterranean rocks, released by occasional earth tremors, effect mass scale natural mutation of the genome (genotype) in various degrees and which, in turn ultimately results in speciation and also in the extreme intraspecific genetic variabilities, converting it, into an active zone of speciation.

Though, the landmass of the peninsular India is geologically as old as the Earth (Himalaya is of recent origin) presenting the altitudinal variations from 0 to 2900 m, receiving abundant rainfall from both monsoons, and being nearer to the equator, receiving more solar energy still it fosters only less than half of the species as compared to E. Himalaya. It is true that the forests of both these regions are think with luxuriant growth of lofty trees of tall boles and spreading canopy, with climbers of various dimensions epiphytes and parasites, shrubs and herbs intertwined with slender twiners, and intermixed with ephemeral rhizomatous ground vegetation rendering them impenetrable. But, while the impenetrable nature of the different stands of vegetation in the South Indian forest is owing to hosts of individual plants of limited number of species belonging to restricted genera, that of the E. Himalayan forests is owing to the presence of limited number of plants belonging to larger number of species, wider range of genera and families. Above ten thousand species of flowering plants are estimated to be present in the E Region (that is about 50% of the flora of erstwhile british India) while the whole of the erstwhile Madras presidency (Andhra, Karnataka, Tamil Nadu and kerala) forests has only about 5000 species. On an average, the district flora of S. Indian comprises of about 700 species, while, it is more than 1500 species in this region. When we take into consideration individual families as to the number of genera and species the representation of taxa is much more in the tremor regions like Burma, Thailand, malaysia, etc, than in South India.

As a result of acculturation, the appreciation of man's dependence on natural resources is waning away fast and the forests are getting denuded very rapidly, and unless effective immediate steps are launched, the renewable natural resources of this region will be lost, once for all to the future generation. According to the forest policy of the Govt. of India, hilly region should have about 60% of the land under forest cover. But unfortunately the E. Region has a forest cover of about 50% only. hence, immediate regeneration is of extreme importance. In 1974, an American satellite discovered by means of infra red photography a gigantic shallow in the gulf of bengal. The shallow has an area of 50,000 sq.kms and is formed by silts carried in the sea by the Brahmaputra and the Ganges due to the erosion from the upper reaches of the Himalaya, consequent, greatly upon the practice of "Jhum" cultivation and partly, owing to land slides, and indiscriminate clearance of forests for road construction and other developmental activities.

Nevertheless, fortunately, the E. Himalaya and the surroundings remain one of the less disturbed geographical zones of the montane ecosystems and fulfil a number of criteria laid down by UNESCO in Biosphere selection namely effectiveness as a conservation unit, representativeness in terms of flora and fauna, in the richness of genetic diversity in respect of wild relatives and primitive cultivars of our crop plants, naturalness of different ecosystems, availability of rare and endangered species, etc. Thus, it becomes imperative to preserve as much are as possible in the E.Himalaya under-forest cover, without disturbing the various ecosystems, so that they serve as natural genetic pools or banks. Conservation is equal to Preservation and protection plus Regeneration and Rehabilitation; C = P + R.

The Belt Biosphere Conservation-BBC is the ideal form of preservation of the virgin forest of different altitudes across the land and along the course of rivers on both sides in a continuous stretch. This type of preservation can greatly facilitate migration of species, their intermingling which in turn would lead to natural hybridisation and evolution of species, and thus, emergence of more and more complex ecosystems with maximum species diversity, hence relatively less amount of energy to maintain them. As the genesis of the rivers is from the altitudinal limits of vegetation and flow down gradually to the lower altitudes, Belt Biosphere is bound to include all types of climax vegetation, BBC along the course of rivers can effectively be implemented in the hill states of this region, since, unlike in other parts of India, here the human settlements are predominantly on the hill tops, rather than along the river sides. Moreover, the rivers run through deep ravines, and once the belt Biosphere Conservation is implemented, not only the erosion of the hill slope soils can be effectively prevented, but also, to a greater extent, the floods can be controlled.

However, preservation of isolated Biosphere of climax vegetation at different altitudes, whatever be their dimensions, is to be encouraged for the prevention of soil erosion or for the protection and preservation of particular species of a curious nature or of great academic interest. Recent phytosociological study in connection with pollen analytical investigation has shown that the shola forests of the Nilgiris in S.India are in delicate equilibrium and are progressively receding, instead of regenerating. They are considered as "living fossil community". Thus, conservation of isolated area or pockets as Biospheres or sacred groves surrounded by clear areas, as in vogue today, is nonviable in terms of geological times. The plant denizens become like the zoo specimens of animal and the viability will be imperceptibly retarded progressively. Such isolated biomes are in delicate equilibrium with the environment, incapable of regeneration, in the long run once they are destroyed. In other words they are under a physiological strain owing to either artificial or the natural physical situation which may be termed as "Shola strain". Only BBC method can avert the situation and promote formation of viable vegetational patterns with evolved entities. The theory of evolution also postulates that the living species are the descendents of the ancestral types, possessing genetical relationship of degrees of proximity.

The flowing river looks the same, though, is ever changing, so is the vegetation. In the time-space continuum the species are more linked to the time, and individuals more to the space. Hence, in any developmental project, one may afford to sacrifice individuals, but never the species; on the contrary in a Biosphere Conservation programme the dimensions of time and space in relation to both species and individuals must be protected Sine die. The conservation of biosphere is made possible only when the nature around us is to everyone primarily an object of love, appreciation and contemplation, which would bestow on us the freedom of joy in the infinite. secondly, it must be an object of interest and curiosity, which would bestow on us the knowledge, which is power. But, never should it be an object of possession, in order to prevent misery and annihilation. Hence, the proper management of environment should be concerned with the promotion of a harmonious co-existence of man with his living as well as non-living resources around him. It is dangerous to protect virtues by ignorance. The present knowledge of the reticulate inter-relationship of the living organisms with one another as well as with their environment is incomplete and inadequate in many respects. Hence, proper regeneration and management are not possible and the knowledge of all operational aspects, especially of the mountain ecosystems are to be acquired through multidisciplinary approaches, without further procrastination, in order to implement effectively the programme of regeneration and preservation of the environment. At present the failure of effective management is, by and large, owing to inadequate legislation, lack of enforcement, poor organisation, dearth of trained personnel and lack of basic information on priorities.

