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Status of Resource Utilization and Management: A Study of Chenani Watershed (J & K)

Jasbir Singh

University of Jammu, Jammu

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FINAL REPORT OF A PROJECT
ON

STATUS OF RESOURCE UTILISATION AND MANAGEMENT: A STUDY OF CHENANI WATERSHED (J&K)

Research Team

Principal Investigators
Dr. Jasbir Singh
Consultant
Sanjay Sharma Goswamy

Research Investigators
Narinder Deep Singh
Rakesh Sharma
Dr. Rachana Dutt

Indira Gandhi Institute Of Development Research, Mumbai

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Jasbir Singh

University of Jammu, Jammu

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Dr. Jasbir Singh

EXECUTIVE SUMMARY

According to a report of National Remote Sensing Agency (NRSA), in collaboration with National Wasteland Development Board (NWDB), Govt. of India, Udhampur district of J&K state was identified along with 147 other district from all over the country, of having more than 17 percent of their total geographical area under wastelands. These wastelands possess a great potential for mitigating the biomass requirement of the people if put to optimal and judicious use. On the basis of this report an Integrated wasteland Development Project for Chenani wasteland of district Udhampur, J&K was started by Forest Department, J&K Government in the year 1992-97 as a centrally sponsored scheme with the help of NWDB. In this project various development works for the conservation and regeneration of natural resources along with management of wastelands were executed in 30 microwatershed selected from 24589 hectares of Chenani Watershed. The total financial outlay for these activities was Rs 229.50 Lakhs.

The present study was undertaken for estimating the present status and condition of natural resources i.e. after the completion of Watershed Development Project, and its comparison with the status and condition of natural resources before the onset of this Project i.e. in the year 1991 which is considered as base year in this study. Moreover in this study efforts were made to make comparisons between areas where Watershed Development Project was implemented (P.A.), and areas where no such project was undertaken (NPA), regarding Land use pattern, carrying capacity and condition of natural resources. The present study was done with the following objectives:-

a) To prepare the inventory of the natural resources available in the study area.

b) To make an assessment of carrying capacity of the area.

c) To assess the extent of efficient management in enhancing the carrying capacity of the study area.

For fulfilling these objectives 15 micro watersheds each were randomly selected from the project area (PA) and non project area respectively, i.e. in all a total of 30

micro watersheds were selected. For primary data collection 10 households each, drawn randomly from each micro watershed, were taken. The total sample size was 300 households which is nearly 4 percent of the total population size. (Table 2.1) with the help of primary data variables like education, income, employment, consumption/ requirement of fuel, fodder etc., production potential of agricultural land, posture lands etc were evaluated. For the estimation of variables like total study area, land use pattern, status and condition of natural resources, their production potential etc. more extensive as well as authenticated information was required therefore satellite image and CD ROM of the study area for both the base year and the current year were procured from National Remote Sensing Agency (NRSA), Hyderabad. The analysis of both the primary as well as secondary data was done by using simple averages, frequencies and percentages as analytical tools.

Geographically the study area was trapezoidal in shape with boundaries stretching between Patnitop ridge on the North, Ladhadhar on West, Shivgarh Dhar on East and Dhar Gaddian on South. The total study areas is almost reniform in its outline and consists of moderate to very steep slopes with elevation varying from 1122m at Chenani, 2450m at Natha top and 2806m above Mean Sea Level at Shivgarh Dhar. The demographic features of the study were that the human population was 50845 persons out of which 61.8 percent lived in PA & the remaining 38.2 in NPA respectively (Table 3.3). The livestock population in the study area was estimated to be 67649 animal heads. The literacy level of the study area 57.3 percent, which is, considered as good level. In the study area nearly 41.7 percent of total population was living Below Poverty Line i.e. having income below Rs 25000 per annum for a family of five members. (Table 3.6). The employment level was very low i.e. only 24.6 percent of people in the age group of 18-60 years were employed and the major employment provides in the study area is agriculture sector with 90 percent of the people in the age group of 18-60, engaged in it.

From the analysis of Satellite Images the total study area was estimated to be 24753.2 hectare of which 14645.9 hectare area falls under Project Area and the remaining 10107.3 hectare in Non project area (Table 4.1). In the study area nearly 37.8 percent of total area was under agricultural use, forests occupied roughly 35.2

percent of total area, scrub lands had 24 percent area, whereas 2.9 percent of the total study area was under drainage systems.

Forests were categorised on the basis of crown density into three classes i.e.

a) Dense forests- Having crown density of more than 40%

b) Moderate /open forest- Having crown density between 10 to 40 percent

c) Degraded forest- Having crown density of less than 40 percent .

The dense forest occupy nearly 60 percent of the study area out of which only 18.6 percent dense forests were in PA and the remaining 81.4 percent in NPA respectively. Moderate/ open forests had appropriately 27 percent of total forest area under them whereas degraded forests occupied 12.9 percent of the total forest area respectively.

The scrub lands were categorised into three classes on the basis of green biomass density. The dense scrub occupied nearly 60.3 percent of the total scrub area, thin scrub area occupied 30.6 percent whereas degraded scrub area occupied 9.1 percent of the total scrub area respectively. (Table 4.6). The comparisons made between the land use pattern in the year 1991 and 2000 showed that forest area had decreased in the current year from the base year. The area under dense forests and moderate forest had also decreased whereas the area under degraded forest had increased in the current year. It can be observed that the immense pressure on forest for fuel wood, timber and fodder had led to their over exploitation and conversion of dense and moderate forest into degraded forests. The comparison of agricultural area in both the year shows that area under agriculture had increased in the current year from the base year. It was observed that an increase in agricultural area was due to an increase in the population size and lack of employment opportunities in this area. In the absence of alternative employment avenues people have remained dependent upon agriculture for their livelihood. As a result many of forest lands and community lands had been brought under agricultural use thereby leaving little or no scope for their regeneration and replenishment. The comparison of scrub area between 1991 and 2000 shows an increase in dense, thin and degraded scrubs by 4.2 percent, 20.3 percent and 38.7 percent respectively.

In the present year the area under dense and moderate forests decreased considerably in both the PA & NPA whereas the area under degraded forests increased in PA & NPA during this period. The area under agriculture increased in the present year, both in PA as well as in NPA. This increase was estimated to be 105 hectare in PA, 406.4 hectare in NPA and an overall increase of 511.4 hectare for total study area i.e. 5.8 percent increase from the base year. The increase of agricultural area in PA was very less when compared with increase in NPA respectively. The area under scrub lands increased by 11.3 percent i.e. 605.2 hectare from the base year. The increase is scrub area was estimated to be 429.9 hectare in PA whereas 175.3 hectare in NPA respectively. All the three classes of scrub type i.e. dense, thin and degraded scrub showed and increasing trend, as more and more forest area is being converted into scrub area due to over exploitation of forest resources by ever increasing population size and demand. The area under drainage system decreased by 8.2 percent i.e. 65.4 hectare when compared with the base year. The major decrease of drainage area is in NPA i.e. 47.9 hectare, whereas it was 17.5 hectare decrease in PA for the same period.

