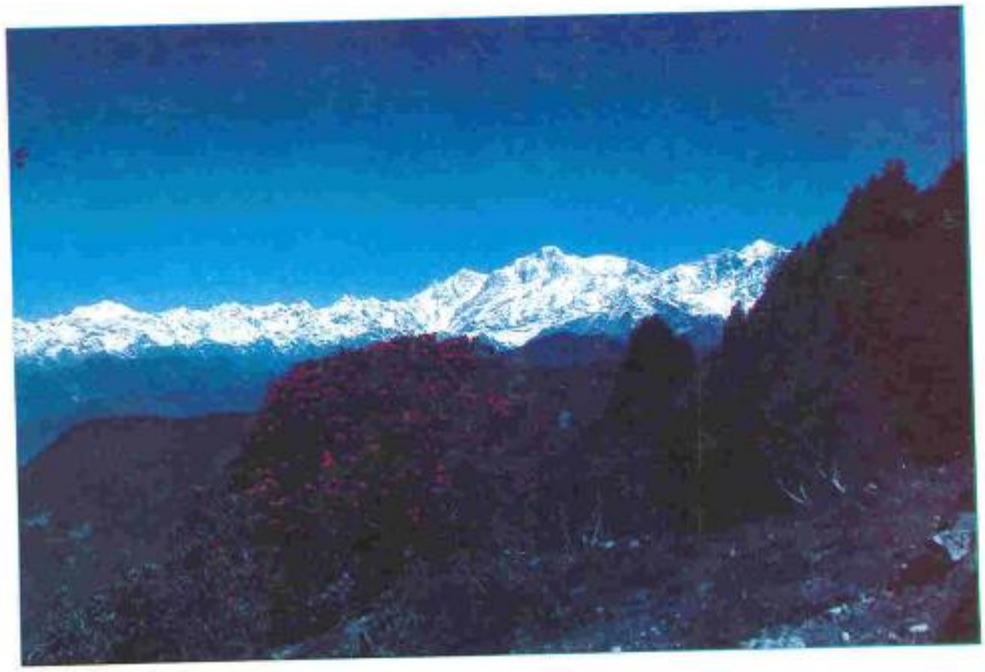
GOVIND BALLABH PANT HIMALAYA PARYAVARAN EVAM VIKAS SANSTHAN

(G.B. Pant Institute of Himalayan Environment and Development)

Annual Report
1990-91



Ministry of Environment & Forests
GOVERNMENT OF INDIA

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CONTENTS

THE YEAR 1990-91 - AN OVERVIEW

The year 1990-91 was a notable period in the formative phase of the Institute established in August, 1988. During this phase, many of the activities and efforts though do not become visible, but are crucial in that they have significant implications for the future of the organization. This Institute has yet to pass through a complete plan period. During the year under review, the First Five year Plan of the Institute was formed and the budgetary requirements were projected. Steps were taken to get the Institute recognized and accepted as the pivotal organization for documentation, dissemination and demonstration of environment oriented research and development in the Himalayan region as envisaged in its mandate.

The Institute functioned from decentralized infrastructural set-ups in Kumaon, Garhwal, eastern and north-eastern Himalaya. These units of programme execution were controlled centrally from Kosi-Katarmal, Almora. Even in the absence of Institute's own infrastructure, it was made possible to continue research and development programmes with the infrastructural support and cooperation of various other organizations.

Issues concerning the construction of Institute's own buildings at Kosi-Katarmal, Almora were vigorously pursued. Architectural plan was given a final shape so that the construction work gets executed as soon as the modalities of acquisition/transfer of land from U.P. Government are over. Hopefully, the Institute will have its own infrastructure at Kosi-Katarmal during the next year.

Stability alongwith Laboratory and Library facilities are the most crucial in determining the quality of output from a research and development organization in the long run. The *ad hoc* human resource set-up was, by and large, discontinued through regular recruitment process. By the year end, the Institute ha 20 young Scientists working on different problems an regions. In spite of the constraints of creatin laboratory facilities at remote areas where Institute i located, a few major equipments including micrometeorological station and growth efficienc analysers have been procured. A good number o reference books and scientific journals have bee added to the Library. The objective of creatin excellent laboratory and library facilities on priorit was not only to strengthen the Institute's own researc and development programmes but also to provide suc facilities to organizations and individuals havin concerns common to those of the Institute. More tha half of the grants received during the year were utilize for laboratory/library purposes.

With a strong realization about the complexitie and diversity of Himalayan Environment at local regional and even at global level, Institute's mandat envisages extension of Institutional Network so as t optimize the use of available talent and to improve th work efficiency in the efforts towards strengthenin the knowledge system for development of the region Signing a Memorandum of Understanding betwee H.N.B. Garhwal University, Srinagar and the Institut was an achievement of the year. Such links with othe identified centres of excellence will enable executio of location specific programmes in the Himalaya.

Undertaking research and development activitie relevant to various problems of Himalayan environment and development are the majo responsibilities of the Institute. The year ended is th second financial year in respect of the ten ongoing projects supported with the grants-in-aid received from the Ministry of Environment & Forests, Government of India and three ongoing projects being supported by other agencies. These projects were planned as multi-disciplinary endeavours to analyse the present problems, to demonstrate the capability of in-hand

science and technology to solve the problems, and to improve upon scientific/technological knowledge of problem-solution in a few representative areas. The report gives the background, objectives and results achieved in each of these projects covering four core themes viz., Land and Water Resource Management, Sustainable Development of Rural Ecosystems, Conservation of Biological Diversity, Ecological Economics and Impact Analysis. This Report attempts to present a comprehensive and abridged account in a simple way so as to reach the people. Detailed project reports specifying the technicalities and academic inputs and outputs shall be covered in the next years' Report by which time all these projects will complete 3 years of duration. Many of the research and development outcome have however been published in various journals. During the year 19 papers published in Journals/Books had gone to the credit of the Scientists of the Institute. The achievements of the year reflect the outcome of the joint efforts at the Institute. The work has been reviewed by Science Advisory Committee on technical matters and the Governing Body on policy issues from time to time. Apart from the 13 ongoing projects, 3 new projects were initiated and 7 were planned to be additionally executed in the next year. Efforts are on to fetch funds required to execute the planned projects from various funding agencies.

With passage of time, the Institute, now in an infant stage, will grow and certainly mature in its thoughts and actions. A step ahead to the common philosophy of working at 'grass-root level', the Institute intends to adopt 'tree-root—level' approach in developing our understanding as well as working in the Himalayan region and this Institute will be dedicated to this vision in the years to come.

A.N. Purohit
Director

1. INTRODUCTION

Govind Ballabh Pant Himalaya Paryavaran Evam Vikas Sansthan (Govind Ballabh Pant Institute of Himalayan Environment and Development) was established as an autonomous organization of the Ministry of Environment & Forests, Government of India in August, 1988 to enhance the knowledge for evolving effective strategies for management of natural resources and sustainable development in the Indian Himalaya.

Envisaging the alround betterment of the Indian Himalaya stretching over an area of about 75,000km^2 and characterized by vast ecological and socio-cultural diversity, the objectives and functions defined by the Institute are:

(i) to undertake in-depth research and development studies on environmental problems of Himalayan region and Shiwalik ranges,

(ii) to evolve and to demonstrate suitable technology packages and delivery systems for integrated and sustainable development of the region,

(iii) to collaborate and cooperate with educational and other institutions and organizations in any part of the world, having objects wholly or partly similar to those of the Institute by exchange of faculty and generally in such manner as may be conducive to their common objectives.

The Institute developed as a decentralized set-up so as to facilitate the execution of research and development programmes in different regions of the

Himalaya, with central administrative control from Kosi-Katarmal, Almora. Efforts were made to create and strengthen the Institute's own infrastructure at Kosi-Katarmal, Almora. In compliance with the advice of the State Government authorities, land acquisition proceedings for transfer of private/state land to the Institute were initiated. The matter was pursued vigorously so as to create a stable base. The success in a true sense however could not be achieved. The first phase requirement of land for construction of Institute's buildings and other activities at Kosi-Katarmal is yet to be satisfied. Efforts were also made to get the architectural plan of the proposed buildings finalized which will be about 8000m^2 carpet area in the first phase.

The Institute continued to enjoy the support of various forms from High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University, Srinagar (Garhwal) and Nagaland Gandhi Ashram, Chuchuyimlang, Mokokchung in executing its projects. A small apartment leased for a period of two years on rent at Tadong, Gangtok in 1989-90 remained the centre of programme execution for eastern Himalaya and its north-eastern extension ranges.

The *ad hoc* set-up of the Institute was almost over by making regular appointments through duly constituted selection committees during the year. By the year end, there were 20 regular scientific personnel and 24 technical/supporting staff distributed in different centres of programme execution on regular strength of the Institute.

2. RESEARCH AND DEVELOPMENT PROGRAMMES

A conceptual framework having four core programmes *viz.*, Land and Water Resource Management, Sustainable Development of Rural Ecosystems, Ecological Economics and Environmental Impact Analysis and Conservation of Biological Diversity formulated when the Institute came in existence, remained the basis of the future growth of the Institute. In view of complex and interactive problems facing the Himalayan region multidisciplinary research approaches rather than individual subject based ones were emphasized. To start with, a couple of projects in each of the core programme were planned and executed soon after the Institute started functioning from Kosi-Katarmal in 1989-90. All these projects were continued during the year 1990-91. It was not possible to give a coherent orientation to the findings as most of the projects involve rigorous data collection and analysis, a task obviously not expected to be completed within a period of two years. However, all the projects have yielded encouraging and interesting results. Although there were no dramatic expansion of resources in terms of finances or manpower, it could be made possible to initiate a couple of new projects. Based upon the experience of the ongoing projects and in-depth appraisal of the environmental problems of the region by reviewing the available literature and by conducting extensive surveys, strategic approaches to be adopted in the future were formulated. Areas of problem oriented research were defined, priorities were fixed and financial and infrastructural requirements were projected.

2.1. Projects funded by the Institute

2.1.1. Projects initiated in 1989-90 and continued in 1990-91

The results and achievements in projects initiated during the preceding year and continued during the current year, alongwith the background and objectives are stated below:

2.1.1.a. Restoration of Degraded Land and Sustainable Rural Development at Katarmal (Almora) in Kumaon Himalaya

Background

Improvement in biological productivity and utility of degraded land is a prerequisite for arresting the ongoing degradational process and conservation of the fragile hill ecosystems. While quite a lot of information have been accumulated on the causes and consequences of environmental degradation, effective technological specifications for solving the problems are felt to be lacking. Although sporadic instances of rehabilitating the degraded lands through plantation forestry and modified agricultural practices have been documented, yet the success achieved so far in this sphere is too little. Much needs to be done to demonstrate the concept of integrated resource management in field during the first phase and subsequently adoption of the standardized packages by the people. A compatability in the scientific/ technological prescriptions and socio-economic set-up of the hill people is a must for the practical success of the ameliorative packages. This project aims to develop and to demonstrate an ecologically sound land management technology for rehabilitation of a highly degraded site (about 3 ha in size) at Katarmal, Almora district in Kumaon Himalaya. A rapid assessment of the resource potential specific to the area selected indicated that adequate availability of water and initiating artificial regeneration of vegetation are the essential immediate tasks to be accomplished. A cost effective technology of diverting the excess flow of water being wasted from a perennial spring adjacent to the site by exploiting the opportunity of gravitational energy in a hilly landscape, augmented with harvesting the rainwater was introduced during first year of the project. Besides, a number of tree and shrub species selected from both ecological and socio-economic considerations in varying mixtures and spatial configurations were introduced so as to identify promising species and their cultural requirements. Attempts were also made to find out constraints in raising agricultural crops in the abandoned agricultural land and to identify the necessary amendments. In-hand science and technology for restoring the degraded land were applied during the first year while refinements in the technology introduced and improvement in the understanding of science relevant to ecological restoration were tried upon during the following year.