Just as the body retains its birth right of health and strength only by eating varied items of food, in minimum quantities at a time, instead of eating a single item in a very large quantity, however, tasty it might be, the 'mother earth' also maintains her enduring fertility, only by maintaining diverse components, in different stands of vegetation instead of a single species. Unity is the law of Nature but not uniformity. More diverse the morphology and requirements of the different biological entities for their progressive stages of development (viz., birth, growth, reproduction and perpetuation) greater will be the concentration of diverse taxa in an unit of space and time, more will be enduring fertility of the earth to sustain them, and more reticulate and fragile will be the ecosystem in terms of energy recycling capacity and less will be competition, just as the more complicated and sophisticated are the parts of the machine, greater will be its efficiency irrespective of the size of various parts. The balanced and long-term management of environment depends on maintaining the diversity of ecosystems and thereby preserving an evolutionary potential among living species which would furnish the humanity, the maximum number to satisfy its needs.

Against the back drop of present day events, like problems of poverty, sickness, malnutrition, unemployment, inflation, etc., the management of environment and conservation is looked with askance. Unless and until, the concept of man as a separate self, independent from the environment is abandoned, and a new ecological outlook is created, the present, 'armageddon' between man and his environment cannot be won. Besides, conservation programme, in general is in great peril, because the national and International capacities are ill organised and fragmented, with consequent duplication of efforts, gaps in coverage, etc. The present state of affairs reminds us of the foolish man of the old story, who was found sitting and cutting his own branch of the tree, blissfully ignorant of the impending danger to his own life or it is like the murder of the goose that lays the golden egg.

Ecological experiences

Food is the first among the hierarchical needs of man. To end the uncertainty in the supply of food, man changed over 10,000 years ago from being a food gatherer to growing food by domesticating paints and animals. This processed started two significant developments. First, various forms of energy, collectively termed "cultural energy", were introduced to enable green plants to give stable and higher yields. The most important components of cultural energy involved in the modernisation of farming are irrigation, fertiliser application and mechanisation. The relative contributions of the different forms of cultural energy have varied over time and geographic regions in different farming systems. In several affluent countries, progress in productivity improvement has resulted in a simultaneous increase in the consumption of non- renewable forms of energy, while in countries like India, labour-intensive techniques and organic recycling procedures are necessary to provide more jobs and income in rural areas.

Secondly, from the millions of species recorded in the world flora and fauna, only a few plants and animals were chosen for domestication. Thus, there are only about 30 plant species whose individual world production exceeds 10 plant species whose individual world production exceeds 10 million tonnes per year and 6 animal species whose production in the form of meat exceeds 1 million tonnes per year. Such dependence on a few species for meeting the food needs of the growing global population has increased the vulnerability of food production systems to hazards arising from weather aberrations and pest epidemics.

The Primary objectives of plant breeding will hence be to assist in increasing and establishing the yield of crop plants. In our country, there is very little scope for increasing the area under cultivation. Therefor, further increases in production will have to come largely from productivity improvement and from an increase in the intensity of cropping (i.e., two or more crops in a year in the same plot of land). Also, in countries with a cereal as the staple, the most serious nutritional problem is undernutrition, resulting in the inadequacy of calories in the diet. Where a tuber like tapioca or yam is the staple, protein malnutrition may also occur. It is possible today to find specific agricultural remedies to the major nutritional maladies of different parts of the country.

Plant breeds should tailor varieties a suited to specific agro-ecological and energy management systems. The efficiency of conversion of cultural energy into food energy should be continuously of cultural energy into food energy should be continuously improved. In addition to elevating and stabilising yield, plant breeders should strive to increase the income and employment potential of small farms by introducing multiple and relay cropping sequences by developing where necessary relatively photo-and thermo-insensitive varieties. While making selections in segregating populations, the needs of the entire farming system and not merely of a single crop should be kept in view.

Most parts of our country are in the tropical or subtropical belt. The country is rich in flora and fauna, and has been the centre of origin of several economic plants. Several of our states are densely populated and are confronted with the twin problems of low productivity and instability of production. The size of an average farm holding is less than one hectare in most parts of the country. Where land is not limiting as in Rajasthan, water is limiting. Fortunately, where land is the most serious limiting factor as in West Bengal and Kerala, water is not limiting. Hence plant breeders have to breed varieties which are capable of giving high yields per units of land, water and time. Also, since 70 per cent of the population depends upon agriculture for their living. Agriculture must be capable of giving more income in addition to the needed quantities of food. Thus, some of the urgent tasks facing plant breeders in India are:

(a) Development of crop varieties which can help to raise yield and income from small holdings with irrigation facilities through the promotion of multiple and relay cropping, mixed cropping and mixed farming systems.

(b) Development of varieties which can tolerate or escape damage by floods and /or drought.

(c) Imparting greater stability to production through greater resistance to pest epidemics.

(d) Improving the ratio of conversion of different forms of cultural energy into food energy, so as to ensure that productivity improvement is not simultaneously accompanied by an exponential consumption of nonrenewable forms of energy. This would involve breeding of varieties which have a high harvest index and which could give maximum economic yield per units of water, fertiliser and time.

(e) Incorporating a nutritional dimension to crop breeding so as to breed *high-yielding - cum-high-stability-cum-high-quality varieties.*

(f) Breeding varieties with resistance to aflatoxin production, and better storage, processing and utilisation qualities, better post-harvest technology would help in the preparation of value added products in the rural areas, thereby enhancing the potential for income and employment generation in villages.

(g) Breeding varieties of commercial crops which can respond to chemical treatments which can confer on them greater capacity to resist competition from synthetic products, e.g., natural rubber vs synthetic fibres. For example, it is now known that some genotypes of cotton (both *Gossypium arboreum and G. hirsutum)* respond well to chemical finishing treatments which can confer on them some of the 'easy-care' properties (like drip-dry and wrinkle-free characters) for which the synthetic fibres are preferred by the consumer. Some strains are also more suited for synthetic-natural fibres mixtures. Hence, interaction between breeders and technologists is important in all industrial crops.