The carrying capacity is defined as the highest population of any society that an ecosystem can sustain over an indefinite period of time. In the first phase of estimation of carrying capacity, production capacity of the study area was estimated in terms of:

a) Fuel wood production capacity

b) Fodder production capacity

c) Timber production capacity

d) Resin production capacity

e) Agricultural production capacity

Then in the second phase carrying capacity with production capacity was estimated on the basis of per person (TFP), per cattlehead (fodder) and per household (fuelwood) of the study area. The fuelwood production capacity of the study area was estimated to be 11807.8 M.T/ yr in a sustainable manner. The forests provide

55.5 percent of this total production whereas agricultural lands and scrub lands provide nearly 39.6 percent and 5 percent of this total fuelwood production respectively. (Table 5.1). The total fuelwood production in the study area was found to be short of the total fuelwood requirement by 43.4 percent i.e. a deficit of 9059.2 M.T/yr . (Table 5.3) The alternative sources of fuel like LPG, kerosene oil etc. were used by very few people due to their limited availability and high cost when compared with fuelwood. (Table5.2).

The carrying capacity of the study area in terms of fuelwood was estimated to be far less than the actual requirement of the fuelwood in this area (Table 5.4). This was due the fact that the production capacity of the study area of fuelwood had decreased in the current year as compared to the base year. Moreover, the increase in the population during this period had also aggravated the problem. The decrease in carrying capacity of fuelwood in NPA was more as compared to PA during this period. The total fodder production capacity of the study area was estimated to be 118563.8 MT/yr which falls short of the total fodder requirement by 203881.7 M.T/yr. (Table 5.5 & 5.6).

The carrying capacity in terms of fodder was also less than the actual requirement of the fodder in the study area as estimated by set standards of Animal Husbandry Department, J&K Government. The existing carrying capacity could support or feed only 22.7 percent of the total animal population of the study area. The carrying capacity of fodder in PA was higher as compared to NPA, as in PA more agricultural areas were under fodder crops (Table 5.7).

The timber production capacity of the study area was estimated to be 159501.5cu. ft/ yr whereas the resin production capacity was estimated to be 3961.3 kilolitres/ yr out of which 1101.8 kilolitres resin was produced in PA & 2859.5 kilolitre in NPA respectively (Table 5.10 & 5.11).

The agricultural production capacity in the study area was found to be very low when compared with Average National Production of crops due to various reason like lack of irrigation facilities poor status of land resources and high level of poverty. The major crops in the study area were Maize, wheat, Barely, Oilseeds, fodder crops etc. The total foodgrain production (TFP) in the year 2000 was estimated to be 6856.04

M.T out of which 5116.34 M.T of TFP was produced in the PA whereas 1739.7 M.T in NPA respectively (Table 5.8).

Due to low agricultural production, the carrying capacity was also very low i.e. it could support only 70.2 percent of the total population and the rest 29.8 percent of the population was creating burden on the carrying capacity. The carrying capacity of the PA was better than NPA as it could support 84.8 percent of its total population whereas NPA could support only 25.4 percent of its total population from the existing production of foodgrains (Table 5.9).

Comparison of carrying capacity of the resources for the base and the current year showed that the production capacity of resources like forests and scrub lands have decreased considerably whereas the production capacity from agricultural lands have increased in the current year but the main reason for this increase is the increase in the area under agriculture.

The production capacity of natural resources in terms of fuelwood, timber and resin has decreased by 3.9 percent, 8.7 percent and 10.8 percent from the base year respectively. The production capacity in terms of fodder and total foodgrain production increased by 10.5 percent and 4.8 percent from the base year, respectively. (Table 5.9 & 5.10).

The water situation in the study area varies from sufficient to scarce status from one MWS to another or within the same MWS. The micro water sheds, were adjusted or given status of sufficient, partially available and scarce, on the basis of availability of water in these areas. It was found that water for drinking and consumption purposes was sufficient in 21 micro watersheds i.e. nearly 70 percent of total study area had sufficient drinking water whereas scarcity of drinking water existed in 2 micro watersheds and the rest 7 micro watersheds were having partial availability of water. Water for irrigation purposes was scarce in 22 micro watersheds and only 3 micro watersheds were having sufficient water for irrigation. (Table 5.16).

Inventory of natural resources i.e. list of physical resources along with their monetary value at a particular period of time, was made for both the current as well as base year to estimate the change in the value of resources in the study area, over a period of time.

For inventory preparation current market prices existing in the study area were used for valuation of each resources along with the products it produced. The products produced include fuelwood, fodder Timber, Resin, agricultural crops etc. The total value of natural resources in the study area during the year 2000 was estimated to be Rs 232883 lakhs.

The forest were valued at Rs 209997.8 lakhs which accounts for nearly 90 percent of the total value of resources. Agriculture lands and products contributed nearly 8 percent i.e. 18984.3 lakhs of the total valuation of resources whereas scrub areas were having 2 percent i.e. 3900.9 share in total valuation. (Table 6.14)

The comparison of inventories of natural resources in the base year (1991) and the current year (2000) were made and it was concluded that value of forests and its products have decreased significantly by Rs 39856.1 lakh in the current year. The value of agricultural land and products have increased by Rs 1579.6 lakhs and the value of scrub lands & products increased by Rs 1230 lakhs in the current year. But the overall value of resources in the current year fell by Rs 37046.5 lakhs from the base year. The decrease in value of resources in PA was Rs 14595.2 lakhs which is quite less than the decrease in value of resources in NPA to the tune of Rs 23365.4 lakhs respectively. (Table 6.15) Keeping in mind the deteriorating condition of natural resources which is severely affecting the carrying capacity as well as the value of the natural resources, various management practices were suggested for efficient conservation and improvement of status and condition of natural resources. These management measures help in reducing the burden of natural resources by improving the carrying capacity moreover will also help in generating stake holder's participation in various conservation and development works for natural resources. Various agronomical, vegetative and mechanical measures were given according to their practical feasibility in the study area. (Chapter 5)

In the end of the study conclusions were drawn and policy implications for framing watershed development Projects, were given so as to make these more efficient ,effective and beneficial for all those for whom these projects are meant.