Objectives

(i) to improve upon the productivity of degraded land by applying the in-hand science and technology,

(ii) to undertake fundamental and applied researches for refining the existing science and technology of restoration/rehabilitation of degraded land,

(iii) to create awareness towards environment related issues in the rural mass.

Results and achievements

(i) Technology of water harvesting introduced in the project site without any further refinement was found to be effective in reducing the magnitude of moisture stress to a considerable extent. Maintenance cost of the technology following a year of its introduction was negligible.

(ii) Protection of the site and surface irrigation once in a fortnight during the dry season could bring in substantial improvement in production of green fodder through natural regeneration. The green fodder production during the second year

A view of degraded land before the project was executed.

Introduction of water harvesting and storage technology at the project site and introduction of a variety of tree species.

Most of the introduced trees were raised in a nursery on the project site.

Efforts for undertaking trials for restoration of degraded land to support agricultural crops.

following introduction of water harvesting technology (3.5 t/ha) was more than ten fold of that observed in first year (0.3 t/ha). This suggests that appropriate water management techniques coupled with protection of the site alone has considerable potential of mitigating the fodder crisis.

(iii) A comparison of survival of the planted species treated with surface irrigation once in a fortnight and organic manure at the time of planting (3 kg/sapling) showed variable species responses. Species like *Quercus leucotrichophora*, *Albizia lebbek* and *Toona ciliata* appeared to be more responsive than the other species.

(iv) Species responses to physico-chemical conditions of the soil were more prominent in terms of growth than survival. Growth measured as elongation of main axis was considerably improved by land preparation in case of all the species. Mixing the soil with organic manure in pits of 0.6m x 0.6m x 0.6m size could bring about 6 fold improvement in growth in case of *Melia azedarach* and four fold increase in *Alnus nepalensis* (Table 1). Further improvement in land as on well tilled terraces (to a depth of 50 cm) and soil mixed with organic manure had significant impacts only on *Melia azedarach* and *Grevillea robusta* amongst the species tested.

(v) Increasing the pit size beyond 0.6m x 0.6m x 0.6m did not seem to accompany any significant gains in terms of survival percentage or growth rates.

(vi) Species like *Alnus nepalensis*, *Alnus nitida*, *Acacia dealbata*, *Celtis australis* and *Quercus leucotrichophora* were found to be prone to insect infection, more so during the growing season. Spray of Ecalux Ec.25 (1% v:v) at an interval of 10-15 days was found to be effective to contr the damage.

(vii) Based upon observational information, number of species including *Dalbergia sisso Ougeinia delbergioides*, *Pyrus pashia*, *Ficu auriculata*, *Ficus cunia*, *Ficus bengalensis*, *Ficu roxburghii*, *Ficus religiosa*, *Bauhinia retus Bauhinia vahli* seemed useful for introductio trials. All these species apparently have fodd and fuelwood values and abilities to add to so nutrient pool. These species were introduced i experimental plots this year.

Table 1. A comparative account of shoot elongation (mean length of the main axis ± standar error of mean after 12 months of transplantation) of important tree species planted in degraded land at Katarmal

Species	*Growth of main axis*	
	Control[a]	*Amende*
Alnus nepalensis	78.0±8.7	306.1±19.
Acacia dealbata	160.2±15.1	267.4±17.
Melia azedarach	27.5±1.4	158.3±30.
Prunus cerasoides	80.0±8.1	185.0±12.
Grewia oppositifolia	40.2±1.0	99.0±7.
Grevilllea robusta	135.6±6.9	146.9±18.
Quercus leucotrichophora	31.6±1.8	81.6±12.
Quercus glauca	34.0±1.8	83.2±12.0
Celtis australis	56.0±7.3	135.2±5.

a - transplants in pits of 0.2m x 0.2m x 0.2m size with n addition of organic manure or soil preparation.

b - transplants in pits of 0.6m x 0.6m x 0.6m size fille with soil devoid of boulders and mixed with organi manure

Table 2. Output from the nursery maintained at Kosi-Katarmal, Almora.

Species	No. of Saplings/Seedlings
Aesculus indica Colebr.	70
Acacia dealbata Link.	350
Agave americana Linn.	520
Albizia lebbek (linn.) Benth.	375
Alnus nepalensis D. Don.	2707
Alnus nitida Endl.	1479
Bauhinia retusa Roxb.	7061
Celtis australis Linn.	6100
Dalbergia sissoo Roxb.	2282
Dendrocalamus strictus Nees.	978
Grewia oppositifolia Roxb.	5461
Grevillea robusta A. cunn. ex.R.Br.	293
Juglans regia Linn.	32
Melia azedarach Linn.	2144
Prunus cerasoides D.Don.	200
Pyrus pashia Buch - Ham.	1050
Quercus glauca Thumb.	4187
Quercus leucotrichophora A.Camus	10484
Robinia pseudoacacia Linn.	65
Rosa brunonii Lindl.	56
Sapindus mukorossi Gaertn.	1625
Biota orientelis Endl.	187

(viii) Having made a comparative assessment of quite a few crops grown in the region and their responses to a gradient of land improvement by managing the locally available resources *viz.* water and organic manure in the previous year, it was possible to improve the economic output: input ratio from 0.62 to 1.41 when the degraded land was put to agricultural use. However, substantial amounts of organic manure @ 12.5 t/ha/year had to be added to the system.

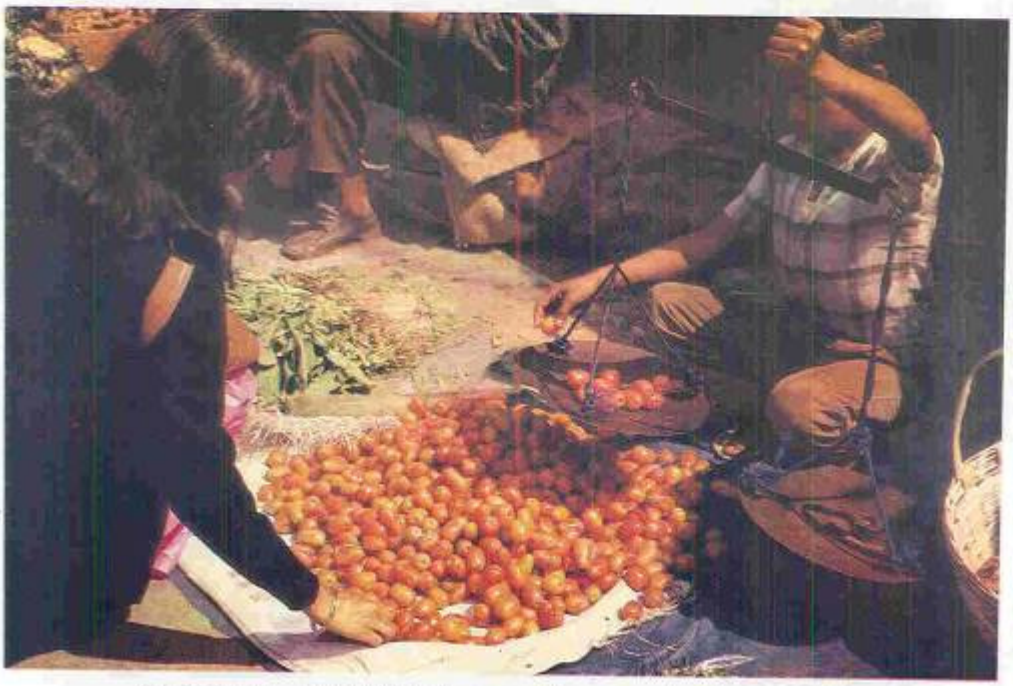
(ix) A nursery of tree/shrub species which have been in use by the people in the region but are not encouraged for one reason or the other, was developed. During the year about 50,000 saplings of 22 species (Table 2) were raised. On demand they were supplied to the Fodder Development Agency of the state government and many local institutions/individuals apart from the use in Institute's experimental plots. The cost per sapling was worked out to be Rs. 0.63.

2.1.1.b. Integrated Watershed Management—A Case Study in Sikkim Himalaya

Background

The consequences of environmental problems invariably with multifarious implications have led to consider watershed as a unit of resource problem analysis and development planning in the hills. Inherent to the watershed management approach is the objective of achieving a balanced development of diverse subsistence needs of the mankind in an integrated rather than sectoral perspective. Such comprehensive studies on watersheds of the Himalaya are only a few and altogether lacking for the eastern and north-eastern extension ranges. This project initiated during the last year aims to identify and to demonstrate integrated resource management strategy in Mamlay Watershed in the South District, the driest region of the Sikkim state. The Watershed lies in catchment area of the river Rangit. Preliminary analysis of structural features of the watershed, socio-economic set-up of the people, resource availability and utilization patterns initiated during the last year were continued during the year.

Large cardamom (*Amomum subulatum*)—an important cash crop of Sikkim.



Sterchulia alata—a wild edible fruit, a source of economy to the villagers in Sikkim.

Objectives

(i) structural analysis of the watershed - studies on vegetation, soil, geology and socio-economic interactions,

(ii) intensive studies on the dominant land use systems,

(iii) analysis of interactions of hydrological cycling and current land uses,

(iv) assessment of the identified integrated management models on the test sites.

Result and achievements

(i) Based largely upon the secondary information and Survey of India topographical sheets, thematic maps depicting relief, drainage pattern, population distribution and land use at a scale of 1:50,000 were prepared. These maps formed the basis of characterizing the fundamental biophysical attributes of the watershed.

(ii) Human settlements were found to be concentrated (79% of the settlements as marked in the watershed area) upto an altitude of 2000 m. amsl. In general, settlements are distributed in a diffused pattern.

(iii) Habitations and settlements beyond 1500 m. amsl. appeared to have come up following the development of roads while those below this level seemed to be age old.

(iv) Age old settlements appeared to be restricted along and adjacent to the streams or lowlands whereas the new ones developed parallel to the roads.

(v) The decinnial growth rate of population in the watershed, though lower than that of the state average, has increased from about 10% in the decade 1971-81 to 18% in 1981-91.

(vi) Except for a couple of isolated patches of pasture/agricultural land use, the upper hill slope of the watershed (beyond 1800 m. amsl.) bears a dense forest cover (> 60% crown cover). Agriculture is the predominant land-use in middle and lower parts of the slope/gradient.

(vii) Most of the agricultural land is in operation current fallow being < 5% of the total agricultural land. However, cropping is mostly rainfed, except traditional irrigational practices used in the valley areas under paddy cultivation.

(viii) Poultry birds constitute the most dominant component of the livestock followed by cattle goats and pigs, almost exclusively of the local breeds. Amongst the cattle, cows and bullocks are common. Buffaloes are rare features. Contrary to open grazing practices in other parts of the Himalaya, stall feeding is predominant in the region.

(ix) An inventory of tree and shrub species in traditional uses in the watershed was made. Efforts are continued to know more about the traditional knowledge of the diverse uses of wild species for subsistence needs. Some of these species, mostly those of fodder/food value, are found in the agricultural fields and can add to rural economy if domesticated.

(x) Data on structure and composition of representative areas in each of the forest types mapped (Fig.1) were collected. Preliminary analysis of the data is indicative of forests of the area facing the problem of timber extraction

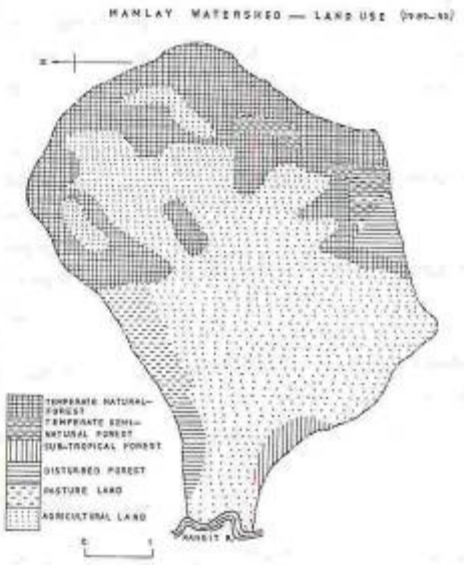


Fig. 1

Disturbances such as uncontrolled grazing/ browsing, clear felling for agricultural expansion detrimental to forest resources though have started their appearances, seemed not to be the overwhelming problems. Amongst the dominant forest trees, *Castanopsis tribuloides* and *Shorea robusta* appeared to be harvested at rates far exceeding the natural regeneration potential.