'System' and 'Cafeteria' approach to crop breeding

As already mentioned, Indian plant breeders will have to assist in making agriculture not only an instrument of improving food production but also of generating more jobs and income in the rural sector. Our farmers differ greatly in their capacity to mobilise inputs and take risks. Hence, there should be scope for choice of varieties based on the management system which different small holders can adopt. Varieties suitable for (a) high density mono-culture, (b) inter-cropping, (c) 3-dimensional crop canopies involving the optimum use of both air and soil space, (d) crop-livestock integrated production systems, (e) agro-forestry, and (f) integrated agriculture and aquaculture farming systems will have to be designed and developed. This will involve a clear understanding of the requirements for improving an entire farming system, so that the improvements made in the components of the system are in harmony with the needs of the entire system. Maturity and pest-resistance properties will need particular attention while selecting varieties of crops suitable for multiple and inter-cropping as well as rainfed farming.

Among the characteristics that need to be considered by plant breeders, the following are important in the tropics and the subtropics.

1. Population performance.
2. High productivity per units of time, water and energy

3. High photosynthetic ability
4. Low photorespiration (where relevant)
5. Photoperiod and thermo-intensitiviy (where relevant)
6. High response to nutrients and other inputs of cultural energy
7. Multiple resistance to pests
8. Better nutritive and storage quality
9. Crop canopies that can retain and fix maximum CO^2
10. Suitability for incorporation in multiple and inter cropping systems.
11. Suitability for improved post-harvest technology.

To realize the yield potential of a given plant type, it is necessary that appropriate changes are introduced in agronomic practices. If this is not done, the potential will remain hidden. The following are some of the important changes now taking place in agronomic concepts.

1. Crop planning in accordance with agro-meteorological and soil -moisture-retention data
2. Minium or appropriate tillage suited for multiplecropping and intercropping systems
3. High plant density leading to dense crop canopies
4. Weed-free environment
5. Controlled release of fertilliser, use of nitrification inhibitors, foliar feeding and use of low cost anhydrous ammonia.
6. Use of bacterial, algal and other microbial fertilisers
7. Integrated nutrient supply involving an appropriate blend of organic and biological sources of fertiliser
8. Better on-farm management of water, including drip irrigation in arid land.
9. CO^2 fertilisation for maximising production in glasshouses
10. Integrated pest and disease management involving crop sanitation, and agronomic, genetic, biological and chemical methods of control
11. Use of hormones and growth regulators in fruit trees and ripeners in sugarcane
12. Organic recyling leading to crop-livestock, cropfish, and crop-llivestock-fish-integration.

An important characteristic of the new plant types of dwarf varieties of wheat and rice is their ability to apportion as much as 50 per cent of the total dry matter produced during the life of the crop for making grains. It is this high harvest index in favour of the grain, as compared with that of straw and leaf that confers on the new straints the ability to give higher yields at low, medium and high levels of fertiliser application. Hence, contrary to the view sometimes expressed, the relevance of appropriate high-yielding varieties increases with a high price and inadequate availability of fertilisers. Plant breeders are also engaged in developing varieties for optimum response to High, Low and Zero input conditions.

The average farmer in several parts of the tropics has a small and often fragmented holding, has little or no risk-taking capacity, has poor resources and is often illiterate. In spite of these handicaps, he is receptive to new ideas and has the power of discrimination to decide what is useful and what is not. Poverty makes it essential for him to base his decisions not on yield per hectare but on stable income per hectare. Hence, profit-maximising technology characterised by stability of income and low risk appeals to him more than just production -maximising technology.

How can the untapped yield reservoir be measured in different cropping and farming systems? In 1965, the Government of India introduced a National Demonstration Programme to provide opportunities to scientists to demonstrate in farmer's fields the economic viability of the new technology. These demonstrations are generally laid out in the fields of the poor farmers in an area since the yields obtained in demonstrations in rich farmers' fields tend to get attributed to the effects of affluence rather than of technology. The impact of good demonstrations will be evident from the fact that from an area of about 4 hectares under high yielding varieties of wheat in 1965, our farmers raised the area to about 4 million hectares in 1971-1972. To the farmer 'seeing is believing' and well laid-out demonstrations serve this purpose. Other components of the communication strategy include the use of radio, newspapers, cinema, television, and fairs and exhibitions. Recurrent training and periodic visits by the extension workers are also very effective. Mobile training teams alone can help to reach rural women.

If the average yield obtained in farmers' field in national demonstrations is compared with the average yield obtained in the area concerned, we get a measure of the untapped yield reservoir. Studies can then be conducted to identify the factors responsible for the gap between the yield demonstrations and of the area as a whole.

Breeding for improved farming systems

It is hardly necessary to stress that the decisions of the farmers are influenced by the entire systems of agriculture around which their day-to-day life revolves. Hence, attention to the farming system as a whole is essential. It is only though such an integrated approach that agriculture can become a potent instrument of generating more jobs and income in the villages.

(a) *Multiple-cropping system in irrigated areas*: Various two, three and even four crops sequences are now being followed. While promoting multiple cropping systems, attention should be paid to ensuring that grain and fodder legumes find a place in the rotation. Also, crops having the same pests and diseases should not be grown in succession. Unscientific multiple cropping could compound pest and soil-fertility

problems, and can become an unmitigated disaster. On the other hand, the introduction of grain and fodder legumes in the rotation will contribute towards improved human as well as soil nutrition. Mung bean-rice-wheat rotation is a good method of combining cereals and legumes in north-west India. The new short-duration varieties of *pigeonpea* (Cajanus cajan) *have made pigeonpea-wheat rotation possible. Rich-wheat rotation is becoming popular in parts of Assam and West Bengal.*

(b) *Rainfed farming*: Production possibilities in high rainfall areas are similar to those of irrigated areas. However, in the unirrigated semi-arid areas, commonly referred to as dry-farming areas, considerable production risks exist. Grain legumes and oilseed crops are mostly cultivated in such areas. A wide variety of fruit trees can also be grown keeping the nutritional needs of the area concerned in view. Research thrusts in semi-arid areas should lay stress on water and soil conservation, and land-use planning. Contingency plans should be developed and introduced so as to minimise the risk of total loss of crops during aberrant weather. It is also necessary to find more profitable crops for some of the semi-arid areas. There are many under-exploited plants with potential economic value. Plant breeders should develop varieties which can be grown in flood- free seasons in chronically flood-prone areas and drought -escaping varieties in drought -prone areas.