Conclusions

From this study it could be safely concluded that the condition of natural resources in the study area in general and PA in particular was very poor. The major reasons being poor production capacity of natural resources, higher population pressure and poor management of these resources regarding their maintenance and use. As these problems were more severe in PA, therefore, one Watershed Development Programme on a small scale i.e. covering only 3300 Ha which is only 22 percent of the total PA was started in this area with the Central Govt. assistance by the Forest Department Of J&K. Various activities for conservation, regeneration and effective management of natural resources were undertaken during this programme. This programme had improved the conditions of natural resources in this area along with improving their production capacity by generating awareness among local population regarding effective management, use and benefit sharing from these resources. These measures would certainly help in improving the status and conditions of natural resources of this area in the years to come.

Due to ever increasing population in the study area problems like increasing demands of fuelwood, fodder and foodgrains had exerted significant burden on carrying capacity of natural resources of this area resulting in their over exploitation and degradation. But still when we compare the status and condition of natural resources in the PA and NPA during the base year (1991) and the current year (2000) we could analyse that the problems like decrease in the forest area, increase in agricultural area, and increase in scrub area was less in project area than NPA. Moreover the carrying capacity of natural resources in terms of foodgrains and fodder was better in PA than NPA. The decrease in the value of natural resources in the PA was very less as compared with NPA.

CONTENTS

Chapter I : INTRODUCTION

Land and water are finite natural resources, which provide food, fuel, fodder, minerals and so many other useful things. Land and water are put to a variety of uses. The applications and uses of both of these resources are in competition with each other. In a country like India where food production is the basic activity, soil requires to be rich in nutrients with assured availability at various stages of production. The conservation of soil and water, and retaining soil moisture are extremely important for creating green cover on wastelands, thick forests, increased availability of moisture in the soils with nutrients rich good quality soils and more infiltration of water in the ground thereby raising the water table. It enables to retain more of the rainwater and reduce the discharge into sea. It creates a healthier and richer ecological balance.

In India the importance of these two natural resources i.e. land and water can be judged from this fact that nearly 65 percent of our total population is dependent upon agriculture for its livelihood and agriculture contributes 26 percent of total GDP. Out of this total agricultural land, 65 percent of agriculture is rain dependant and it contributes about 44 percent food and supports 40 percent human and 60 percent of livestock population. Therefore conservation of these resources is must for their sustainable use (Shanker, Vinay-1999).

But conservation of land and water has badly suffered after independence. The quest for economic development to provide food, fuel, clothing housing, education and healthcare etc. to ever growing population without being conscious of and taking into consideration the adverse effects that could be produced by thoughtless development process have resulted in exerting tremendous pressure on natural resources, particularly on land and water. As more land was required for agriculture and other uses for the growing population, marginal lands which were earlier used for growing village forests and reserved as protected forests got diverted to housing, producing food, building, irrigation, dams and mining. Consequently, the major forest reserved and protected forests have steadily been lost.

There can be number of approaches to natural resources conservation. These approaches could be sectoral. However, experience has shown that with the

conservation of all natural resources the problems of poverty, unemployment and equality has been addressed very well. The soil and water conservation are organically linked to each other and their conservation must slow down and reverse the degradation of environment and lay down the foundation of sustainable production from all types of land crop lands and non-arable lands.

Water resource utilisation and soil conservation through an integrated approach is a key to sustainable production of food, fibre, fodder and fuel and meaning fully addresses the social, economic and other concerns of the rural people. However, this approach should not be viewed as merely an anti-erosion and anti-run-off approach of land and water resources management, designed to regenerate a lush green cover. It is a comprehensive approach integrating all the relevant scientific approaches. It must increase rural employment and income through dry land farming, horticulture, agro forestry, biomass production and animal husbandry in the area under study. It should also provide fodder and fuel for the livestock and masses.

In past, it has been observed that individual components by themselves could not result in an increased crop yields. It is necessary to ensure that the village community internalise the context, design and execution of the project and this is a requirement that is not simple to achieve. Hence, the concept of Integrated Watershed Development Programme (IWDP) has been propagated. This programme is not just a strategy for enhancing the natural capital to bring the degraded land back to its optimal level of biomass production through the use of appropriate soil and moisture conservation technology but also to improve socio-economic, institutional, individual and societal behavioural aspects.

The unique integration of natural resources, human resources, sectoral activities in agriculture, horticulture, pastureland, silvi-pasture culture and forestry innovative approach to community involvement in all aspects of the project for planning, implementation and maintenance, expected outputs and benefits, technology and implementation strategy makes Watershed Development Programme superior to any other developmental programme (Shankar. V, 1999). A Watershed Development Programme seeks to integrate the conservation of natural resources i.e. soil, water

and biological system with the process of comprehensive development of rural areas comprising the watershed.

A watershed is primarily a hydrological unit-draining run off water at a common point and is demarcated based on the ridge and gully lines. The programmes under watershed approach broadly fall into soil and water conservation, dry land farming and rainfed farming, ravine reclamation, control of shifting cultivation and improvement in the vegetative cover. The basic objective is to increase production and availability of food, fodder and fuel, restore ecological balance, improve the economic status of the farmers and rural communities, and generate sustainable rural employment opportunities. Thus in this programme all aspects are considered, addressed and improved upon for overall development of the area.

1.1 NEED FOR CONSERVATION APPROACH

The environment crisis today is not just local, scattered here and there but global multidimensional. It encompasses a long list of continuing and urgent problems like global warming, depletion of ozone layer, extinction of species, loss of genetic diversity, land degradation, contamination of ground water, acid rain, depletion of fisheries and so on. In India, the depletion and degradation of natural resources is found to be more because of over population, poverty, poor management and ignorance towards their importance among masses. Depletion and degradation means, reduction or loss, of the biological or economic productivity in arid, semi-arid and dry sub humid areas, and complexity of rainfed crop land, irrigated crop land, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns such as soil erosion caused by wind or water, deterioration of the physical, chemical or biological or economic properties of soil and long term loss of natural vegetation.