(xi) Experiments were planned to measure the flow rates between different compartments of the hydrological cycling under varied land uses. Regular data collection will start in the following year.

(xii) It appears that degradational process in the watershed has set in motion during the recent past (say 5-10 years) and is not as grave as in other parts of the Himalaya - *e.g.* central Himalaya. The research and management priority should be oriented towards protective and conservative measures to avoid degradation in the future.

2.1.1.c. Designing Ecologically Sound Natural Resource Management Strategies for Sustainable Rural Development in Kapkot Block, Almora District in Central Himalaya

Background

Based upon the discussions with administrators/ planners and subsequently a rapid self-appraisal, analysing the magnitude of shortage of indigenous resources supporting the cottage industries in the higher reaches of the Kumaon Himalaya and its consequences were conceived as broad aims of this project. Further, in these remote areas with difficult accessibility, it seemed pertinent to attempt for rejuvenating and strengthening the traditional use systems through science/technological inputs rather than bringing abrupt changes. This project aimed to

Ringal supposed to have decreased in abundance for varied reasons—natural growth.

Efforts for artificial regeneration on scrubland—a close up of 1 year old transplant in the project area.

develop and demonstrate the science/technology for sustainable development in a few villages in the higher reaches of Kapkot block of Almora district. In all these villages ringal based cottage industries significantly affect the rural economy and land use systems. Gramin Uthan Samiti, a local voluntary organization, came forward as a collaborator in the action oriented work component of the project.

Often the scope of research efforts concentrated on micro-level for obvious reasons fail to reach the developmental agencies. Realizing the serious incompatibilities and conflicts in the development needs desired at micro and macro geographical scale, it was planned to project the conclusions on resource problems, available options and their implications at varied geographical scales and administrative units so as to facilitate a more sensible planning. Action oriented work involving introduction of appropriate species of local needs in land apparently exhausted of its utility potential was undertaken during first year. Simultaneously, an analysis of the geo-physical set-up of the Kapkot block was also initiated. The work undertaken during the current year pertained to evaluating the success of rejuvenating efforts, finding out the reasons of the failures/success and some analysis of resource problems at micro level (viz.village) and macro level (viz.block).

Objectives

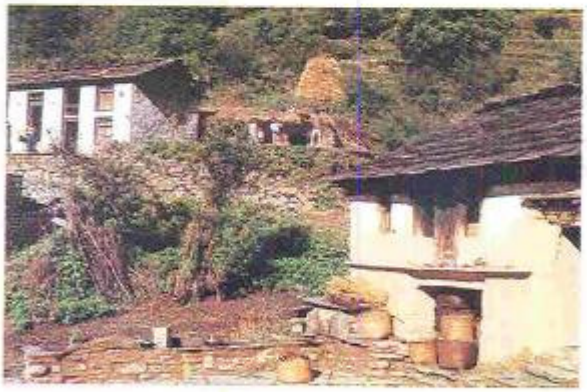
(i) analysing the current problems and consequences of ringal based cottage industry,

(ii) identifying appropriate land management practices so as to solve the current problems and

(iii) defining integrated resource management on geographical unit vis-a-vis administrative unit.

Ringal harvested from natural forests.

Conversion of harvested material into a form used for making handicrafts.



Ringal articles in domestic use.

Ringal the basis of cottage industry in the region.

Results and achievements

(i) The difficulties in getting healthy planting material in the area and cost involved in transporting seedlings/saplings from the distant agencies led to create a nursery adequate enough to meet the project requirements. A nursery of broad leaved species to be intermixed with bamboos for hastening the restoration process and covering partly the risks of single species plantation failures was developed. About 25,000 saplings of all the species taken together could be produced. The saplings were used for the experimental sites and also given to the villagers on demand (Table 3).

(ii) Survival of ringal observed in the range of 80% - 50% in the first year of planting was found to be reduced to a range of 72% - 2% in the 2nd year (Table 4). The latter data correspond to the stage when planted individuals start giving new shoots. Further mortality if any is expected not because of defective planting techniques but by man induced disturbances.

(iii) Amongst the three villages, planting efforts proved to be most successful in Khaljhuni (2000-2500m amsl.) followed by Mikhila-Khalpatta (2000-2500m amsl.) and Chowda (1100-1900m amsl.)

(iv) The reasons of success achieved in Khaljhuni are (a) shortage of ringal in area surrounding the village (b) enthusiastic participation of people in taking up the plantation activity and more importantly its protection and management.

(v) The probable reasons of failure in Mikhila-Khalpatha and Chowda appeared to be (a) reluctance towards the prescriptions given for planting (b) harsher habitats (c) negligence towards protection and management.

(vi) Micro-level patterns are masked by the trends and patterns observed for macro-level units. As an example, while cultivable waste is reflected as the most dominant land use class at block level data (Table 5), it constitutes only a small proportion in the villages selected for detailed analysis (Table 6). Development efforts designed on the basis of macro-level analysis are obvious to prove futile when micro-level assessments are not appropriately taken care of.

(vii) The information available in census while provide the base line information, were felt to be of limited use for the kind of data needed for resource use modelling in the perspective of sustainable development. Data on cropping pattern, agricultural yields, availability of forest resources, livestock and social - cultural - economic set-up were collected to deduce the past trends. Efforts are continued to develop a conceptual framework for predicting the future trends.

(viii) The interactions of ecological and managerial considerations and attributes through map overlay method were studied. The ecological controls and opportunities of strengthening the rural economy in the region were also studied. A stratified sampling design taking care of the diversity of the region was identified for village level analysis to project the resource analysis and management plans at varied scales.

Table 3. Output from nursery developed at Khaljhuni

Species	*Number of seedlings/saplings*
Quercus leucotrichophora	7,000
Juglans regia	3,000
Aesculas indica	12,000
Fraxinus micrantha	3,000

Table 4. Outcome of plantation efforts made in three villages in the Kapkot Block.

Species	Villages					
	Khaljhuni		Mikhila-Khalpatta		Chowda	
	Establishment %	Survival %	Establishment %	Survival %	Establishment %	Survival %
Thamnocalamus falconeri	80	72	80	11	-	-
Chimnobambusa falcata	-	-	-	-	52	2
Juglans regia	25	-	3	-	-	-
Quercus leucotrichoprora	13	-	Nil	-	-	-
Aesculas indica	63	-	12	-	-	-

- Data based on 30 random plots of 10m x 10m quadrats in highly degraded community land on steep slopes.
- Local/vernacular names of *Thamnocalamus falconeri, Chimnobambusa falcata, Juglans regia, Quercus leucotrichophora, Aesculas indica* are Deo ringal, Ghad ringal, Acroat, Banj and Pangar, respectively.
- Two years have been completed of Ringal plantations. The data correspond to survival (% of plants which could produce new leaves latest by the end of the first year of plantation) and establishment (% of plants that could produce new shoots latest by the end of second year of plantation).
- While *Thamnocalamus falconeri* was planted in Khaljhuni and Mikhila-Khalpatta (both in the altitudinal range of 2000m - 2500m amsl), *Chimnobambusa falcata* was planted in Chowda (1100-1900m amsl.).
- Tree species introduced during the second year of plantation have completed only one year.

Table 5. Land use/cover (area in ha, values in parentheses represent the area in a given category as percentage of the total area) statistics of the village land in Kapkot Block*

Land use	Area
Forest	18,289.09(30.30)
Agriculture irrigated	1,828.34 (3.03)
Agriculture unirrigated	8,458.95(14.02)
Cultivable waste	24,830.24(41.14)
Area not available for cultivation	6,948.71(11.51)

* Based upon District Census Report, 1981

Table 6. Land cover/use in the villages selected for restoration work in Kapkot block (Open values are the areas in ha in a given land cover/use category while those in parentheses represent the area as percentage of the total geographical area*)

Land cover/use	*Villages*		
Category	*Khaljhuni*	*Mikhila-khalpatta*	*Chowda*
Forest	301.91 (59.87)	420.89 (73.76)	370.7 (60.62)
Agriculture	67.99 (13.48)	61.11 (10.71)	82.56(13.50)
Cultivable waste	63.13 (12.52)	51.40 (9.01)	53.83 (8.80)
Area not available for cultivation	71.23 (14.13)	37.23 (6.25)	104.41(17.07)

* Based upon District Census Report, 1981.

2.1.1.d. Development of Agroforestry Model in Garhwal Himalaya

Background

Mass migration of people, more so of males, and declining trend of agricultural production during the recent past are common in the region above the foothills of the Himalaya. The situation is more grave in areas where technology of intensified agriculture has not yet reached or failed to deliver goods. These areas are characterized by rainfed agricultural systems, high female: male ratio and a high ratio of abandoned land: cropped land. Sumari village situated at a distance of 24 km from Srinagar township in Garhwal Himalaya is a typical example. In this village, as much as 90% of the agricultural land that was cropped till 1972, was found to be abandoned in 1989. There was a three fold reduction in the number of families inhabiting the village during this period. This pilot project was an attempt to assess the feasibility of technological interventions in redeveloping the degraded agricultural land and thereby improving the rural economy in a village depauperate in both biological and human resources. In view of the interest shown and assurance given by the villagers towards the proposed work, a participatory action oriented research was undertaken over an area of 3 ha of agricultural land. Though planned for a period of 3 years, the project had to be wound up due to non-cooperation of villagers.

Objectives

(i) to identify agricultural land use practices as suited to the ecological and socio-economic attributes of the area and their implementation in the field on experimental basis,

(ii) to evaluate the acceptability of the identified management practices/use systems to the people,

(iii) to undertake fundamental researches so as to design refinements in the existing/indentified agricultural land use practices for sustainable development.

Result and achievements

(i) Before the project was executed, the Institute's representatives held discussions with the villagers in general and the owners of the land in particular. An understanding that the people shall cooperate in protecting the experimental plots and participate in the proposed land management alterations, the cost being borne by the Institute though not on record, emerged out of these discussions.

(ii) Tree saplings of native species with a potentia of providing fuelwood/fodder resources an nutrient enrichment were introduced in th area at a density of 1000 individuals/ha. Specie were planted in carefully dug pits filled with soi amended with organic manure.

(iii) Variable species combinations, mixtures an configurations were planned in subplots.

(iv) Water overflow from an adjacent natural sourc was diverted to the experimental site to avoi mortality as a result of moisture stress.

(v) A nursery was developed to produce saplings o the promising tree species. Over 10,000 health saplings raised were used for experimenta purposes and occasionally also given to th villagers on demand.

Table 7. Survival percentage of agroforestry tree species planted* in agricultural land at Sumari in Garhwal Himalaya.

Tree species	*Percentage of survival*	
	Cropped land	*Abandoned terraces*
Albizia lebbek	77 (70)	68 (64)
Alnus nepalensis	12 (2)	5 (2)
Bauhinia variegata	90 (78)	78 (63)
Celtis australis	58 (58)	92 (90)
Dalbergia sissoo	50 (50)	83 (83)
Ficus glomerata	88 (82)	66 (66)
Ficus rumphi	83 (60)	87 (67)
Ficus roxburghii	83 (67)	87 (70)
Grewia optiva	69 (63)	88 (88)
Kydia calycina	78 (68)	33 (31)
Ougeinia dalbergioides	86 (66)	63 (50)
Quercus leucotrichophora	23 (23)	17 (17)

* Plantation was done in rainy season (July, 1989). Open values indicate survival after the rainy season ir the same year (November, 1989). Values in parentheses are survival percentages after a year of plantatior (July, 1990)

(vi) Survival values of planted species based upon complete population census are given in Table 7. A wide range of variation amongst the species was noted. Species like *Bauhinia variegata, Ficus glomerata, Ougeinia dalbergioides* were most successful (> 85% survival) in the cropped land while *Celtis australis* and *Grewia optiva* (> 80% survival) gave similar responses in abandoned agricultural land.