(c) Mixed and inter cropping: Various combinations of crops are sown particularly in unirrigated areas by farmers. Not all the combinations currently grown are scientifically sound. Therefore, intercropping systems based on the extent of co-operation generated between the companion crops have to be developed. Among the major components of co-operation are:

1. Efficient interception of sunlight
2. Ability to tap nutrients and moisture from different depths of the soil
3. Non-overlapping pest sensitivity
4. Introduction of legumes for promotion of biological nitrogen fixation and increasing protein availability.

(d) Multi-level or 3-dimensional cropping: In garden ;lands, where a wide variety of plantation crops, fruit trees, palms and other tree crops are grown it is possible to design a crop canopy where the vertical space is utilised in a more efficient manner. Crop panning in the future will have to take into account the effective use of both horizontal and vertical spaces. Efficiency in such a cropping system will again be based on the extent of co-operation generated among the crops in the system. For example, studies at the Central Plantation Crops Research Institute at Kassargod have revealed that coconut, cocoa and pineapple form a good combination. They can intercept sunlight efficiently in a combined canopy and also remove nutrients and moisture from different depths in the soil profile. The introduction of grain and fodder legumes in these 3-dimensional crop canopies will provide opportunities for animal husbandry. A careful study of all the major garden land cropping systems

based on the extent of symbiosis and synergy that the different components of the system exhibit will be useful in deciding specifications to plant breeders for developing ideotypes for efficient performance in 3-dimensional crop canopies. Plant architects in states like Assam have great opportunities for *designing crop combinations which can help to exploit in an integrated manner both soil and air spaces.*

(e) *Kitchen gardening and home fish gardening*: Kitchen gardening can be one of the most efficient systems of farming from the point of view of solar and cultural energy conversion. Vegetables rich in beta carotene and iron, need to be developed and popularised. If planned intelligently and scientifically, backyard gardens, roof gardens and other methods and other methods of growing vegetables and fruits in whatever space is available around mud-huts as well as brick-house can make a substantial contribution to improved nutrition. Where small ponds are available in large numbers, home fish gardening can be an excellent method of supplementing nutrition and income.

(f) *Forestry and ago-forestry*: He importance of improving the productivity of forests cannot be over-emphasised. Agro- forestry has been defined as a sustainable management system for land which increases overall production, combines agricultural crops, tree crops, forest plants and/or animals simultaneously or sequentially. Sylvi-pastoral, sylvi-horti-culture, sylvi-sgricultureand other combined land food, feed fuel and fertiliser needs of people in many hilly regions. Plant breeders are yet to pay attention to the breeding of varieties suitable for such systems of sylviculture. Shrubs and trees suitable for raising energy plantations in villages and for initiation "Gasoline Agriculture" need to be identified and improved.

(g) *Mixed farming*: Mixed-farming systems may involve (1) crop-livestock. (2) crop-fish and (3) crop live stock-fish production programmes. Minimal use of chemical pesticides will be important in such systems so as not to create problems of fish mortality and transfer of toxic residues through the plant animal man food chain. This will involve incorporation of genetic resistance as far as possible and the development of integrated pest management systems.

Thus the emerging farming systems in our country provide new challenges of plant breeders. Only a clear understanding of the production system for which the breeder has to cater will help in the selection of widely accepted and successful strains. A 'Cafeteria approach' in selection which will enable the breeder to offer considerable choice to the farmer for matching the variety grown with the management system adopted will be useful.

Improving the efficiency of energy conversion

The efficiency of both solar and cultural energy conversion and the relative cost-benefit relationships of the different forms of cultural energy used in a specific farming system will determine the efficiency and cost -competitiveness of that farming systems. Hence, the whole area of bio-energetics in relation to farming systems requires attention. Plant geneticists and physiologists will have to select straints which are efficient in the conversion of different forms of cultural energy into food energy. Each component of the solar and cultural energy cycle and the 'double tandem' use of energy through the plant-animal-man food chain needs study. Appropriate screening producers will have to be developed for identifying geno-types with superior energy conversion efficiency.

Until recently, the economics of crop production was assessed mainly in terms of monetary input and output. This will no doubt continue to be the major consideration with farmers in times to come. However, the recent awakening to the energy input-output -relationship in agricultural production and food lisation. Since agriculture is predominantly a solar energy harvesting enterprise, discussions on energy requirements generally centre on the needs of industry, housing, travel, etc. Pimental and co-workers have shown that maize production in the USA gave a ratio of 1:282 for energy input and output. There was no consideration of straw in this study; otherwise this figure might be higher.

The major items of energy input in the USA, according to this study, were heavy machinery, gasoline and fertiliser. The last item was the most significant input. However, a further analysis showed that by the time farm produce reaches the consumer, more energy has been invested than harvested through its production in the field. Thus, the energy balance sheet showed a negative value for farm products utilised as food by the time they reach the consumer.

In India, the items of energy investment are relatively low and the energy used for food processing and marketing is near negligible as compared to that in the USA. The current farming practices involve a low input of mechanical energy but a relatively high investment of human and animal energy.

We need to develop an agricultural technology where productivity improvement is not simultaneously accompanied by loss in the efficiency of energy conversion.

Considering the utility of biological nitrogen fixation, and the fact that many pulse crops may leave reasonable quantities of nitrogen in the field, this mechanism can provide a feasible method of saving non-renewable forms of energy. Besides the urgent need for more pluses, this is yet another reason for stressing the desirability of growing legumes in multiple-cropping and intercropping systems.

Conservation of genetic resources

With an accelerated tempo of plant breeding, there is every possibility that a very large number of native cultivates may be replaced by a few high-yielding varieties. It is our duty to preserve for posterity the fruits of thousands of years of natural and human section. Fortunately, international collaboration among plant breeders is growing. Systematic efforts for collecting, conserving and cataloguing germplasm of plant material are in progress. The benefits of plant introduction and exchange could be very great, but it is essential that the quarantine capability of the country is strengthened so that no harmful pests and disease are unknowingly introduced.

The North-Eastern Himalayan region is rich in valuable genes in rice, citrus, maize, cotton and many other economic plants including orchids. In addition to collection and maintenance by plant breeders, it is necessary that the environment which promotes variability in specific plants is also preserved. There is need and scope for establishing 'Gene Sanctuaries' in rice, citrus and orchids in this area.

The Indian Council of Agricultural Research is planning to establish shortly a National Bureau of Animal and Fish Genetic Resources, In addition to the National Bureau of Plant Genetic Resources which is already in existence. We have rich genetic resources of buffalo, cow, sheep, goat, poultry and pigs, and these need to be preserved.