Out of the total geographical area of 329 m ha an area of about 150 million hectares is subjected to water or wind erosion. Compared to this, a net area of about 140 million hectares is cropped at present. It is estimated that 53.3 percent of total geographical area of the country is subject to various erosion and land degradation problems like saline alkali soil, waterlogged areas, ravenous and gullied lands, area

under shifting cultivation, desertification, etc. out of a total geographical area of 329 m ha about 127 m ha are affected by serious problems of soil erosion. Soil erosion leads to far-ranging impacts like formation of gullies and floods causing damages to farm lands and villages, drop in flow during the dry season, consequent loss crops, siltation of reservoirs and canals. The continuous land degradation by soil erosion is degrading the production base and destroying balance between land – water – plant-human –animal systems. This has resulted into economic insecurity and ecological imbalance. It has been estimated that sheet and rill erosion takes place at the rate of 4-10 tons/ha/year in red soil, 17-43/ha/year in black soil and 4-14 tons/ha/year in alluvial soils. Gully erosion has resulted in 33-tons/ha/year soil loss in ravine areas. Hillside erosion in landslide area results in 80-tons/ha/year soil loss. Erosion occurs in agricultural lands, construction sites, roadways, disturbed lands, surface mines and in areas where natural or geologic disturbances take place. The deposition of eroded sediments takes place at the base of concave slopes, strips of vegetation, flood plains and reservoirs. Sediments deposit due to reduction in the flow velocity. In recent analysis of annual soil erosion rates in India was estimated that about 5334 million tons (16.35 tons/ha) of soil is detached annually due to agriculture and associated activities. Out of this 1600 million tonnes was permanently lost in the sea. The average soil loss was estimated to be 16t/ha both from mild and steep slops. Alongwith soil nutrients to the extent of 8.4 million tons of NPK were lost annually. Streams, rivulets and rivers carry about 2052 million tons, of which 1572 millions tons (29 percent of the total eroded soil) are carried away by various rivers into the sea every year and 480 million tons (10 percent of the total; eroded soil) are being deposited in various reservoirs (Rajoura, Rajesh-2002).

Moreover, India loses nearly 180 m ha m water due to runoff and 120 m ha m water flows into sea despite the fact that we have 65 percent of agriculture unirrigated, 30 percent of our land is drought prone and 200 million people do not have access to safe drinking water (Shankar. V.-1999).

If this trend continues, the ecological and economic consequences that follow in terms of soil degradation, large tracts of barren lands, shortage of forests products like fodder, fuelwood, timber and resin etc. would have tremendous adverse impact on the livelihood of large number of people, who are directly or indirectly dependent

upon these resources. Therefore preventing further degradation, protecting and regenerating degraded forests, sustainable use of these resources for meeting essential requirements can act as a source of enhanced income of local people through planned production and management approach which would help in effective development of these areas in the near future.

1.2 BACKGROUND OF WATERSHED APPROACH

Watershed development has been conceived as a strategy for protecting the livelihoods of the people inhabiting the fragile eco-systems, experiencing social erosion and moisture stress. The basic aim was to ensure the availability of drinking water, fuelwood and fodder and raise income and employment for farmers and landless labourers through improvements in agricultural production and productivity. Since 1930's watershed approach has been followed for the development of agriculture and rural areas. In the early years Dry Farming Research Station and Demonstration Centres were established and special thrust was given to soil conservation and water harvesting.

The *Sukhomajri* village experiment is the first and most well known model of micro-watershed development through efficient watershed management in India. This village located in *Pinjor* range of lower *Shivaliks* with 87 households and a population of 570 people, was selected for Ford Foundation Financed Operational Research Project in the year 1975 by the Chandigarh Center of the Central Soil and Water Conservation Research and Training Institute, Dehradun.

The large-scale denudation of hills resulting in siltation at an alarming rate of *Sukhna* Lake, poor condition and productivity of agricultural lands, forest lands and high rate of soil erosion in this area resulted in its adoption for development and conservation of natural resources on watershed basis. Various measures like construction of 10 earthen dams, soil conservation measures, water harvesting measures were taken up in this project with people's participation.

The economic benefits other than environmental benefit due to this project were that the total foodgrain production increased from 45 to 185 tonnes per year, fodder production increased from 73 tonnes to 317 tonnes per year and the milk production increased from 248 litres to 1200 litres per day. The entire project cost was

recovered in three years from increased agricultural production. This project helped in converting the denuded areas into greenery, checking siltation problem by bringing the siltation rate down from 150 tonnes per year in 1974 to 14.7 tonnes per year in 1989 and increasing the water storage capacity to 45,24,00 m^3 and providing irrigation facility to 181.9 ha of farm lands located in the valley area. Nearly 95.6 ha of forest catchment area were treated for soil and water conservation measures(Arya, Suman Lata & Samra, J.S. -2001).

Following the footsteps of *Sukhomajri* experiment many watershed development programmes in different areas were launched. In seventies various programmes like Drought Prone Area Programme (DPAP) in 1973 and Desert Development Programme (DDP) in 1977 were launched for controlling the desert expansion and maintaining ecological balance along with improving the productivity of land in different areas.

The central soil and water conservation research and training institute (CSWCRTI), Dehradun initiated work on watershed management from mid-fifties. The concept of community participation for sustainable development of watershed resources was implemented in four villages in location in the 1980's with the financial assistance of ministry of agriculture and some of state agriculture universities were also made partners in the programme. Some of the Non-Government Organisations (NGOs) also pooled these resources for demonstrating people's participation and large scale programme were initiated during the nineties (Samra. J.S.-1997).

Based on the experience gained during the sixth plan (1982-87) through a pilot project spread over 19 watershed in the country, national watershed development project for Rainfed Areas (NWDPRA) was launched during the seventh five year plan in 99 selected watersheds of the country. The emphasis was on increasing crop production of arable lands. During this period funds were not provided for non-arable lands. During the Eighth Five Year Plan the scheme was modified to provide a single window financing for both arable and non-arable lands, with 100 percent finance (75 % grant and 25 % loan). Union territories without legislature, received 100 percent grant in aid. The allocation during Eighth Five Year Plan was Rs. 11,000 crores spread over, 2479 watersheds covering 350 districts located in 25 States and 2 Union Territories. Community development blocks having less than 30 percent of

arable land under assured irrigation were qualified for inclusion in the project (P.L. Sanjeeva Reddy, P.L. & K. Prasada Rao - 1999).

Ultimately an integrated approach to watershed programmes as a strategy for overall development of rain fed areas was initiated during the period 1975 and 1983 with the launching of three pilot projects financed by World Bank and International Development Association to develop agriculture in regions where assured irrigation were not existing. Integrated Watershed Development Programme (IWDP) is working as a movement for overall development of rural areas in the country since Seventh Five Year Plan (1985-90). By 1984-85 work was launched in 4400 micro-watersheds covering an area of 4.2 m ha. The type of works undertaken in this programme included rainwater harvesting, in-situ conservation of water, checking soil erosion through vegetative measures, land levelling, contour bunding and construction of terraces, improvement of crops, fodder and animal, horticultural development, afforestation etc. By the Ninth Five-Year Plan (1997-2002) various Ministries of Government of India, State Governments, Non-Government Organisations, Multilateral Financial Institutions and International Funding Agencies have been associated with the implementation of the Watershed Development Programmes in India.

Watershed Development Programme is being implemented all over the country producing excellent demonstration of the potential of local resources and potential of people to develop and manage them. Up to May 2000, there were 320 IWDP Projects running in 25 states covering 22.96 lakh hectares of area with a total outlay of Rs 1,056 crores, at various stages of implementation. These programmes were being implemented on watershed basis where all aspects are considered, addressed and improved upon for overall development of an area (India-2001).