(vii) Though the people participated with enthusiasm in the initial stages of the project work, their cooperation gradually diminished. This basically appeared due to the fact that they would continue to get direct benefits in the form of wages which was not possible after transplantation was completed. Despite of repeated discussions with owners of the land and also with village community, it was not possible to rejuvenate their enthusisam and to achieve their cooperation to the desired level. The reluctance on their part on protection of the area, adversly affected the survival and growth of introduced trees.

(viii) The vested interest of the rich people, though only a few in number, discouraged the poor owners of the experimental land. The former started exerting pressure for development activities beyond the scope of the project.

(ix) With the experience gained, it became imperative to acquire a piece of land so that the Institute is in a position to exert its control over the land for a period of 5-10 years for developing and demonstrating a model agroforestry system. Through interactions with the people and exposing them to the long term benefits of ecologically sound development strategies, about 5 ha of community land was offered to the Institute to demonstrate the technology of restoration in village Banswara (District Chamoli) situated on Rudraprayag-Kedarnath road. The local priorities were identified. Costs involved in ensuring the protection of the area were worked out. The specific activities involved in rejuvenating the area were planned for execution in the following year.

2.1.1.e. Jhum and Sustainable Development of a Village Cluster in Nagaland

Background

Development in critical areas of Himalaya, whether in terms of ecology of the region or economy of the people, is a goal which cannot be achieved solely by the governmental efforts.

People's participation in policy planning and programme execution though undoubtedly difficult to achieve, is a must. One possible way would be to prioritize the development programmes focussing on the values which people already understand. North-eastern hill region of India is inhabited largely by the tribals prefering isolation. The tribes still are conservative to a great extent by virtue of their culture. Shifting agriculture (Jhum) apart from being a land use practised by these tribals for subsistence historically, is strongly linked to their social organization and cultural values. On account of being age old and being not practised by those considered to be 'developed', this land use is argued to be the primary cause of environmental degradation in the

region. However, conclusions on the efficiency of this traditional system when compared with the more modern ones are conflicting. Considering physical, biological, economic, social and cultural factors affecting the land uses together, straightway replacement of Jhum often advocated seems neither the most suitable option nor feasible because of people's resistence. It would be more useful to avert the distortions appeared in this traditional system in the recent past with possible science/technology inputs. This project in collaboration with Nagaland Gandhi Ashram, Chuchuyimlang, District Mokokchung aimed to develop and to demonstrate sustainable technology packages which ensure the requirements of and acceptable to the tribals. The work was undertaken in three villages viz. Yaongyimsen, Salulmang and Chuchuyimlang (District Mokokchung, Nagaland) differing in natural resource potential, population pressure and remoteness.

Objectives

(i) to find out ways and means of hastening the process of recovery in soil fertility under Jhum cultivation,

(ii) to explore the possibilities of introducing new crops,

(iii) to identify fast growing native tree species valuable to the local tribals and to standardise the cultural techniques,

(iv) to develop low cost water harvesting technology ensuring availability of water during the lean period,

(v) to develop, demonstrate and popularise suitable small scale enterprises to supplement the family income,

(vi) to create awarness on the consequences of forest degradation, exploitation and conservation through direct involvement of local people in the project.

Results and achievements:

(i) Around 10,000 saplings of tree species including *Alnus nepalansis*, *Terminalia chrysophylla*, *Grewia oppositifolia*, *Pyrus pasia* with a potential of adding to the soil fertility, providing fodder/ fuelwood needs of the people were raised in a nursery. These plants were introduced in a few farmer's plots to test their efficiency in hastening the process of soil fertility recovery during fallow phase, the intervening period between two successive croppings on the same site. Data on performance of the introduced species are being collected at regular intervals. These species are indigenous and also traditionally known to the people. With closer interactions, it was made possible to introduce tree species in an area of 2 ha of Jhum land with involvement of about 20 families. Apart from the tree species, perennial cash crops like

cardamom was also planned to be evaluated for introduction.

(ii) A low cost technology of harvesting, diverting and storage of the perennial surface water flow making use of locally available resources was demonstrated as a potential tool of improving upon the economy by raising cash crops. Mustard was found to have considerable scope. This crop also is traditionally known but is not emphasized. In a few experimental plots it was demonstrated that cash economy could be considerably improved by raising the crop and applying low dozes of chemical fertilizers. Possibilities of introducing other crops like sunflower, turmeric, sugarcane, groundnuts, pigeon pea in farmer's plots were explored.

(iii) Cost effectiveness and responses of the farmers to the introduced alterations are being analysed.

(iv) Propagules of many other fast growing species such as *Bambusa khasiana*, *Dendrocalamus hamiltonii*, *Macaranga denticulata*, *Anthocephalus cadamba*, *Schima wallichii* and *Albzia* spp. seemed to have potential of reducing the pressures of shifting agriculture on forest degradation. Seeds of these species were collected and tested for germination. These species though coming up naturally in situations of lesser degree of shifting agriculture disturbances, fail to regenerate under high disturbance regime. There is no option but to introduce them artificially if one has to reduce the cycle of cultivation.

(v) In the initial phase it was difficult to convince the farmers about the suggested interventions. However, the continued interactions in informal ways proved to be effective and voluntary involvement of people, specifically in introducing alders and water harvesting technology, became apparent.

(vi) In addition, technical advice to local institutions involved with environmental concerns and development was provided. Scientific support was provided to Nagaland Gandhi Ashram in its activities on sericulture, non-traditional agriculture, bee keeping enterprise and other small scale industries.

2.1.1.f. Mechanisms of the Maintenance of Biological Diversity and Their Role in Ecosystem Organization and Function in Conservation Areas.

Background

While several attempts have been made to describe diversity as a community property, the mechanisms which contribute towards the apparent biological diversity have not been adequately looked into. The studies on latter aspects have relevance in understanding the implications of conservation oriented management for sustainable development of mankind. This project was planned as an attempt to fill the lacunae in the existing knowledge on biological diversity and ecological design parameters for preserving diversity with special reference to Binsar Sanctuary, a typical representative of an 'undisturbed ecosystem in Kumaon Himalaya. An area of about 46km^2 around Binsar was notified to be reserve forest as early as in 1880. It got the status of sanctuary only in 1988.

Objectives

(i) to prepare thematic maps of the study area,

(ii) to study population dynamics of the tree species,

(iii) to study growth and regeneration patterns of individual tree species,

(iv) data analysis and synthesis to identify mechanisms maintaining biological diversity and associated attributes.

Results and achievements

(i) Thematic maps depicting land use/forest types, habitations, drainage, slope and aspect were prepared based upon the information given in Survey of India topographical sheets and the records available with the state forest department. Some of the important points of the spatial analysis of these maps are:

(a) Inside the sanctuary there is only one, 11 km long, road which terminates at the highest point (about 2500 m. amsl) in the buffer zone. Thus core zone is devoid of any road communication.

(b) The core zone is likely to be subjected to human pressures more on northern and southern boundaries with settlements located adjacent to it than on eastern and western sides where settlements are altogether lacking. An attempt is being made to update the mapping of habitation areas and population densities.

(c) The sanctuary is covered partly in Sarju river catchment and partly in Kosi river catchment. The drainage pattern could be described as a third order drainage system and of dendritic type.

(d) Buffer zone is much more diverse in terms of physiography as well as vegetation types than the core zone.

(e) Amongst the six forest types recognized in the area only three *viz.* 'Pine', 'Oak mixed pine' and 'pine mixed oak' are represented in the core zone. 'Tilonj - Oak - Deodar' type and 'Oak' type forests though occur in the buffer zone are altogether lacking in the core zone.

(f) Considering the buffer and core zone together, pine forests are spatially more dominant followed by Pine - Oak mixed types. There is only one patch of Tilonj Oak - Deodar type covering 1.2% of the total area of the sanctuary.

(ii) Spatial analysis of the thematic maps to elucidate the climatic and topographic controls on vegetation structure and composition is continued.

(iii) Data on population structure and regeneration characteristics of tree species were collected in each of the forest type mapped. Preliminary analysis of the data collected so far indicates that rarity or commonness is not a species specific static attribute but is dynamic both in space and time. The generalized inverse

relationship of commonness and recruitment rate seems not to hold true in quite a few instances. However, a more rigorous data collection and analysis is required to elucidate precisely the mechanisms maintaining community diversity.

Table 8. Forest types and their area (values in parentheses represent area of a given category as percentage of the total area of Binsar Sanctuary).

Forest Type	*Characteristics*	*Area in ha*
Pine	Exclusive dominance of pine	3004.4(51.7)
Oak	Exclusive dominance of oak	196.9 (3.4)
Pine mixed oak	> 60% spatial coverage of pine, < 40% spatial coverage of oak	1284.4 (22.1)
Oak mixed pine	> 60% spatial coverage of oak, < 40% spatial coverage of pine	1017.6(17.5)
Mixed oak pine	Almost equal proportion of pine and oak	231.9 (4.0)
Tilonj oak - Deodar	Co-existence of Deodar and Tilonj oak in varied proportions	69.6 (1.2)

2.1.1.g. Environmental Impact Assessment and Rehabilitation of Jhiroli Magnesite Mining Operation

Background

Exploitation of geochemical reserves through mining has been an issue of deep concerns and conflicts among the environmentalists, the industrialists and the people. In the absence of a rational impact assessment and effective management plans, the adverse consequences of such exploitive activities and associated costs of rehabilitation often far exceed the immediate economic gains. In many instances, mining operations accompany irrepairable damages to the native ecosystems. Through this project initiated in the year 1989-90, the Institute provided assistance to the Almora Magnesite Limited, a U.P. Government Undertaking in rehabilitating Magnesite mined area at Jhiroli (Almora District) on an experimental basis.

Objectives

(i) to assess the impacts of magnesite mining on the ecosystem,

(ii) to identify ways and means of rehabilitating the mined areas,

(iii) to promote peoples' participation in environmental management.

Results and achievements

(i) Attempts initiated to promote regeneration of vegetation in the experimental plot of mined land were continued.

(ii) Applying cost-effective methods of soil amendments such as application of farmyard manure, repair of damaged terraces, reseeding the area with promising grass species, replacing the aborted/damaged saplings planted earlier were tested in sub-plots.

(iii) Informal discussions were held with the mining agency and the inhabitants of the affected villages to create awareness towards the environmental and economic costs associated with such development activities in the hills and their implications in ecosystem and socio-economic stability.

2.1.1.h. Audio-visual Production on Himalayan Environment and Development

Background

Mass awakening on environmental issues and dissemination of appropriate science and technology are essential for arresting the ongoing degradation and restoring the degraded environment in the Himalaya. More often the outcome of research endeavours documented as research papers either fail to reach the decision makers and the target group or are not presented in a form appropriate to their perception and needs. The Institute has planned to come out with audio-visual materials effective in disseminating the outcome of research focused on the problems and feasible solutions in the region.

Objectives

- to develop effective ways and means of disseminating the outcome of research relevant to all those who are directly or indirectly concerned with the region.

Results and achievements

'Himalaya mein Jan Jeevan ke Vikalp' a 25 minute colour video film in Hindi is the first production in

this direction dealing with the medicinal plants. The film projects the wealth of medicinal flora in the high altitude zones and their potential in improving the economy of the people inhabiting harsh environments.