Plant breeding for stability of production

Agriculture in Assam is a good example of a farming system which requires considerable attention from the stability point of view. Flood is almost a regular feature in Assam. About one-eighth of the net cropped area of over 2.3 million hectares is chronically flood -affected area, while about one-fourth of the net cropped area is vulnerable to occasional floods.

The successive waves of floods from the Brahmaputra and Barak as well as from their tributaries cause extensive damage to agriculture as;

(i) *ahu* crop *(rice)* is damaged before the harvest.

(ii) *Sali* or the main crop of rice cannot be transplanted in time as the seedlings are damaged either in nursery or after transplanting, sometimes even destroyed in the field,

(iii) jute crop is damaged or quality is adversely affected,

(iv) granaries, grazing lands and kitchen gardens, and sometimes even perennial crop plants are damaged,

(v) livestock are killed or affected, and

(vi) the economy of the farmer is shattered.

Hence specific strategies need to be developed for insulating the farmers from the adverse effects of recurrent floods. These strategies may be grouped under 4 heads, namely; (a) contingency measures, (b) restructuring of cropping patterns, (c) development of infrastructures, and (d) afforestation and soil-conservation measures in catchment areas.

(a) The contingency measures will include:

(i) building reserve stocks of seeds for adopting alternative cropping patterns,

(ii) arrangement for community/institutional raising of rice seedlings by 'dapog method', and other methods and their distribution,

(iii) keeping reserve stocks of fodder in fodder banks,

(iv) cropping of medium tall Ahu rice with deep water rice in low-lying areas as an insurance so that if the Ahu crop is damaged there will be some production from the deepwater rice, and

(v) improved flood-warning system.

(b) *Restructuring of cropping pattern*: The safest way to assure crop production in the flood-prone area is to make the flood-free period the major cropping season. The flood-free period and the potentialities of growing crops in the period is shown in Fig.2. There may be some problems regardings suitable varieties and crop-production technologies. These problems, are, however, not beyond, solution. An other advantage of this restructuring of cropping is that productivity of crops can be increased during the rabi season due to more sunshine hours being available during this period and better response to fertiliser.

(c) *Development of infrastructure*: The specific infrastructures deserving attention in this regard are:

(i) *Irrigation*: Development of irrigation should receive high priority if restructuring of the cropping pattern has to be successful. In planning irrigation works, priority should be given to flood-prone areas. Provision of sluice gates in the embankments deserve consideration in this regard.

(ii) *Community Drying and Storage Facility*: Grain drying poses serious difficulties. Community drying facilities need to be created. Raised storage facilities to ensure safety of grains/ fodder may deserve consideration.

(iii) *Marketing Facility*: Stress on production campaigns of certain crops, such as vegetables, as post-flood measure often result in a glut in the area leading to wastage and non-economic prices, thus destroying the incentive to produce again. Organisation of marketing facilities in such cases is very essential.

(d) *Afforestation and soil conservation*: The Brahmaputra has about 35 tributaries with their catchment areas in the hills of Bhutan, Arunachal Pradesh, Nagaland, Meghalaya and Assam, Similarly, the tributaries of Barak have their catchment areas even in Manipur and Mizoram. Large -scale deforestation in the catchment areas due to jhuming have led to soil erosion which in turn promotes silting and rise in the level of river-beds of the tributaries as well as the major rivers, viz., Brahmaputra and Barak.

Research and development programmes

Strong research development programmes are necessary in order to operate the strategies outlined above.

Research Programme: A multi-disciplinary research programme needs to be initiated for (a) breeding suitable varieties of crops (b) development of production technologies for pre-flood and post-flood periods, (c) studies on water resources and management,

(d) studies on physico-chemical changes in soil properties resulting from flooding and deposition of silt and sand, (e) development of alternative cropping patterns including contingency planning and mid-season correction for flood-prone areas, and (f) development of strategies for increasing production in upland and flood-free areas.

Raising the ceiling to yield

Considerable progress has taken place in the last 20 years in improving the yield potential of major cereals like wheat, rice, maize and sorghum through improved harvest index and nutrient utilisation arising from either alterations in plant architecture or from exploitation of hybrid vigour. While another "quantum" jump in yield potential in wheat or rice may not be easy, steady improvements in yield potential will certainly be possible.

So far much of the advance in increasing yield potential either through heterosis or additive gene action has taken place through increased apportionment of the total photosynthate to the part of value to man like grain in cereals. The next major advance will take place only when the total biomass production is also improved considerably.

The challenge is particularly great in pulses and oilseeds. One gram of glucose can produce 0.83 gm carbohydrates, 0.40 gm of proteins with nitrate as nitrogen source and 0.32 gm of lipids. Obviously, there may be a calorie penalty if there is increase in protein content and a protein penalty if there is increase in calorie content. Geneticists will hence have to devise an optimum balance the two. This will require a detailed analysis of "yield potential constraints" as indicated in Fig. 16.3 and 16.4. Geneticists and Physiologists working together may be able to overcome some of these constraints. This is a major task for the coming years.

Blending agriculture with aquaculture

North-east India provides great scope for promoting scientific agriculture-cum-aquaculture production system. This will help to improve both income and nutrition. I will hence like to refer briefly to the results obtained by the scientists of the Central Inland Fishers Research Institute.

Capture fisheries

A survey of 600 km of Brahmaputra and its tributaries between Biswanath Charali and Bhubri on the north bank of Saikhoweghat and South Salmora on the south bank has been conducted, and 42 important fish landing centres and 140 fishing villages with sizeable population of nomadic fisherman have been identified. Principal fishing gears operated in the river have been suited. Studies on the fish-catch statistics have indicated Fancybazar and Uzanbazar as the most potential fish-landing centres. While the miscellaneous groups of fishes formed the mainstay of the fisheries, catfishes, major carps, minor carps and prawn showed irregular trend of contribution to the total annual yield. Hilsa landings showed a declining trend through the years 1974-77.

With a view to solving the problem of paucity of fish seed, investigations on the riverine carp spawn prospecting and collection techniques were carried out in the State.