The National Remote Sensing Agency (NRSA) in collaboration with National Wasteland Development Board (NWDB), Govt. of India identified 147 districts in the country, which have more than 17 percent of their total area under wastelands. Such wastelands possess a great potential of mitigating the biomass requirement of the people if put to optimal and judicious use. The Udhampur district of J&K was one of such districts with more than 17 percent of its area under wastelands. An Integrated Wasteland Development Project for Chenani Watershed (Udhampur district) was

formulated by J&K Forest Department during the year 1990 and was started as a centrally sponsored scheme with the help of NWDB, in 1992. The Chenani Watershed Development Project was executed in 30 micro watersheds drawn from 24589 ha of Chenani Watershed, Udhampur district with financial implication of 229.50 lakh for:

a. Conservation of ecologically fragile area of 3300 ha.

b. Regeneration and development of degraded forests in this degraded area.

The present study was undertaken for estimating the availability and condition of resources and their respective use over a period of time. As very limited information about natural resources, their condition and utilisation was available, therefore the present study was undertaken for estimating the status and condition of natural resources and changes in it over the period of time i.e., from 1991 to 2000. Hence, the study with following objective was initiated.

1.3 OBJECTIVES OF THE STUDY

The present study aims at investigating the following objectives:

1. To prepare the inventory of the natural resources available in the study area.

2. To make an assessment of carrying capacity of the area under study.

3. To assess the extent of efficient management in enhancing the carrying capacity of the study area.

1.4 LIMITATIONS OF THE STUDY

The study area was full of problems like poor road conditions, militancy and lack of up to date official records. There were only two metal roads i.e. NH 1A and *Chenani – Sudhmahadev* road and in rest of the areas all roads were either *Kuccha* or no roads at all existed. Moreover movement of vehicles and people is restricted in the odd hours due to militancy in this region.

The official records in government departments were not up to date and certain records were not available. Inspite of all these problems every effort has been made for making this study very realistic to the existing situation.

Chapter II : METHODOLOGY

2.1 SAMPLING DESIGN

2.1.1 Selection Of Micro-Watersheds And Villages

According to the objectives of the study a total of 30 micro-watersheds were randomly selected from the total study area on the basis of drainage map (Made from satellite images) of the area (A detailed drainage map of the study area is attached in the end of this chapter). From these 30 micro-watersheds, 15 micro-watersheds were selected from the project area (PA) i.e. area where Watershed Development Project was undertaken by the Department of Forests, Government of Jammu & Kashmir and the remaining 15 micro-watersheds were taken from Non Project Area (NPA) i.e. area where no such project has been undertaken. The maps showing the demarcation of the PA and NPA in the total study area (TSA), and the situation of all micro-watersheds selected are given at the end of this chapter. This was done to make the study a comparative one in terms of benefits of Watershed Development Project, improvement in the condition of natural resources and decrease in degradation level of natural resources. Therefore an equal number of micro-watersheds were selected from PA and NPA, which jointly formed the Total Study Area (TSA). In all 37 villages fall under these 30 micro-watersheds (Table-2.1). This includes 20 villages in 15 micro-watersheds in Project Area and 17 villages in 15 micro-watersheds in Non-Project Area.

2.1.2 Selection of Households

From these 30 micro-watersheds 10 households from each micro-watershed were selected on the basis of Stratified Simple Random Sampling Technique for primary data collection. In all a sample of 300 households was taken from a total of 7588 households in the study area, which comes to 4 percent of the total population. The 150 households each taken from PA and NPA accounted for 3.3 percent and 4.9 percent of the total households in these respective areas. (Table –2.1)

Table: 2.1
Size And Composition Of The Sample

S.No	Particulars	Project Area	Non-Project Area	Total Study Area
1.	No. of Watersheds Taken	15 (50%)	15 (50%)	30 (100%)
2.	No. of villages falling under WS	20 (54.1%)	17 (45.9%)	37 (100%)
3.	No. of households	4522 (59.6%)	3066 (40.4%)	7588 (100%)
4.	Households taken	150 (3.3%)* (50%)	150 (4.9%)* (50%)	300 (4%)* (100%)

Note: 1). * Stands For Percentage of The Total Households In The Area.

2). WS= Watershed.

2.2 DATA COLLECTION

2.2.1 Secondary Data

In the beginning, information about the study area was collected from the offices of Revenue Department, Forest Department, District Statistical Department of the J&K Government, Department of Animal Husbandry. The secondary data include information regarding area under the PA and NPA, land use pattern in these areas, land holdings, number of villages, number of households, total human as well as animal population, availability of fuel, fodder and other by-products of natural resources in the study area, pasture development and wastelands in the study area. Information regarding the activities of the Watershed Development Project like lists of plantations, fencing erected, seeds of grasses and legumes sown, soil conservation methods adopted and usufructs of the Project among the locals of the area, forest protection committees and people's participation in the project activities was also collected.

In order to authenticate/verify the secondary data collected from different sources the satellite images of the study area were acquired from NRSA, Hyderabad. The images of 1:50,000 scale along with CD-ROM for the years 1991-2000 helped in analysing the land use pattern/ land cover, types of waste lands, forest cover/types,

surface water resources, drainage pattern, potential ground water zones, soil types, and structural features. Slope /aspect is prepared using topographic contour information and metrological data. These images helped to make a clear picture of the study area regarding availability of natural resources and their existing condition. These images also helped in making comparisons between two years i.e., 1991 (Base year) and 2000 (Current year) in terms of area, condition (i.e. Dense, Moderate degraded etc) and level of degradation in different areas of the watershed.

2.2.2 Primary Data

The primary data are collected with the help of interview schedules regarding economic variables, consumption pattern of fuel, fodder, water and other by products of natural resources. Information regarding awareness among locals of natural resources conservation and their problems due to poor resource availability were also collected.

The details of economic variables collected are given below:

2.2.2.1 Education level

The information was collected under different heads like total number of minors, illiterates, level of education at primary, middle, matric, undergraduates, graduates and postgraduates in each household. From the collected data total literacy rate was calculated.

2.2.2.2 Income level

In order to calculate per household income from all sources i.e., agriculture, livestock, salary from jobs, (government as well as private), pensions, trade, labour, other sources annually were added so as to form total annual income of a family. The sample households were divided into different strata on the bases of their income level into four classes i.e.,

a. Below poverty line- income of less than Rs. 25000/year for a family of five members.

b. Rs. 25000-35000

c. Rs. 35000-50000

d. Rs. 50000 & above.

2.2.2.3 Employment level

Information regarding employment in various sectors like in government as well as private sectors, work in agriculture, trade, human labour (hiring out) etc was collected from all the households. This gave the details of the employment potential in various sectors.