2.1.1.i. Publication on Agricultural Economy of Kumaon

Realizing the availability of huge qualitative as well as quantitative information as isolated published/ unpublished records on various aspects of agricultural economy of Kumaon region, it was planned to bring out a comprehensive publication consolidating such information. The data aspects including human resources, land use, cropping pattern, production, land holdings, livestock, horticulture and forests collected from secondary sources, were subjected to standard analytical techniques. Temporal trends and spatial patterns of a variety of parameters over a long period were analysed and lacunae in the existing knowledge were identified. Comments from the subject matter specialists outside the Institute were also sought and the draft manuscript was moderated accordingly. The press-ready copy of the manuscript contains chapters: (a) The region (b) Human resources (c) Livestock resources (d) Land resources (e) Land holdings (f) Agricultural implements and machinery (g) Irrigation (h) Cropping pattern (i) Horticulture (j) Forests (k) General considerations and conclusions (with 150 tables/figures). This publication is expected to be released in August, 1991.

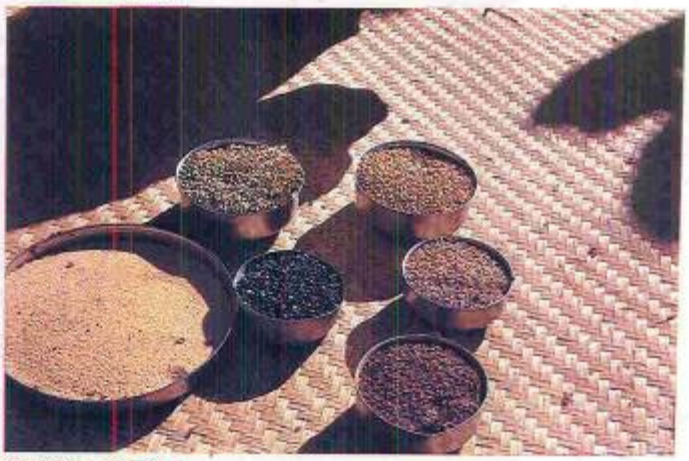
Based upon the experience and outcome of this excercise on documentation and analysis of data already collected by one agency or the other for the Kumaon region, it is proposed to undertake similar analysis for the other sectors of the Himalaya and subsequently regional comparisons and synthesis.

2.1.1.j. Environmental Management Information System for the Himalayan Region

Maximum possible use of data/information is perhaps more important than the collection of data/ information itself. It often happens that the data collected in research studies conducted by an individual with some defined objective are felt useful to the others aiming to achieve quite different objectives. Thus full utility potential of data/ information collected at a time/place is not exploited at the time/place when/where it was collected. Advantages conferred by the computer technology for storage, quick retrieval and varied processing of data/ information were planned to be made use of. Efforts to develop a Management Information System for the Himalayan Region and extending the data retrieval and processing facilities to those interested were initiated. National and International agencies undertaking similar activities were contacted. Information and Decision Support Systems (IADSS) and Computerized Documentation Services/Integrated Set of Information Systems (CDS-ISIS) developed by the United Nations Education, Scientific and Cultural Organization were procured. Trials were made towards developing Experimental Data Base, Multipurpose Tree Species Data Base, Abstract/Bibliographical Data Base, Soil Data Base, Data Analysis Models by making use of the common readily available softwares and incorporating necessary modifications therein. Automated and rapid data processing through computers would facilitate interactive and multidisciplinary analysis at varied time and spatial scales for resource modelling and identifying management needs and options in the future.

A menu driven computerized Library Management Package was developed to enhance accessibility of literature procured in the Institute to other organizations and individuals.

A diverse landscape in Central Himalaya (elevation about 2800m amsl.)—a crop field just after harvest of barley surrounded by *Fagopyrum* sps. crop fields and forests.



A few traditional food grains in use in the higher elevation zones of Central Himalaya.

Traditional (top in figure) and new variety of wheat (bottom in figure) introduced recently in remote high elevation areas of central Himalaya.

2.1.1.k. Institutional Networking

The gigantic task of in-depth understanding of the Himalayan environment and development taking care of both local and regional problems with probable global manifestations too, can be accomplished when all those responsible for the judicious use of natural resources join hands and work in harmony. The Institute aims to march towards its goals by undertaking research and development not only on its own but also through collaboration and seeking support from other organizations. Strengthening the work already being carried out in the region and bringing a broader coherence in an integrated perspective are the networking tasks identified for the Institute. Discussions at various fora were held to establish linkages of the Institute with the relevant educational, scientific and people's organizations working for problem oriented surveys/data collection. A couple of collaborative research projects were planned to be executed in the following year. Efforts were made to fetch infrastructural and financial support to the Institute for Institutional networking and thereby optimizing the use of available scientific talent and human resource.

2.1.2. New Projects initiated in 1990-91

2.1.2.a. Exploration of Lesser-known Crops of Garhwal Himalaya as Food Source

Background

Difficult terrain, poor communication and susceptibility of the land to erosion come in way of adoption of the so-called modern agricultural technology involving use of high yielding varieties and massive material and energy inputs to create optimal conditions for crop growth in the hills. In the hills, it seems more useful to look at the traditional resource uses and to develop science/technology to strengthen them instead of their straightway replacements by the new systems. Assessing potential of traditional food crops and the reasons behind their declining acreages and production are the aspects which urgently need in-depth investigations. Historically, the hill people depended upon a variety of food crops rather than only a few as elsewhere. On account of being domesticated in restricted and remote regions, many crops remained 'lesser-known' and perhaps are still 'under-exploited' (Table 8). They are likely to have considerable potential in meeting the food demand and improving upon the quality of nourishment. This project was initiated to fill up the lacunae in the knowledge on the traditional but 'lesser-known crops' and cropping systems in the Garhwal Himalaya.

Objectives

(i) to survey plant species of potential food value domesticated by the traditional societies,

(ii) to study the contribution of 'lesser-known' crops in meeting the food requirements of the traditional societies,

(iii) to compare the nutritional attributes of the 'lesser-known' crops with those of the common food crops,

(iv) to analyse the land management, cultural practices and eco-physiological requirements of 'lesser-known' crops and their comparison with common crop agro-ecosystems,

(v) to identify strategic actions for conservation of the 'lesser-known' crops.

Table 8. Important 'lesser-known' crops of Garhwal Himalaya.

Botanical Name	*Family*	*Local Name*	*Altitudinal zone of cultivation*
Chenopodium album L	Chenopodiaceae	*Jangli palak/Bathu*	upto 3600m. amsl.
Cleome viscosa L	Capparaceae	*Jokhya*	upto 1800m. amsl.
Fagopyrum dibotrys (D.Don) Hora	Polygonaceae	*Kandli*	1800-3300m. amsl.
Fagopyrm esculentum (Monech)	Polygonaceae	*Ogal*	2000-3000m. amsl.
Fagopyrum tataricum (L) Gaerten.	Polygonaceae	*Fafar*	1800-3500m. amsl.
Hordeum himalayense L	Poaceae	*Va-Jau*	2800-4000m. amsl.
Macrotyloma uniflorum L	Leguminosae	*Gahat*	500-2000m. amsl.
Panicum miliaceum L	Poaceae	*Chenna/Bhegna*	500-2700m. amsl.
Parilla frutescens L Britt	Labiatae	*Bhangjierra*	800-2800m. amsl.
Vigna unguiculata	Leguminosae	*Sonta*	500-2000m. amsl.
Vigna spp.	Leguminosae	*Rons*	500-2000m. amsl.
Secale cereale (L)	Poaceae	*Rye grass*	2800-3800m. amsl.
Setaria italica	Poaceae	*Koni*	500-1800m. amsl.

2.1.2.b. Co-operative Planting Programme of Nitrogen Fixing Trees (NFTs) for Revegetation of Degraded Landscapes.

Background

This programme was initiated in collaboration with Nitrogen Fixing Tree Association (NFTA). The work undertaken is covered in Co-operative Planting Programme (CPP) of the NFTA envisaging improvement in the Science & Technology available for rehabilitation of degraded lands. The CPP is designed to assist field research and development projects. To this end, NFTA provides technical assistance, small quantitites of seeds, species descriptions, *Rhizobium* inoculant and planting instructions. In return, the Institute would collect data on species performance and share its results with other NFTA Associates. The work of this project was planned as an additional activity in the projects of the Institute.

Objectives

(i) to encourage a systematic evaluation of NFTs,

(ii) to evaluate NFT growth and utility in a range of environments,

(iii) to stimulate the utilization of NFTs,

(iv) to demonstrate the rapid growth and multiple uses of NFTs.

Results and Achievements

(i) Propagules of species *viz. Mimosa scabrella, Acacia mearnsii, Acacia acuminata, Alnus accuminata, Chasnaechystisus palmensis* and *Caragana arborescens* supplied by the NFTA were introduced in experimental sites in a range of altitudinal zone. The results have been absolutely discouraging. In most of the instances there was very poor germination (< 10%) and those germinated showed severe mortality (> 95%) within a short period of one month.

(ii) Efforts are continued to repeat the trials incorporating cultural and soil amendments.

2.1.2.c. Defining Development and Identification of Appropriate Rural Development Approaches in the Hills

Background

Environmental constraints and peculiar socio-cultural attributes demand development policies and programmes in the hills radically different from those in the plains. Modern development imperatives are characterized by predominance of achievement norms, a high degree of mobility, an occupational system insulated from and independent of other social structures, and presence of functionally specific non-ascripitive social structures. These are definitely opposed to the traditional agarian hill societies characterized by ascripitive, particularistic and diffused patterns, limited mobility and simple occupational differentiation. Although ineffectiveness of the conventional development planning is realized, the better alternatives are lacking. Development paths ensuring preservation of indigenous culture, social stability, environmental quality and consistent welfare of the hill people in the long run ought to be identified. Capability of the 'technological innovations' in improving the life quality have to be evaluated in both short and long term perspectives. A rational blending of economic and ecological approaches is required while evaluating the suitability of a given development alternative. Looking over the current scenario and near failure of developmental

activities in hills, a rethinking on 'what the development is' itself is required. This project attempts for identifying the development markers, needs and sustainable paths in the central Himalayan hills based upon sequential integrated analysis of villages differing in economic activities and natural resource potentials. In the first phase three villages *viz.* Seal, Natadol and Adhuria in Almora District have been selected.

Objectives

(i) to assemble, analyse and interpret the historical accounts of social, cultural and political set-up of the selected villages,

(ii) to compile descriptive information and secondary data relevant to developmental issues for the past and detailed survey to document the present scenario,

(iii) to analyse people's perception of development and to quantify development changes in the recent past - an economic and ecological appraisal of development issues and their implications,

(iv) to undertake cost-benefit analysis of the ongoing development efforts,

(v) to identify feasible and effective development approaches for sustainable development.

2.1.2.d. An Analysis of Nomadic Repository of Knowledge in the Central Himalaya

Background

Nomadism and associated pastoral systems are the historical land use systems exemplifying elegantly how human beings could survive in the extremely unfriendly and inhospitable environments. On account of being age old and the people involved being away from the centres of modern civilisation, nomadism is considered to be an inferior, inefficient and destructive land use. Such empirical conclusions are derived on the basis of observations rather than any systematic analytical research. From ecological considerations, nomadic systems which continue to exist for centuries preserving the traditional culture and stable social set-ups, have strong elements of sustainability. Rationality in exploitation of biological resources and realization towards the constraints limiting their regeneration are apparent in these systems. The high altitudes of Himalaya supporting alpine pastures are inhabited by three ethnic races *viz.* Bhotiyas, Jadhs and Merchas. A prejudice against the traditional production and management systems of these nomads is detrimental to very survival of these pastoral communities. This project aims for systematic research on social, cultural, economic and biological attributes of the pastoral systems in an integrated perspective. It aims to create a data base to resolve the problems and issues threatening the existence and development of these communities.

Objectives

(i) to compile and analyse the historical accounts of social, cultural and economic set-up of pastoral enthnic races in Central Himalaya,

(ii) to analyse the spatial patterns and temporal trends of the fundamental requirements of pastoral communities,

(iii) to estimate the efficiency of resource use in terms of both economic and ecological costs in pastoral systems in representative areas,

(iv) to analyse the current problems in migration vis-a-vis kind and level of interaction with sedentary population during the course of movement of nomads,

(v) to identify appropriate institutional and managerial inputs required for preserving the culture of nomads and improvement in their life quality.