During 1977-78, besides the river Brahmaputra, some of its important tributaries, viz., Jia Bharahi, Jia Dhansiri and Lauit, were also prospected for the availability of quality fish seed. Silghat and Bhomoraguri on the river Brahmaputra have been found to be potential seed-collection centres with the seasonal indices of spawn quality and quantity being, respectively, 25.7% and 560.6 ml at Silghat and 97.5% and 84 ml at Bhomoraguri centres for the carp spawn.

Culture fisheries

With a view to intensify scientific fish farming in the State of Assam, composite fish-culture technology was adopted under the agro-climatic conditions of the State through the All-India Co-ordinated Research Project on composite fish Culture and Fish Seed Production which started functioning in the State since 1974. The central theme of the composite fish -culture technology developed at this Institute is the maximum exploitation of available ecological niches of the impoundment by introducing easily compatible and fast-growing species of Indian (catla, rohu and mrigal) and exotic (silver carp, grass carp and common carp) carps. The adoption of the technology has proved to be the turning point in the annals of freshwater aquaculture of the State. At Gauhati, fish yields from the composite fish culture could be remarkably increased in 1977 when compared to that of the preceding year. During 1977, the gross productions obtained with six species combination ranged from 6,145-6,537 kg/ha as against 3,731-4,083 kg/ha in 1976. With the increasing popularity of the composite fish culture technology and as a result of its massive application, the demand of quality fish seed in the State has further increased. To meet the challenge of shortage of stocking material, the Co-ordinated Project also took up induced breeding of Indian and exotic carps in this State. Successful breedings of silver carp was for the first time achieved in Assam at Gauhati in 1975. A trend-setting contribution in the yield of fish-speed production of the State has been the double spawning of the same individual of rohu in 1977 breeding season. These accomplishments in the field of fish breeding will contribute significantly towards the domestication of the species, besides optimising the fish-seed production of the State.

Extensive researches conducted on air-breathing fish culture have opened up a new avenue of exploitation of hitherto unexploited derelict weed-infested swampy waters in the State through the All-India Co-ordinated Research Project on Air-breathing Fish Culture. The project is actively engaged in location -specific problem of air-breathing fish culture at Gauhati in Assam. Considering the local specific demands, the centre has laid emphasis on developing techniques to breed and culture magur, singhi and koi. Techniques to induce breeding of these commercially important air-breathing fishers have been demonstrated and a large quality of stocking material has been handed over to the State Departments of Fishers of Assam, as well as that of Meghalaya since 1974. Recently successful demonstration of breeding the choice air-breathing fishmagur using freshly prepared paddy fields at Kahikuchi has opened up considerable scope of integrating paddy cultivation with fish farm in the premises of the Kahikuchi Horticulture Research Station of Assam Agriculture University provided a suitable venue for demonstrating various aspects of air-breathing fish culture systems for the Co-ordinated Project Centre.

Culture systems of air-breathing fishes for extensive utilisation of derelict swampy shallow water bodies without fertilisation and supplementary feeding have been developed. In Assam, production of 1,687.5 kg/ha yr of murral could be achieved with the provision of cheap artificial feed comprising rice bran and slaughter house waste (1:1). In the cage-culture experiments, a production of 9kg/sq in cage area/yt could be achieved in experiments conducted in weed-infested waters. Collaboration of the State Department of Fisheries with the Indian Council of Agricultural Research Project is highlighted by a much appreciated demonstration of mixed culture of magur, singhi and koi with special emphasis on low input at the Hajo Fish Farm of the directorate of Fisheries, Assam. An estimated production of over 4 tons/ha/yr was demonstrated, and the fishes have been retained to be used as breed stock for undertaking large-scale breeding for the production of stockable material. Activities of the Co-ordinated Project Centre on air-breathing fish culture at Gauhati are the base for propagation of various techniques, and the centre is the source of information for the neighbouring states of North-Eastern Hill Region. Enthusiastic response to adopting newly developed techniques of air-breathing fish culture by states such as Tripura, Manipur and Meghalaya is worth nothing. On the basis of the progress made by the Centre at Gauhati, the Government of Assam has supported and planned various research and development activities pertaining to air-breathing fish culture in the State.

Air breathing fish culture development activities in Assam

Based on the progress of the All-India Co-ordinated Research Project on Air-breathing Fish culture, a massive demonstration scheme on air -breathing fish culture has been proposed by the Government of Assam. Among the air-breathing fishes, magur (Claries batrachus) has been selected for large-scale demonstration of farming. Private fish farmers will be encouraged to take up *magur culture* for which the Department of Fisheries will bear the expenditure on essential material inputs. Department will organise demonstration plots for three types of magurculture system, viz. (i) mono-culture of magur, (ii) polyculture with carps, and (iii) breeding of magur in paddy fields. Year-wise target for extensive magur culture systems have been proposed by the Government of Assam. I am mentioning all this because of the need for plant breeders to work for systems of agriculture which are compatible with the needs of aqua culture.

In the years to come, countries whose wealth depends mainly on renewable resources will be the ones which are economically strong. Agriculture, including animal husbandry, fisheries and forestry, is the primary source of renewable wealth. We should ensure that the ecological infrastructure upon which this renewable wealth is based is not only not damaged but is continuously improved. For this we have to introduce a widespread awareness of the measures which are essential for building the ecological security of the nation. A mismatch between the ability to grow food and the ability to purchase and consume it on the part of large numbers of people could lead to a situation where a country may have large grain reserves but many children, women and men may still go to bed hungry. Hence, social security measures which ensure that everyone has his daily bread are important. Depending on social conditions, such measures could take the form of 'Food for work', employment guarantee, minimum wage, etc. social security measures should not be based on dole and patronage concepts but should aim at providing opportunities for earning a minimum wage. Under conditions of sudden disasters, relief and nutritional intervention programmes will be essential. Social security measures should not only cover consumers but farmers also. Though integrated pricing policies farmers also. Though integrated pricing policies farmers should not only be assured a fair price for their produce but also articles of daily consumption in rural areas at a fair price. The return to farmers should ensure that they have adequate funds for re-investment on the land.

Future developments in solar energy utilisation, genetic engineering and weather forecasting and modification could open altogether new vistas of terrestrial and aquatic productivity. However, while working and\waiting for such breakthroughs, no time should be lost in building dependable and effective national and international food security systems based on known knowledge and technology. Given appropriate political decisions and resource back-up, this task is capable of being accomplished within 1984, the deadline set by the World Food Congress of 1974, for banishing hunger from the earth. The finite resources of the "Spaceship earth" (to use the terminology of Buckminister Fuller) can provide food, clothing and shelter for all, provided the resources are conserved and utilised by all countries in a manner that will generate synergy and symbiosis. This will call for a highly co-operative interaction between those who serve science and those who move society as well as both among scientists belonging to different disciplines and social leaders belonging to different political ideologies.