2.2.2.4 Consumption Pattern Of Fuel Wood, Fodder & Water

Data pertaining to type of fuel used i.e., coal/coke, kerosene oil, electricity, fire wood, dung cakes, crop waste, LPG and others along with the source, distance covered for collection, frequency of collection and quantity consumed per month along with the purpose of use were collected. The average of the fuel consumed during a month in a particular area was multiplied with the total households in that area in order to calculate the total demand of the area under study.

Fodder requirement was calculated by multiplying per cattle head per day requirement (as per Animal Husbandry Deptt, J&K Government, Set Standards) by total number of cattle head of the study area.

Water requirement of the study area is calculated by multiplying the average per household requirement per day with total number of households in that area.

2.2.2.5 Carrying Capacity

The production capacity of various types of lands in terms of fodder, fuelwood and agriculture production was calculated. The over all average productivity of these goods from different categories of lands were multiplied with total area under respective categories of land for calculating the total production capacity. For estimating carrying capacity of the study area in terms of timber and resin, 15 sample plots of size 20 Mts x 20 Mts were laid in different categories of forests i.e. dense, moderate and degraded. From these sample plots total number of timber and resin producing trees, their species distribution in percentages, total number of

mature timber and resin producing trees and their production potential were calculated. Thereafter, averages of these were used for estimating total timber and resin production from the forest in the study area.

2.2.2.6 Inventory

Inventory of natural resources is the physical list of natural resources in an area with its monetary value at a particular period of time. For estimation of the inventory list of all the natural resources alongwith their production potential during a particular year, were made. Then in the second step its valuation was done by using current market prices and opportunity cost (in case of forest lands) of the resources.

2.3 DATA ANALYSIS

2.3.1 Analytical tools used:

Simple averages, frequencies and percentages were used for the analysis of the data collected both from conventional sources and satellite images.

Analysis of the conventional and Remote Sensing data was done for :

a. Calculating the total study area;

b. Estimating the present land use pattern and its comparison with the base year's land use pattern;

c. Estimating the present carrying capacity of the study area and its comparison with base year's carrying capacity to know the change in carrying capacity of the area due to over-exploitation and degradation of natural resources,

d. Preparing an inventory of the natural resources in both base year and current year to estimate the approximate difference in the value of natural resources during these years.

The detailed analysis of the above said variables is done separately for PA and NPA to estimate the comparative condition of resources and their carrying capacity respectively.

The difference between base year's and present year's land use pattern, carrying capacity and inventory of the natural resources is estimated in percentage increase or decrease from base year's value.

Economic variable like employment pattern, education level, income level and consumption pattern of fuelwood, fodder & water of the study area were calculated from the average sample households.

On the basis of the results deducted from the analysis of the data, various management practices were suggested for enhancing the carrying capacity of the study area, steps for improving the stake holder's participation in conservation of natural resources steps for avoiding environmental degradation due to poor management of agricultural and scrub lands. Some suggestions for better implementation of Watershed Development Programme in this area on the basis of shortcoming of the previous watershed programme were also being given.

Chapter III : AREA PROFILE

3.1 SITUATION AND TOPOGRAPHY OF THE AREA

The study area is situated on the South - South West facing aspect of *Patnitop – Nathatop – Shivgarh Dhar* ridge. The ridge separates it from *Chenab* valley and its upper part forms the catchment area of the project. The 30 micro watersheds selected from the study area were trapezoidal in shape with boundaries stretching between *Patnitop* ridge on the North, *Ladhadhar* on West, *Shivgarh Dhar* on East and *Dhar Gaddian* on South. The 24,753.2 hectares watershed area is almost reniform in its outline and consists of moderate to very steep slopes with elevation varying from 1122m at *Chenan*i, 2450m at *Natha* Top and 2806m above Mean Sea Level at *Shivgarh Dhar.*

3.2GEOLOGY & SOIL TYPE

The soils are clay to loam clay at lower reaches and are sandy clay at the upper reaches. The geology of the area consists of formations ranging from Pleistocene to Precambarian and comparing mostly of the clay and sandy deposits coarse grain, Quartizite, Granite, Phylites, Mica, Schist etc. Since the area falls in outer Himalayas the tectonic movements make the area very susceptible to the rock movement and soil erosion.

3.3 DRAINAGE

The project area almost forms a saucer shape structure with the river Tawi flowing through the centre of the watershed. The whole area is traversed by large number of *Nallahs* and *Khads,* the main being *Margana Nallah*, *Madda Nallah, Dewak Nallah, Sudh Mahadev Nallah, Deodi Nallah, Samroli Nallah, Trangori Khad, Nakalta Nallah*, etc. All these big and small *Nallahs* ultimately drain into river *Tawi* at different spots.

3.4 CLIMATE OF THE AREA

As the study area stretches from Sub tropical to temperate zones for great variability between the extent and amount of rainfall received and occurs between different parts of the study area. The total Mean Annual Rainfall in the area is 148.258 mm

and most of it is received in July, Aug & Sept. during summer while Jan & Feb. in winters. Winter Rains are Scanty and this shows great variability of the rainfall during *Rabi* season, which is crucial for important crops like wheat, mustard, gram etc. The rainfall pattern indicates possibilities of harvesting excess monsoon rainwater for its use during subsequent dry spells. (Table -3.1).

Table – 3.1: Total Rainfall (In Mm) Recorded At Udhampur For The Last Five Years

MONTH	*YEAR 1996*	*YEAR 1997*	*YEAR 1998*	*YEAR 1999*	*YEAR 2000*	*MONTHLY MEAN*
JANUARY	51.8	127.4	121.6	12.5	272.1	117.08
FEBRUARY	102.1	80.7	256.9	133.6	155.8	145.82
MARCH	311.4	119.9	280.2	126.9	176.6	203
APRIL	36.8	46.3	23.4	201.8	32.5	68.16
MAY	13.2	36.9	20.8	25	75	34.18
JUNE	98	72	104	92.2	18.6	76.96
JULY	849.6	494.6	394.8	237.9	354.6	466.3
AUGUST	417.8	163.3	321.9	250.6	416.2	313.96
SEPTEMBER	597	85.6	270	146.3	232.1	266.2
OCTOBER	6	11.2	32.7	7.4	12.4	13.94
NOVEMBER	8	10	7.5	0.7	25.8	10.4
DECEMBER	137	62.9	286.3	22.1	7.4	103.14
ANNUAL RAINFALL	219.0583	109.233	176.675	104.675	148.238	

SOURCE: Meterological Section (MET) Northern Area Control Centre, Air Force Station, Udhampur

Due to altitudinal variations ranging from 600-mtr to3000-mtr there is wide variation in temperature between various parts during different months. The temperature rise sometimes as high as 42 degree Celsius during June and July and very seldom its goes below 1.C during Dec, Jan. & Feb. (Table -3.2).