2.1.2.e. Publication on "Environmental Status Report of District Chamoli".

It was planned to publish the information on various issues of environment and development for the District Chamoli pooled by the Society for Himalayan Environmental Rehabilitation and Peoples' Action, Lucknow. Work was initiated to finalize the contents and format of the publication. The publication giving a coherent scenario of the district would include chapters on the aspects like physical setting, human resources, natural resources, resource management practices, quality of life, current problems, possible solutions and the prospects.

2.2. Projects Sponsored by other Funding Agencies

2.2.1. Projects Initiated in 1989-90 and Continued in 1990-91

2.2.1.a. Introduction of Rainwater Harvesting Technology for Sustainable Rural Development in the Himalaya

Background

Development in the Himalaya is most often constrained by lack of water in desired quality and quantity. Poor health, economy and environmental quality are believed to be due to acute shortage of water in the hills. While much is known about the underlying causes and consequences of the water problems, the solutions appropriate to the rural area of the hills have yet to come out and reach to th people. Slopes and slope gradients in the hill landscape provide opportunities of harvesting th surface run-off from perennial springs and run-of component of the rainwater.

This project a collaborative venture of the Institut and Jawaharlal Nehru University, New Delhi bein financed by the Department of Science & Technology Government of India was executed in the year 1989 90 to introduce and to propagate appropriate wate harvesting technology in critical rural areas.

Objectives

(i) survey of the existing surface water harvestin techniques,

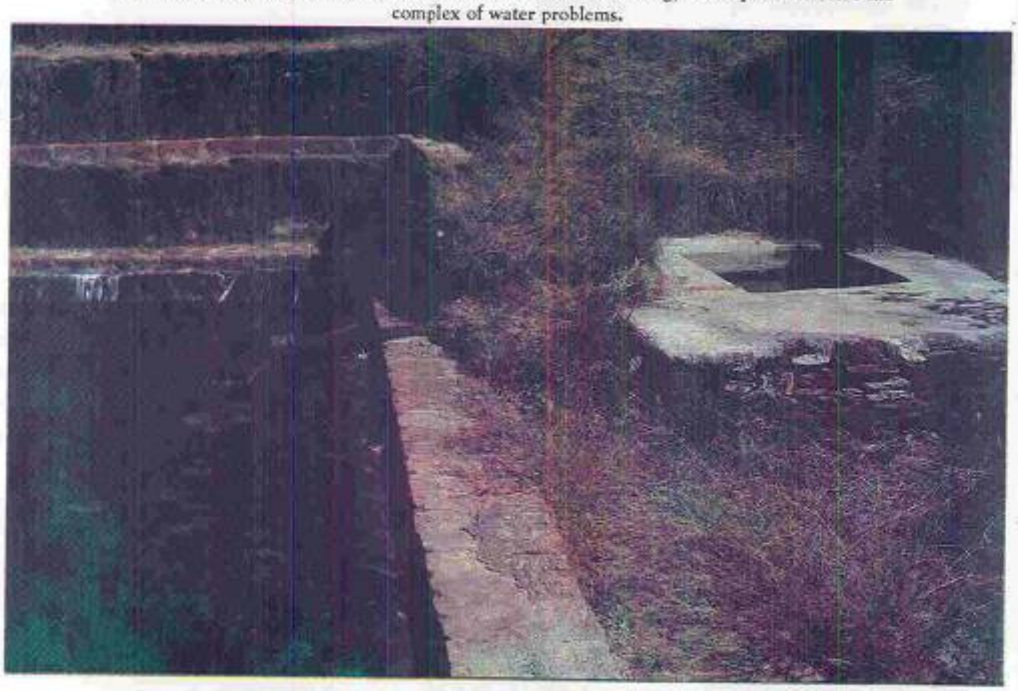
(ii) designing the water harvesting tanks (in term of shape, size, capacity and constructio specifications) as suited to the prevailin requirements and environmental conditions,

(iii) assessment of performance and impact c introduced technology and possibl refinements, if needed.

Results and achievements

(i) Water harvesting/storage tanks constructed a Banswara (Garhwal), Panchgaon and Kapkc (Kumaon) during the previous year wer maintained. Varied land use practices wer tested to improve the food, fodder and fuelwoo production in the respective areas an suggestions were made so as to miximise th benefits of the introduced technology. Th benefits became apparent as reduction i mortality and fast growth of tree specie

Traditional practice of storage of spring water—a view of cleaning of storage tank by villagers in Central Himalaya—appropriate modifications in the traditional technology are required to solve the complex of water problems.



Introduction of technology of harvesting and storage of rainwater and/surface overflows as a component of restoration work.

planted, higher levels of green fodder production specifically during the dry period of the year, cultivation of off-season vegetable crops and intensification of agriculture in general. The maintenance cost of the introduced technology was assesed to be virtually negligible.

(ii) It was observed that harvesting the rain water alone was not quite sufficient to meet even the basic requirements. Instead a mix of technologies for harvesting the rain-water from mini catchment and storing the water being wasted as overflow from the perennial springs was found to ensure the supply of water in substantial quantities in the areas that were worked.

(iii) It was also felt that a cost effective water purification technology could be very well integrated with the water harvesting/storage tanks to ease the availability of drinking water.

(iv) Work was planned to introduce the technology in Namchi village in South District of Sikkim and ChuchuYimalang village, District Mokokchung in Nagaland.

(v) An objective analysis of the potential of the introduced technology in meeting the water requirements and its impact was initiated.

2.2.1.b. All India Coordinated Project on Water Health & Sanitation (Involvement of rural women)

Background

Frequent incidences of water borne diseases and poor health, particularly of women are the manifestations of improper drainage, shortage of potable water and insanitation in a large number of villages in the hills. Mass awakening among the rural women towards the linkages of water, health and sanitation and possible science/technology inputs to ease the problems hence ought to be prioritized.

An All India Coordinated project was launched by the Department of Science & Technology for developing appropriate site-specific sanitation technology in different agroclimatic regions of the country. The project is executed and centrally coordinated from the Centre of Appropriate Rural Technology, Indian Institute of Technology, New Delhi. The Coordinator of the project sought the cooperation of the Institute in demonstrating a cost-effective sanitation technology in a couple of villages in Almora District.

Objectives

(i) to develop strategies for involving women in implementing projects on water, health and sanitation,

(ii) to field test integrated models with women's participation in various agroclimatic regions of the country,

(iii) to create awareness in rural areas on water, health and sanitation related issues,

(iv) to carry out an impact analysis for feedback and future planning and implementation.

Results and achievements

(i) Environmental awareness towards water, health and sanitation was created through informal discussions with women in Katarmal and Kapkot villages of Almora District.

(ii) A cost-effective sanitation technology (Sulabh Shauchalaya) evolved at Indian Institute of Technology was introduced in the village Katarmal.

(iii) Based upon the bench mark surveys of the selected villages, key issues of awareness were planned to be projected through exhibitions/ audio-visual aids.

2.2.1.c. Ecology of Earthworms and Soil Arthropods in Central Himalayan District of Almora

Background

Soil fauna play a significant role in regulating the fertility of soil. Amongst a variety of animals constituting the soil fauna, earthworms are considered to be most crucial. A clear understanding of the decomposition processes and their rates performed by these animals would help in improving soil fertility levels in the managed ecosysterms. Except for a few stray preliminary reports, information on these aspects in the Himalayan region is altogether lacking. This project aimed to generate information on the role of earthworms and soil arthropods in regulating the fertility of soil in managed and natural ecosystems in the Kumaon Himalaya. This project was executed as an independent Research Associate Award of Council of Scientific and Industrial Research. It was discontinued in March, 1991 as the concerned Associate shifted from the Institute.

Objectives

(i) to identify the earthworm species in a few selected ecosystems representative of varied level of disturbance regimes,

(ii) to analyse the population dynamics of earthworms in the identified ecosystems,

(iii) to estimate the contribution of earthworms in the nutrient cycling under different disturbance regimes,

(iv) to analyse the response of earthworms towards soil management practices.

Results and achievements

(i) Survey and identification of earthworms inhabiting different ecosystems has been completed.

(ii) Considerable data on the abundance of earthworms and their population dynamics have been collected.

(iii) Regular sampling of soil-plant and animal components was done.

2.2.2. New Projects Initiated in 1990-91

2.2.2. a. All India Coordinated Project on Biological Maintenance of Soil Fertility

Background

The Department of Science & Technology, Government of India initiated an All India Coordinated Programme on 'Biological Maintenance of Soil Fertility' to create a strong information base for evolving ecologically sound land management strategies. The Institute has a substantial participation in this programme. A Scientist of the Institute was identified by the DST to coordinate the programme in which about 10 investigators are working on basically the same problem but in different bioclimatic regions of the country. Two projects one for the studies in Kumaon Himalaya and the other for the studies in eastern Himalaya, were sanctioned to the Scientists of the Institute.

Objectives

(i) to quantify nutrients/water demand and supply in managed, degraded and protected ecosystems,

(ii) to analyse the biological mechanisms of maintenance of soil fertility already existing or which have a possible scope in the region,

(iii) to study the impact of different land use/ cultural practices on soil fertility processes and identification of appropriate biological amendments.

2.3. Workshops/Symposia

2.3.1. Workshop on Biological Maintenance of Soil Fertility

With financial support from the Department of Science & Technology, Government of India, the Institute organized a workshop on Biological Maintenance of Soil Fertility on March 9-10, 1991. Over thirty Scientists participated in the Workshop. The progress of work done and the work planned for future in the All India Coordinated Programme of the DST under its Young Scientist Scheme were discussed. In addition, a number of new project proposals to be submitted to the DST for strengthening the ongoing programme through involvement of both the senior and young scientists were considered. The philosophy of International Tropical Soil Biology and Fertility (TSBF) as reflected in some of the case studies in the country and abroad was outlined. It was decided that the investigators involved in the programme follow the methodology standardized in the TSBF to ensure a rational data analysis and synthesis. The future strategies for expanding the All India Co-ordinated Programme of the DST and for putting it in the network of the TSBF were chalked out.

2.3.2. Proceedings of the International Workshop on Ecology of Biological Invasions in the Tropics

The proceedings of the Workshop sponsored by the Scientific Committee on the Problems of the Environment (SCOPE), Paris and organized by the Institute in September, 1989, were published and released by the National Institute of Ecology, New Delhi. The volume consists of thirteen chapters covering 189 printed pages.

2.4. Perspective Planning for the Future

'Strategy 2000 AD and beyond' - a document giving a comprehensive account of the perspective planning of the Institute was prepared. Priorities for the near future based upon the experience of the ongoing projects and subsequent discussions at various fora were set. Four projects in each of the core programme were planned.

Land and water resource management

- Classification, biology and fertility of soils in the Himalaya
- Research and extension on water harvesting
- Integrated watershed management
- Inventory of resources and creation of data bank for resource monitoring

Sustainable development and rural ecosystems

- Survey of energy needs and energy alternatives in the Himalaya
- Identification of critical enviornmental and developmental issues along the altitudinal and longitudinal gradient

Aggregation among butterflies - a rarely observed behaviour.

Fragaria vesca—A wild herb yielding edible fruits—an example of untapped edibles.

Aristolochia dilatata—a rare plant.

- Demonstration of restoration of degraded land for sustainable rural development
- Sustainable development in relation to socio-economic status

Conservation of biological diversity

- Inventory of bioresources and study of pattern of biodiversity in the protected area network
- Establishment of two arboreta and genebanks in central and eastern Himalaya
- Defining the conservation strategies and multiplication techniques of multipurpose trees and medicinal plants
- Linkages between conservation, resource recycling and development in the mountain perspective

Ecological economics and environmental impact assessment

- Study of impact of water resource development in the Himalaya
- Impacts of road construction, tourism and mining in the Himalaya
- Impact of biological invasions
- Climatic changes and their impacts on the Himalayan ecosystems

Supporting activities and networking

Following activities will emphasize on human investment and initiation of sponsored programmes.