Vegetal wealth of Eastern Himalaya

The Eastern Himalayan ranges stretching between 23-29°N. Lat from one of the richest abodes of botanical treasures, fostering about 17% of thee total forest cover of our sub-continent. Fifty per cent of the total number of species of India hail from this region (ca 8,000) and also the genetic variability in a wide group of crop plants like Citrus, Banana, Coffee, Maize, Paddy, Oil Seeds, Jute, Sugar-cane, etc., is enormous, which makes E. Himalaya a natural germ plasm bank. Besides, the origin of many cultivated plants has been (either primary of secondary) attributed to the N.E. Himalaya.

Hooker remarked that the vegetation of the Khasi hills, Meghalaya is "richest in India and probably in all Asia". This is true for the whole of N.E. India as well. There is so much mingling of the dominant components of different types of the vegetation in this region that neither the correct classification is feasible nor zonation of vegetation is perceptible. Champion's classification does not hold good in many respects.

It is also interesting to record here that phytogeographical studies have brought to light the presence of many typical tropical elements, although, normally neither the altitude nor the latitude permit their occurrence.

From an analysis of the distribution of the primitive plants, Takhthajan concluded that E. Himalaya forms a "cradle of many flowering plants" belonging to the genera like Magnolia Linn., Michelia Linn., Tetracentron Oliv., Betula Linn., Taxus Linn., Almus Mill., Holboellia wall., Exbucklandia R. W. Brown., etc. Recent explorations by the Botanical Survey of India (B.S.I.) and other agencies have discovered more than 70 new species belonging to about 50 genera, not known to the botanical world hitherto. These include two new species of carnivorous plants.

Besides, there are many instances of discontinuous distribution of elements, hitherto known from regions like China, Burma, Indo-China, Thailand, Sri Lanka, Africa, etc. Examples are Nymphaea pygmaea Ait. (Siberia, N. China), Epipogium roseum Lindl. (W.Africa, Java, Australia), Polystachya concreta (Jacq.) Garay at Sweet (Java, Africa, S. India), Dioscorea laurifolia Wall. (Penang Malaysia), Mitrastemon yamamotoi Makino (Japan, Sumatra), Illicium cambogiamum Pierre (Southern Indo-China, Burma), Utricularia stanfieldii P. Taylor and U. pubescens Sm. (Africa).

Another interesting aspect of the plant wealth of this region is the presence of several curious and rare plants like insect catching pitcher plant Nepenthes khasiana Hook.f. (Nepenthaceae), the rare root parasites like Sapria himalayana Griff. (Rafflesiaceae), Rhopalocnemes phalloides Jung (Balanophoraceae), stem parasite like Korthasella opuntia Merr. (Viscaceae) and saprophytes like Monotropa uniflora Linn. Hypopithys lanuginosa Nutt. (Monotropaceae), the shrubby gymnosperm Gnetum gnemone Linn., etc.

Out of 151 species of Bamboos, 47 species have their concentration in this region alone. The eastern Himalaya as a whole is very prolific in the epiphytic as well as terrestrial orchids (700 to 1000) species. Many of them, species of 'Cymbidium' Sw., Dendrobium Sw., paphiopedilum Pfitz., Vanda R.Br., Aerides Lour., etc., are of great horticultural value and some of them are the progenetors of the present day highly priced commercial hybrids. They richly deserve protection and regeneration applying the formula C=P+R (Conservation is equal to protection/preservation plus regeneration/rehabilitation) for the future genetic engineering programmes. Even a single tree of the virgin forests of this region affords perch for more than 30 species of different genera of orchids (in S.India, one comes across only a few on a host despite of the high humidity) like Dendrobium eria Lindl., Bulbophyllum Thou., Coelogyne Lindl., Oberonia Lindl., Pholidota Lindl., Vanda, Otochilus Lindl., Cymbidium, etc.

Still, there are vast areas (more than two third) of climax forest stands in this region which remain terra incognita botanically; others are under explored, owing to the inaccessibility and inclemency of climatic conditions. Hence, when thoroughly botanised this region is bound to yield very many interesting findings.

The high incidence of taxa in the E. Himalayan region as compared to Western Ghats of Peninsular India led to the hypothesis that "More dense and varied is the flora and vegetation of an area which experiences occasional earth tremors". The E. Himalaya together with the adjoining region fall within the tremor belt. The pent up magnetic, electric and other invisible forms of energy of the subterranean rocks, released by occasional earth tremors, effect mass scale natural mutation of the genome (genotype) in various degrees and which, in turn ultimately results in speciation and also in the extreme intraspecific genetic variabilities, converting it, into an active zone of speciation.

Though, the landmass of the peninsular India is geologically as old as the Earth (Himalaya is of recent origin) presenting the altitudinal variations from 0 to 2900 m, receiving abundant rainfall from both monsoons, and being nearer to the equator, receiving more solar energy still it fosters only less than half of the species as compared to E. Himalaya. It is true that the forests of both these regions are thick with luxuriant growth of lofty trees of tall boles and spreading canopy, with climbers of various dimensions epiphytes and parasites, shrubs and herbs intertwined with slender twiners, and intermixed with ephemeral rhizomatous ground vegetation rendering them impenetrable. But, while the impenetrable nature of the different stands of vegetation in the South Indian forest is owing to hosts of individual plants of limited number of species belonging to restricted genera, that of the E. Himalayan forests is owing to the presence of limited number of plants belonging to larger number of species, wider range of genera and families. Above ten thousand species of flowering plants are estimated to be present in the E. Region (that is about 50% of the flora of erstwhile British India) while the whole of the erstwhile Madras presidency (Andhra, Karnataka, Tamil Nadu and Kerala) forests has only about 5000 species. On an average, the district flora of S. India comprises of about 700 species, while, it is more than 1500 species in this region. When we take into consideration individual families as to the number of genera and species the representation of taxa is much more in the tremor regions like Burma, Thailand, Malaysia, etc., than in South India.