Table - 3.2 : Temperature Data Recorded At Udhampur Temperature in Degree Celsius

MONTH	*maxi. 1996*	*min. 1996*	*maxi. 1997*	*min. 1997*	*maxi. 1998*	*min. 1998*	*maxi. 1999*	*min. 1999*	*maxi. 2000*	min. 2000
January	19.6	5.5	17.4	2.5	20.8	5.9	17.8	3.5	17.7	5.2
February	22.4	6.5	20.4	4.4	18.6	6.5	19.7	7.2	3.6	5
March	23.9	10.1	23.7	9	22.5	8.1	27.2	10.4	23.3	8.8
April	33	16.3	29.7	12.7	30.2	14.3	27.3	13.6	20.4	14.3
May	39.1	22.6	35.8	20.6	37.6	24.3	35.2	22.5	31.8	22.7
June	38	22.8	31.7	21.5	31.5	23.5	34.5	23.5	32.7	23
July	30.3	22.8	31.7	21.5	31.5	23.5	34.5	23.5	32.7	23
August	31.1	22.1	31.3	21.4	30.4	22.6	30.7	22.5	32.7	23
September	30.8	19	32.2	11.3	30.2	20.8	20.9	20.5	30.4	19.1
October	29.9	11.6	30.9	12.2	27.8	12.9	29.4	11.3	29.4	12.8
November	25.8	6.8	25.3	6.2	25.4	7.5	24.2	6.3	24.1	7
December	20.1	4.2	19.4	4.6	19.3	4.3	19.5	5	21.1	4.1

SOURCE: Meterological Section (MET), Northern Area Control Centre, Air Force Station, Udhampur.

3.5 DEMOGRAPHIC FEATURES OF THE STUDY AREA

3.5.1 Area:

The total study area is estimated to be 24753.2 ha from which 14645.9 ha i.e. 59.2 percent of the total area falls in PA and the rest 10107.3 ha i.e. 40.8 percent of the total study area is NPA.

3.5.2 Population

The human population in the total study area is 50845 persons out of whom 31419 persons i.e. 61.8% percent of the total population lives in PA and the rest of 19456 persons i.e. 38.2 percent in NPA, respectively (Table –3.3).

Table: 3.3

Demographic Features

PARTICULARS	PA	NPA	TSA
Area (in ha.)	14645.9 (59.2%)	10107.3 (40.8%%)	24753.2 (100%)
Population (in persons)	31419 (61.8%)	19426 (38.2%)	50845 (100%)
Households	4522 (60.0%)	3066 (40.0%)	7588 (100%)
Livestock pop.	33682 (49.9%)	33814 (50.1%)	67469 (100%)
Households taken	150 (3.3%)	150 (4.9%)	300 (4.0%)

3.5.3 Livestock Population:

The livestock population in the study area is 67469 heads out of which 33682 heads were in Project Area and 33814 in Non-Project Area (Table-3.4). From the table it is clear that sheep alone account for 28 percent of the total livestock population and were maximum

in number. Cows and Bullocks come at the second and third place with 22.4 percent and 22.1 percent of the total livestock population, respectively.

TABLE: 3.4 : Details Of Livestock Population Of The Study Area (2000)

Animals (%Age)	Project Area	(%Age)	Non-Project	(%Age)	Total	
Buffalo's 12.3	3469	10.3	4859	14.4	8328	
Cows	8068	24.0	7027	20.8	15095	22.4
Bullocks	8231	24.4	6642	19.6	14873	22.1
Goats	4221	12.5	6067	17.9	10288	15.2
Sheep	9693	28.8	9219	27.3	18912	28.0
Grand Total	3682	100.00	33814	100.00	67469	100.00

3.6 SOCIO-ECONOMIC PROFILE OF THE STUDY AREA

3.6.1 Education Level

Out of the 300 households interviewed the literacy level came out to be 58.4 percent in the project area and 56.2 percent in non-project area of the Chenani Watershed. Only 12.1 percent of total population were above Matric level in the Project Area and in the Non-Project Area it was only 10.1 percent of the total population (Table –3.5). This indicates that the education level of the people was not so high in the area under study i.e., 57.3 percent.

Table: 3.5
Educational Level of the Study Area (Below 6 years)

Particulars	Minor		Illi.	Pri.	Mid.	Matric	Grad.	P.G.	Total
1. Project Area	138	363	341	216	138	6	3		1205
	(11.4%)	(30.1%)	(28.3)	(17.9%)	(11.5)	(0.5%)	(0.3%)		(100%)
2. Non-Project	187	357	409	164	117	7	1		1242
Area	(15.1%)	(28.7%)	(32.9%)	(13.2%)	(9.4)	(0.6%)	(0.1%)		(100%)
3. Total Study	**325**	**720**	**750**	**380**	**255**	**13**	**4**		**2447**
Area	(13.3%)	(29.4%)	(30.6%)	(15.5%)	(10.4%)	(0.5%)	(0.3%)		(100%)

3.6.2 Income Level

Income from all sources i.e. agriculture, livestock, salary from jobs (govt. as well as pvt.), pensions, trade and income from other sources were added up so as to form the total annual income of a family/household. Out of 150 households in the Project Area it was concluded that 58 households i.e., 38.7 percent of the population were having income below the poverty line and 35 households i.e., 23.3 percent of the population were living just above (near to) the poverty line level i.e., income between Rs.25000-35000. (Table -3.6).

In the Non Project Area out of a total of 150 households taken, 67 households i.e., 44.7 percent of the population were below poverty line and 31 households i.e., 20.7 percent of the population were just above the poverty line level.

On overall basis, in the study area nearly 123 households out of 300 households were living below the poverty line, which constitutes nearly 41.7 percent of the total population.

TABLE: 3.6

Income Level Of The Study Area. (In Rs.)

Particulars	Below 25000	25000-35000	35000-50000	Above 50000	Total HH
1. Project Area	58	35	30	27	150
	(38.7%)	(23.3%)	(20%)	(18%)	(100%)
2. Non Project	67	31	22	30	150
Area	(44.7%)	(20.7%)	(14.6%)	(20%)	(100%)
3. Total Study	**125**	**66**	**52**	**57**	**300**
Area	(41.7%)	(22%)	(17.3%)	(19%)	(100%)

3.6.3 Employment Pattern:

Information regarding employment in various sectors like government jobs, private jobs, agriculture, trade, labour etc. was collected from the selected households.

From the Table-3.7, it is concluded that in the Project Area, out of 697 persons between the age group of 18 – 60 years, 174 persons were employed i.e., nearly 25

percent of the population. The maximum employment was being provided by the government and private sector i.e., nearly 6.3 and 6.3 percent respectively.