- Environmental impact assessment training programmes for the officials
- Orientation workshop for school teachers for imparting environmental education through informal means
- "Nature-Study" courses for the trekkers
- For disseminating the knowledge, automated facilities of data storage, processing and retrieval will be made operational during the next decade.

A number of agencies were contacted to get funds required to excute these projects. Preliminary work on some of the projects was also initiated.

3. LABORATORY AND LIBRARY

Laboratory and Library are the most curcial assets on which the quality of research and development outcome depends. Equipping the laboratory with adequate facilities and enriching the library were taken on priority. Facing the constraints of making such facilities available at remote areas with difficult accessibility where Institute is located, considerable progress could be made, though only by the end of the year. Out of the total allocation of Rs. 85.8 lakhs, about Rs. 41 lakhs were spent on the purchase of equipments.

A Micrometeorological Station, a Weather Station, a Plant Efficiency Analyser, Gas Chromatograph, Area Meter, Polycorder (all with computerized data recordings), Soil Water analytical kit, Video Camera were the major equipments procured by the Institute.

With the arrival of 698 standard reference books during the year, the Institute has now 1278 books in its library. Subscriptions for 18 standard periodicals, journals were continued.

4. ACTIVITIES ON ENVIRONMENTAL AWARENESS

- As an effort to create environmental awareness among the students, a competition of speech on common environmental problems of the Kumaon hills was organized on the World Environment Day on June 05, 1990. About 40 matric level students from 10 Colleges in and around Almora participated in the competition. Special prizes to the best speakers as judged by a Committee and consolation prizes to all the participants were distributed. Scientists of the Institute actively participated in the functions organized on the World Environment Day at Kapkot, Jhiroli and Kanda in Almora district.

- A meeting of the people's representatives of local bodies was called to discuss the expectations of the people from this newly established Institute. In this meeting held on September 21, 1990, the possible strategies for developing mechanisms to make appropriate use of science/technology for development of the region were discussed.

- The Institute actively participated in an exhibition organized by district administration at Ranikhet on October 2-10, 1990 and projected the 'environment-development scenario in the hills' to the visitors.

- In a meeting of the people's representatives and district level officers with the Scientists of the Institute held at village Namchi, South District, Sikkim on September 10, 1990, the strategic approach for environmentally sound development in the eastern Himalaya was outlined.

-Second issue of the Institute's Newsletter 'Hima-Paryavaran' was brought out. This Institutional publication is towards stimulating research and development activities and disseminating the knowledge as relevant to Himalayan environment and development. Efforts put in by the Institute and other organizations are disseminated through this publication. The feedback from stringers on the current environmental and developmental issues were planned to be covered through this publication.

Besides a few specific events and activities mentioned above, a number of informal meetings were held in the villages specifically adjacent to sites of research and development programmes. The interactions apart from having made impacts on the people towards environment, facilitated in orienting the ongoing programmes to those directly involved and thereby ensured their constructive participation.

5. ACADEMIC ACTIVITIES

5.1. Publications

Dhar, U. & Sidduque, M.A.A. 1991. Ethnobotanical studies and biological diversity in Suryu valley (Zanskar). In: *Glimpses in Plant Research volume XI, Today & Tomorrow Publication, New Delhi.* (in press)

Kothyari, B.P., Rawat, D.S., Sharma, S., Rao, K.S. & Saxena, K.G. 1990. Afforesting wastelands in the Himalayan region: problems and perspectives. In: *Proceedings of National Seminar on Technology for Afforestation of Wastelands*, Forest Research Institute, Dehra Dun.

Maikhuri, R.K. and Ramakrishnan, P.S. 1990. Land use and village ecosystem function of traditional societies co-existing in the same area in Meghalaya in North-east India. *Agri. Ecosyst. Environ.* 31: 17-37.

Maikhuri, R.K. and Ramakrishnan, P.S. 1991. Comparative analysis of the village ecosystem function of different tribes living in the same area in Arunachal Pradesh in North-eastern India. *Agricultural systems* (in press).

Maikhuri, R.K. 1991. Fuelwood consumption pattern of different tribal communities living in Arunachel Pradesh in North-eastern India. *Bioresource Technology* (in press).

Maikhuri R.K. 1991. Nutritive value of some lesser-known wild food plants and their role in tribal nutrition. A case study on Nishi tribe of Arunachal Pradesh in North-east India. *Tropical Science*. (in press).

Maikhuri, R.K. and Gangwar, A.K. 1991. Fuelwood use by different tribal and non-tribal communities in north-east India. *Natural Resources Forum*. (in press).

Maikhuri, R.K. and Ramakrishnan, P.S. 1991. Ethnobiology of some tribal societies of Arunachal Pradesh in north-east India. *Journal of Economic Taxonomic Botany*. (in press).

Purohit, A.N. 1991. Possible impact assessment of future climatic change based on physiology and phenology of plants - the Himalayan scenario. In. *Proceedings Indo-US Workshop on Global Climatic Changes: Photosynthesis and Plant Productivity*. (in press)

Rawat, D.S. 1990. Evaluation of place name: a case study from Kumaon Himalaya. *The Geographical Society of India Journal*. (in press).

Rao, K.S., Ramakrishnan, P.S. & Saxena, K.G 1991. Architectural plasticity of bamboos and its significance in the succession. *Bamboo Journal* (in press).

Rao, K.S. & Saxena, K.G. 1991. An ecological assessment of man–made forests. In: *Proceeding International Conference on Conservation of Trpical Biodiversity*. Malayan Nature Society, Kualalumpur Malyasia. (in press).

Ramakrishnan, P.S., Saxena, K.G. & Rao, K.S 1991, Land use problems and emergent tendencies *Seminar*, 378, 32-35.

Saxena, K.G., Tiwari, A.K., Porwal, M.C. & Menon, A.R.R. 1991. Vegetation maps, mapping needs and scope of digital processing of landsat-TM data in a tropical region in south-west India *International Journal of Remote Sensing*. (in press).

Saxena, K.G., Rao, K.S. & Kothyari, B.P. 199 Remote sensing for management of biologic resources - a rational outlook for the Himalayas. In *Proceedings of Seminar on Mountain Resour Management and Remote Sensing*, Indian Society Remote Sensing, Dehra Dun. (in press)

Saxena, K.G., Rao, K.S., Kothyari, B.P., Rawa D.S. & Sharma, S. 1991. Management consideratio for sustainable production in agro-silvo-pastor systems of the Indian Mountain region. *Proceedings International Rangeland Congress*, Montpellier. (press)

Sharma, Eklabya & Ambasht, R.S. (1991). Bioma productivity and energetics in Himalayan ald plantations. *Annals of Botany* (in press).

Sharma, S. 1991. Agroforestry for sustasinab development in Indian Central Himalaya. ILEIA. (press).

Sharma, S. 1991. Energy budget studies of some multiple cropping patterns of the Central Himalaya. *Agriculture, Ecosystem & Environment.* (in press).

5.2. Participation of Scientists in Symposia/ Workshops/ Conferences

- A Scientist of the Institute participated in 'International Conference on Conservation of Tropical Biodiversity' organized by Malayan Nature Society, at Kualalumpur, Malayasia on June 11-17, 1990.

- Acting Director participated in the Workshop on 'Monitoring of Projects under Himalayan Ecodevelopment Programme" of the Ministry of Environment & Forests, Government of India held at Srinagar, Garhwal in May, 1990.

- A Scientist of the Institute attended the V International Ecology Congress held on August 23-30, 1990 at Yokahama, Japan.

- A Scientist of the Institute was deputed to participate as guest faculty in the Training Course for Group B Officers of the State Government organized by the Administrative Training Institute, at Almora in the months of August, September and December, 1990.

- A Scientist of the Institute participated in 'Group Monitoring Workshop on Projects Funded by the Department of Science and Technology for Tribal/Weaker Sections of the Society Development Programme' organized at the Institute of Wasteland Reclaimation and Rural Development, Gaurigunj, Sultanpur on October 3-5, 1990.

- The Director attended the Golden Jubilee Celeberations of the National Acadamy of Sciences organized at Indian Agriculture Research Institute, New Delhi in January, 1991.

The Director participated in the Indo-US Workshop on 'Global Climatic Changes: Photosynthesis and Plant Productivity' organized at Hotel Riyadh, New Delhi in January 8-11, 1991.

- A Scientist of the Institute participated in the Brain Storming Session on Plants and their Relation with Environment' held at the University of Pondicherry, Pondicherry on February 5-7, 1991 and organized by the Department of Science and Technology, Government of India.

- A Scientist of the Institute participated in the Advisory Committee meeting of 'Bamboo Information Centre' programme of Kerala Forest Research Institute, Peechi, Trichur on February 7, 1991.

- Director of the Institute participated in International Geosphere Biosphere Programme-Asian Workshop organized at National Physical Laboratory, New Delhi on February 11-12, 1991.

- Two Scientists of the Institute participated in National Symposium on Planning for Environmentally Sustainable Development - An Indian Perspective, organized by National Institute of Ecology at Jawaharlal Nehru University, New Delhi on February 21-23, 1991.

- A Scientist of the Institute attended the training course on 'Watershed Management' organised at North-Eastern Regional Centre of National Institute of Rural Development, Guwahati.

- Director of the Institute participated in the 13th meeting of the 'Expert Working Group on Integrated Ecodevelopment Research Programme in Himalayan Region' held at Ministry of Environment & Forests, New Delhi in March, 1991.

A scientist represented the Institute in a meeting on Soil Conservation Programs in Almora district organized by the district administration in March, 1991.

6. MISCELLANEOUS

Several dignitories including officials of British High Commission, faculty members/scientists from Universities/Institutions abroad and academicians and decision makers of the state government visited the Institute and discussed the ongoing and future programmes.

Keeping in view the importance of feedback from those interested in the Himalayan region, the previous Annual Report (1989-90) was circulated to as many as 200 National and International Organizations. Responses from more than 120 individuals/ organizations were received. While some pointed out the mistakes, others suggested that the report needs to incorporate some scientific data also. These comments/suggestions were given due consideration while drafting this report.

7. SOCIETY OF GOVIND BALLABH PANT HIMALAYA PARYAVARAN EVAM VIKAS SANSTHAN

Minister-in-charge Union Cabinet, Ministry of Environment & Forests, Government of India, New Delhi	President
.Minister of State in-charge Ministry of Environment & Forests, Government of India, New Delhi.	Vice-president
Two Members of the Parliament	
Shri M.S. Pal Member of Parliament, Lok Sabha.	Member
Shri Jagpal Singh Member of Parliament, Lok Sabha.	Member
Minister in-charge Environment, Government of Jammu & Kashmir.	Member
Minister in-charge Environment, Government of Sikkim.	Member
Minister in-charge Environment, Government of Himachal Pradesh.	Member
Minister in-charge Environment, Government of Uttar Pradesh.	Member
Minister in-charge Environment, Government of West Bengal.	Member
Minister in-charge Environment, Government of Assam.	Member
Minister in-charge Environment, Government of Arunachal Pradesh.	Member

Minister in-charge Environment, Government of Mizoram.	Member	Secretary Ministry of Environment & Forests New Delhi.	Member
Two Members of Legislative Assembly, State of Uttar Pradesh.	Members	Secretary Department of Science & Technology, New Delhi.	Member
Five non-officials (nominated by the Government of India)		Secretary Department of Scientific & Industrial Research,	Member
Prof. S.P. Nautiyal Vice-chancellor, Garhwal University, Srinagar.	Member	New Delhi.	
		Secretary Ministry of Human Resource Development, New Delhi.	Member
Professor Mahatim Singh Vice-chancellor, G.B. Pant University of Agriculture & Technology, Pantnagar.	Member		
		Secretary Department of Rural Development, New Delhi.	Member
Professor Mrinal Miri North-Eastern Hill University Shillong.	Member	Secretary Department of Urban Development, New Delhi.	Member
Shri Chandi Prasad Bhatt Desholigram Swarajya Mandal, Gopeshwar (Chamoli).	Member	Secretary Department of Biotechnology, New Delhi.	Member
Shri Natwar Thakkar Nagaland Gandhi Ashram, P.O. Chuchu Yimlang, District Mokokchung, Nagaland.	Member	Secretary Department of Non-Conventional Energy Sources, New Delhi.	Member
A representative from Indian Institute of Forest Management Bhopal.	Member	Secretary Department of Mines, New Delhi.	Member
		Secretary Department of Water Resources, New Delhi.	Member

Secretary
Department of Agricultural
Research & Education,
New Delhi.