As a result of acculturation, the appreciation of man's dependence on natural resources is waning away fast and the forests are getting denuded very rapidly, and unless effective immediate steps are launched, the renewable natural resources of this region will be lost, once for all to the future generation. According to the forest policy of the Govt. of India, hilly region should have about 60% of the land under forest cover. But unfortunately the E. Region has a forest cover of about 50% only. Hence, immediate regeneration is of extreme importance. In 1974, an American satellite discovered by means of infra red photography a gigantic shallow in the gulf of Bengal. The shallow has an area of 50,000 sq. kms and is formed by silts carried in the sea by the Brahmaputra and the Ganges due to the erosion from the upper reaches of the Himalaya, consequent, greatly upon the practice of "Jhum" cultivation and partly, owing to land slides, and indiscriminate clearance of forests for road construction and other developmental activities.

Nevertheless, fortunately, the E.Himalaya and the surroundings remain one of the less disturbed geographical zones of the montane ecosystems and fulfil a number of criteria laid down by UNESCO in Biosphere selection namely effectiveness as a conservation unit, representativeness in terms of flora and fauna, in the richness of genetic diversity in respect of wild relatives and primitive cultivars of our crop plants, naturalness of different ecosystems, availability of rare and endangered species, etc. Thus, it becomes imperative to preserve as much area as possible in the E.Himalaya under-forest cover, without disturbing the various ecosystems, that they serve as naturalgenetic pools or banks. Conservation is equal to Preservation and Protection plus Regeneration and Rehabilitation; C=P+R.

The Belt Biosphere Conservation—BBC is the ideal form of preservation of the virgin forests of this region. BBC concept envisages preservation of virgin forests of different altitudes across the land and along the course of rivers on both sides in a continuous stretch. This type of preservation can greatly facilitate migration of species, their intermingling which in turn would lead to natural hybridisation and evolution of species, and thus, emergence of more and more complex ecosystems with maximum species diversity, hence relatively less amount of energy to maintain them. As the genesis of the river is from the altitudinal limits of vegetation and flow down gradually to the lower altitudes, Belt Biosphere is bound to include all types of climax vegetation. BBC along the course of rivers can effectively be implemented in the hill states of this region, since, unlike in other parts of India, here, the human settlements are predominantly on the hill tops, rather than along the river sides. Moreover, the rivers run through deep ravines, and once the Belt Biosphere Conservation is implemented, not only the erosion of the hill slope soils can be effectively prevented, but also, to a greater extent, the floods can be controlled.

However, preservation of isolated Biosphere of climax vegetation at different altitudes, whatever be their dimensions, is to be encouraged for the prevention of soils erosion or for the protection and preservation of particular species of a curious nature or of great academic interest. Recent phytosociological study in connection with pollen analytical investigation has shown that the shola forests of the Nilgiris in S. India are in delicate equilibrium and are progressively receding, instead of regenerating. They are considered as "living fossil community". Thus, conservation of isolated area or pockets as Biospheres or scared groves surrounded by clear areas, as in vogue today, is nonviable in terms of geological times. The plant denizens become like the zoo specimens of animal and the viability will be imperceptibly retarded progressively. Such isolated biomes are in delicate equilibrium with the environment, incapable of regeneration, in the long run once they are destroyed. In other words they are under a physiological strain owing to either artificial or the natural physical situation which may be termed as "Shola strain". Only BBC method can avert the situation and promote formation of viable vegetational patterns with evolved entities. The theory of evolution also postulates that the living species are the descendents of the ancestral types, possessing genetical relationship of degrees of proximity.

The flowing river looks the same, though, is ever changing, so is the vegetation. In the time-space continuum the species are more linked to the time, and individuals more to the space. Hence, in any developmental project, one may afford to sacrifice individuals, but never the species; on the contrary in a Biosphere Conservation programme the dimensions of time and space in relation to both species and individuals must be protected Sine die.

The conservation of biosphere is made possible only when the nature around us is to everyone, primarily an object of love, appreciation and contemplation, which would bestow on us the freedom of joy in the infinite. Secondly, it must be an object of interest and curiosity, which would bestow on us the knowledge, which is power. But, never

A hypothetical belt biosphere

should it be an object of profession, in order to prevent misery and annihilation. Hence, the proper management of environment should be concerned with the promotion of a harmonious co-existence of man with his living as well as non-living resources around him. It is dangerous to protect virtues by ignorance. The present knowledge of the reticulate inter-relationship of the living organisms with one another as well as with their environment is incomplete and inadequate in many respects. Hence, proper regeneration and management are not possible and the knowledge of all operational aspects especially of the mountain ecosystems are to be acquired through multidisciplinary approaches, without further procrastination. In order to implement effectively the programme of regeneration and preservation of the environment. At present the failure of effective management is, by and large, owing to inadequate legislation, lack of enforcement, poor organisation, death of trained personnel and lack of basic information on priorities.

Just as the body retains its birth right of health and strength only by eating varied items of food, in minimum quantities at a time, instead of eating a single item in a very large quantity, however, tasty it might be, the 'mother earth' also maintains her enduring fertility, only by maintaining diverse components, in different stands of vegetation instead of a single species. Unity is the law of Nature but not uniformity. More diverse the morphology and requirements of the different biological entities for their progressive stages of development (viz., birth, growth, reproduction and perpetuation) greater will be the concentration of diverse taxa in an unit of space and time, more will be enduring fertility of the earth to sustain them, and more reticulate and fragile will be ecosystem in terms of energy recycling capacity and less will be competition, just as the more complicated and sophisticated are the parts of the machine, greater will be its efficiency irrespective of the size of various parts. The balanced and long-term management of environment depends on maintaining the diversity of ecosystems and thereby preserving an evolutionary potential among living species which would furnish the humanity, the maximum number to satisfy its needs.

Against the back drop of present day events, like problems of poverty, thickness, malnutrition, unemployment, inflation, etc., the management of environment and conservation is looked with askance. Unless and until, the concept of man as a separate self, independent from the environment is abandoned, and a new ecological outlook is created, the present, mageddon' between man and his environment cannot be won. Besides, conservation programme, in general is in great peril, because the national and International capacities are ill organised and fragmented, with consequent duplication of efforts, gaps in coverage, etc. The present state affairs reminds us of the foolish man of the old story, who was founding and cutting his own branch of the tree, blissfully ignorant of the pending danger to his own life or it is like the murder of the goose that is the golden egg.