Secretary
Planning Commission,
New Delhi.

Chief Secretary
Government of Uttar Pradesh,
Lucknow.

President
Forest Research Institute,
Dehradun.

Inspector General of Forests,
New Delhi.

Director
Botanical Survey of India,
Calcutta.

Chairman
Indian Council of Social
Science Research,
New Delhi.

Director
Centre for Social Development,
New Delhi.

Director
Govind Ballabh Pant Himalaya
Paryavaran Evam Vikas Sansthan,
Almora.

Member

Member

Member

Member

Member

Member

Member

Member

Member

Member

8. GOVERNING BODY

Secretary
Ministry of Environment & Forests,
Paryavaran Bhawan,
C.G.O. Complex, Lodi Road,
New Delhi-110 003.
— Chairman

Secretary
Department of Biotechnology
C.G.O. Complex, Lodi Road,
New Delhi-110 003.
— Member

Chief Secretary
Government of Uttar Pradesh,
Government Secretariat,
Lucknow.
— Member

Inspector General (Forests)
Ministry of Environment & Forests,
Paryavaran Bhawan, C.G.O. Complex,
Lodi Road, New Delhi-110 003.
— Member

Joint Secretary & Financial Advisor
Ministry of Environment & Forests,
Paryavaran Bhawan,
C.G.O. Complex, Lodi Road,
New Delhi-110 003.
— Member

Prof. A.K. Sharma
Department of Botany,
University of Calcutta,
35 Ballygunge Circular Road,
Calcutta-700 019.
— Member

Prof. T.N. Khoshoo
Tata Energy Research Institute,
7 Jor Bagh,
New Delhi-110 003.
— Member

Prof. S.K. Sinha — Member
Water Technology Centre,
Indian Agricultural Research Institute,
New Delhi.

Prof. K.S. Valdiya — Member
Department of Geology,
Kumaun University,
Nainital.

Director — Member-Secretary
G.B. Pant Institute of Himalayan
Environment and Development,
Kosi, Almora-263 643.

9. SCIENCE ADVISORY COMMITTEE

Prof. S.K. Sinha — Chairman
Professor of Eminence,
Water Technology Centre,
Indian Agricultural Research Institute,
New Delhi.

Prof. K.S. Valdiya — Member
Department of Geology,
Kumaun University,
Nainital.

Dr. C.L. Acharya — Member
Department of Soil Science,
Himachal Pradesh Agriculture University,
Palampur, Himachal Pradesh.

Prof. J.S. Singh — Member
Department of Botany,
Banaras Hindu University,
Varanasi.

Dr. P.V. Sane — Membe
Director,
National Botanical Research Institute,
Lucknow.

Dr. Ram Guha — Membe
Institute of Economic Growth,
University of Delhi,
Delhi-110 007.

Dr. Baldev Sahai — Membe
Group Director,
Remote Sensing Area,
Space Application Centre,
Ahmedabad.

Dr. Manju Sharma — Membe
Adviser,
Department of Biotechnology,
B-Block, C.G.O. Complex,
Lodi Road,
New Delhi-110 003.

Dr. P.G. Lavakare — Membe
Adviser,
Department of Science & Technology,
Technology Bhawan, New Mehrauli Road,
New Delhi.

Dr. G.D. Sootha — Membe
Adviser,
Department of Non-Conventional
Energy Sources,
Paryavaran Bhawan, C.G.O. Complex,
Lodi Road,
New Delhi-110 003.

Director
G.B Pant Institute of Himalayan
Environment and Development,
Kosi, Almora 263643.

Convenor

Subrat Sharma

S.S. Samant (w.e.f. 11.1.91)

Uppeandra Dhar (w.e.f. 6.11.90)

10. SCIENTIFIC PERSONNEL & ADMINISTRATION

Prof. A.N. Purohit - Director
(w.e.f. 7.8.1990)

Scientific:

A.K. Gangwar

B.P. Kothyari

Dhrupad Choudhury (w.e.f. 11.3.91)

D.S. Rawat

Eklabya Sharma

K.G. Saxena

Kireet Kumar (w.e.f. 28.2.91)

K.S. Rao

Nehal A. Farooque (w.e.f. 4.3.91)

P.K. Samal (w.e.f. 31.1.91)

R.C. Prasad

R.K. Maikhuri

R.C. Sundriyal

R. Swarup

S.C. Joshi (w.e.f. 19.2.91)

S.C. Rai

S.C. Ram

Administration:

Anil Joshi - Administrative Officer (w.e.f. 12.11.1990)

P.S. Kaira - Public Relations Officer

11. AUDIT CERTIFICATE

I have examined the Accounts and the Balance Sheet of Govind Ballabh Pant Himalaya Paryavaran Evam Vikas Sansthan, Kosi-Katarmal, Almora, for the year ending 31st March, 1991. I have obtained all the information and explanations that I have required and I Certify, that as a result of my audit, in my opinion, these Accounts and Balance Sheet are properly drawn up so as to exhibit a true and fair view of the state of affairs of the Institute according to the best of my information and explanations given to me and as shown by the books of the organisation.

sd/-
(Rajesh Sethi)
Partner
for J.C. Bhalla & Co.,
Chartered Accountants,

Place: New Delhi
Dated: 8.7.1991

G.B. Pant Institute of Himalayan Environment & Development,
Kosi-Katarmal, Almora - 263 643 (U.P.)

Receipts & Payments Account for the year ending 31st March 1991

Receipts			Payments	
Opening Balance:			Salary to staff	1076632.56
Cash in hand	9421.85		T.A. (Officials)	82083.30
Advances	29068.64		T.A. (Non officials)	59859.60
			Wages	48963.70
Balance in bank:			Postage	25459.80
			Stationery	38388.27
-CSIR	870.00		Petrol/fuel	146301.05
-DST (RW)*	100000.00		Telephone	11135.25
		139360.49	Electricity and water charges	29875.60
			Vehicle repair and maintenance	130357.07
ME & F			Hospitality	15539.16
		8580000.00	Building maintenance	60901.70
			Rent and taxes	21600.00
-DST (WS)**	25000.00		Advertisement	4251.00
-DST (SF)***	195000.00		Office contingencies	85643.79
			Research and development	566648.57
		220000.00	Workshop/Seminar	1339.50
			Printing charges	182277.00
Grants from CSIR		37600.00	DST (WS) expenses	29271.23
			DST (RW) expenses	37216.24
Miscellaneous receipts on account of:			DST (SF) expenses	1605.00
license fee for residential accomodation	5030.00		CSIR expenses	32288.00
personal use of telephone expenses	643.00		Office equipments	171210.10
personal use of staff car	881.00		Library	447575.65
excess insurance paid	191.00		Lab equipments	1158295.05
			Furnitures & Fixtures	38863.30
excess payment in scope Workshop	2460.00		Deposit with CCU for construction	600000.00
lodging charges for transient stay	40.50		Money deposited with Sp. L.A.O.	
excess wages paid	186.00		for acquisition of land	80000.00
miscellaneous	80.00			
		9511.50	Cash and Bank balances:	
			Cash in hand	7955.66
*(RW) : Rain water Harvesting Project			CBI	1319.85
**(WS) : Workshop			SBI (for LCs & Margin money)	3503640.00
***(SF) : Soil Fertility Projects			SBI	21279.83
			CBI (DST - RW)	30783.76
			CBI (DST - SF)	118395.00
			CBI (CSIR)	2300.00
			Advances:	
			To staff	6334.40
			DST (RW)	32000.00
			DST (SF)	75000.00
			CSIR	3882.00
Total		8986471.99	Total	8986471.99

Dated: 8.7.91

Sd/-
(Rajesh Sethi)
Partner
for J.C. Bhalla & Co.
Chartered Accountants

Sd/-
Anil Joshi
Administrative Officer
(Drawing & Disbursing Officer)

Sd/-
A.N.Purohit
(Director)

Sd/-
K.G.Saxena
(Scientist-C & Officer Incharge)

G.B. Pant Institute of Himalayan Environment & Development
Kosi-Katarmal, Almora (U.P.)

Balance Sheet as on 31st March, 1991

Liabilities	As on 31.3.90	During 1990-91	As on 31.3.91	Assets	As on 31.3.90	During 1990-91	As on 31.3.9
				Office Equipments	417644.98	171210.10	588855.0
Balance as per last				Furnitures & Fixtures	959623.32	38863.30	998486.6
Balance Sheet	6140912.63		6140912.63	Vehicles	649186.78	-	649186.7
				Library	656745.61	447575.65	1104321.2
During the year received				Building	2713848.10	-	2713848.1
				Laboratory	690223.35	1158295.05	1848518.4
-From ME & F		8580000.00	8580000.00	Deposit with CCU for			
-From DST	100000.00	220000.00	320000.00	construction	-	600000.00	600000.0
-From CSIR	870.00	37600.00	38470.00	Deposit with Sp L.A.O for land acquisition	-	80000.00	80000.0
				Security deposit	15150.00	-	15150.0
			15079382.63	Advances			117216.4
				Cash at Bank			3677718.4
Less: Excess of Expenditure				Cash in hand			7955.6
over Income			2678125.89				
Total			12401256.74	Total			12401256.74

Dated: 8.7.91

Sd/-
Anil Joshi
Administrative Officer
(Drawing & Disbursing Officer)

Sd/-
(Rajesh Sethi)
Partner
for J.C. Bhalla & Co.
Chartered Accountants

Sd/=
K.G.Saxena
(Scientist-C & Officer - Incharge)

Sd/-
A.N.Purohit
(Director)

G.B. Pant Institute of Himalayan Environment & Development
Kosi- Katarmal, Almora (U.P.)
Income & Expenditure Account for the year ended 31.3.1991

Expenditure			Income		
To	Salary	1076632.56	By	Miscellaneous receipts	9511.50
"	T.A. (Officials)	82083.30		Excess of Expenditure over Income	2678125.89
"	T.A. (Non officials)	59859.60			
"	Wages	48963.70			
"	Postage	25459.80			
"	Stationery	38388.27			
"	Petrol/fuel	146301.05			
"	Telephone	11135.25			
"	Electricity and water charges	29875.60			
"	Vehicle repairs and maintenance	130357.07			
"	Hospitality	15539.16			
"	Building maintenance	60901.70			
"	Rent and taxes	21600.00			
"	Advertisement	4251.00			
"	Office contingencies	85643.79			
"	Research & Development	566648.57			
"	Workshop/Seminar	1339.50			
"	Printing charges	182277.00			
"	DST (WS) expenses	29271.23			
"	DST (RW) expenses	37216.24			
"	DST (SF) expenses	1605.00			
"	CSIR expenses	32288.00			
	Total	2687637.39	Total		2687637.39

Notes:

(1) All items of income as well as expenditure are accounted for on cash basis

(2) Till 31st March 1990, Research & Development expenses - Both Revenue & Capital - were being debited to the Income, & Expenditure Account. However, in the current year, this policy has been changed and only expenses of revenue nature have been debited to the Income & Expenditure Account.

Dated: 8.7.91

Sd/-
Anil Joshi
Administrative Officer
(Drawing & Disbursing Officer)

Sd/-
(Rajesh Sethi)
Partner
for J.C. Bhalla & Co.
Chartered Accountants

Sd/=
K.G.Saxena
(Scientist-C & Officer - Incharge)

Sd/-
A.N.Purohit
(Director)