In the Non-Project Area nearly 718 persons in the age group of 18 – 60 years, out of which 175 persons i.e., 24.4 percent of the population was employed in various sectors. Maximum employment was provided by government sector and agriculture sector i.e., 7.4 and 7.2 percent, respectively. Thus, in the study area out of 1416 person in the age group of 18– 60 years, only 349 persons i.e., 24.6 percent of the population were employed.

Table: 3.7

Employment Pattern Of The Study Area (Between 18 – 60 Years)

Particulars	Govt. job.	Pvt. Job	Trade	Labourer	Others	Total persons	Persons employed
1.Project Area	44	44	41	39	6	697	174
	(6.3%)	(6.3%)	(5.9%)	(5.6%)	(0.9%)	(100%)	(25%)
2. Non Project	53	37	33	52	---	718	175
Area	(7.4%)	(5.2%)	(4.6%)	(7.2%)	---	(100%)	(24.4%)
3. Total Study	**97**	**81**	**74**	**91**	**6**	**1416**	**349**
Area	(6.9%)	(5.7%)	(5.2%)	(6.4%)	(0.4%)	(100%)	(24.6%)

Chapter IV : LAND USE PATTERN

The land use/land cover map of the Chenani watershed (Year 1976) was delineated from the Topo- sheet of the area and then comparisons of land use/ land cover between the base year and the current year were made from the classified satellite images procured from NRSA, Hyderabad (Maps attached at the end of this chapter).

The total study area was calculated to be 24753.2 ha of which 14645.9 ha was Project Area i.e. the area where Watershed Development Programme had been implemented and the rest 10107.3 ha was in the Non-Project Area i.e., the area where no such programme had been launched. In the study area nearly 9347.9 ha of land was under agriculture i.e. nearly 37.8 percent of the total study area. Forests extended on 8717.5 ha of land with 35.2 percent of total study area, which was 2424.8 ha under Project Area & 6292.7 ha under Non-Project Area, respectively.

Scrub area included area under community lands, pasturelands, wastelands etc and it was estimated to be 5957.9 ha i.e. 24 percent of the total study area. Out of this total 4806.6 ha of area was in PA and 1151.3 ha in NPA.

The drainage system i.e. *Nallah's* etc., covered 729.9 ha i.e. 2.9 percent of the total study area. From this area 390.5 ha was in PA and 339.4 ha in NPA (Table –4.1)

Table – 4.1
Land Use Pattern Of The Study Area For The Year 2000 (In Hects.)

S.NO	PARTICULARS	P.A	N.P.A	T.S.A
1.	Agriculture	7024 (75.1%)	2323.9 (24.9%)	9347.9 (37.8%)
2.	Forests	2424.8 (27.8%)	6292.7 (72.2%)	8717.5 (35,2%)
3.	Scrub Area	4806 (80.7%)	1151.3 (19.3%)	5957.3 (24%)
4.	Drainage System	390.5 (53.5%)	339.4 (46.5%)	729.9 (2.9%)
	Total	**14645.9**	**10107.3**	**24753.2** (100%)

Note: P.A= Project Area, **NPA**= Non-Project Area,
TSA=Total Study Area.
This has been invariably used throughout the analysis.

4.1 AGRICULTURE

An area of 9347.9 ha i.e. nearly 37.8 percent of the total study area (24753.2 ha) was under agricultural use. The area under agriculture in the Project Area and Non Project Area was estimated to be 7024 ha and 2323.9 ha respectively (Table-4.1). From the total agricultural land only 18.6 percent area was irrigated and the remaining 82.3 percent area was unirrigated or rainfed. In the PA nearly 21.6 percent area was irrigated whereas in NPA only 9.4 percent area was under irrigation. In TSA 18.6 percent area was irrigated and 81.4 percent area was unirrigated (Table-4.2).

Table No – 4.2

Broad Description Of Agricultural Land (2000) In Hects

S.NO	PARTICULARS	P.A	N.P.A	T.S.A
1.	Total Agriculture land	7024 (75.1%)	2323.9 (24.9%)	9347.9 (100%)
2.	Cultivable	5654.7 (80.5%)	2090.5 (90%)	7745.2 (82.9%)
3.	Uncultivable	1369.3 (19.5%)	233.4 (10.0%)	1602.7 (17.1%)
4.	Irrigated	1519.4 (21.6%)	217.2 (.9.3%)	1736.6 (18.6%)
5.	Unirrigated	5504.6 (78.4%)	2106.7 (90.7%)	7611.3 (81.4%)

In the study area 82.9 percent of agricultural area was cultivable and the rest 17.1 percent area is uncultivable or unused. The percentage of cultivable land in NPA was higher i.e. 90 percent than of PA which is 80.5 percent of the total agricultural land in these areas. (Table-4.2).

The uncultivable agricultural land or badly degraded agricultural land accounted for 19.5 percent and 10 percent for PA and NPA respectively.

The textural classification of soils revealed that majority of the sites, the soils are clay-loam at top most layer, silt loam at 40 cms depth and silt clay at 60 cm depth. The moisture content of these soils is low to moderate. Soils of the PA at upper reaches are mostly acidic which directly correlates the obscene of carbonates in

these soils. The available nitrogen is also of very low value. The soils are generally deficient in phosphorus, chlorides and carbon. Though these soils are not very much rich in calcium and magnesium, these are present in recognisable quantities.

4.1.1 Cropping Pattern

Agriculture was mainly practised in *Kharif* season with Maize being the principle *Kharif* crop and it accounted for 42.2 percent of the total cropped area. Other crops like Paddy and vegetables like Tomatoes, Bringal, Onion, Bitter gourd etc., were also grown but only in those areas where assured irrigation facilities existed. Paddy accounted for 8.5 percent and vegetables only 1.3 percent of the total cropped area.

In the *Rabi* season the principle crop in the study area was wheat and it occupied 30.4 percent of the total cropped area. Fodder crops and oil seed crops being the other crops of the study area accounted for 7.3 percent and 2.8 percent. The left out area was generally the area left for animal grazing or for other purposes. Generally low cropping intensity was observed in the *Rabi* season in the study area due to heavy snowfall in the mountainous region in winters (Table- 4.3).

Table No – 4.3

Cropping Pattern (2000) In Hects

S.NO	PARTICULARS	P.A	NPA	TSA (ha)	%age of Total Cropped Area
1	Maize	2518.8	737.0	3255.8	42.2
2	Rice	504.6	181.2	685.8	8.5
3	Wheat	1690.0	655.4	2345.4	30.4
4.	Other Cereals & Millets	54.7	61.0	115.7	1.5
5	Pulses	124.1	61.1	185.2	2.4
6	Vegetables	78.2	22.1	100.3	1.3
7	Oil Seed Crop	92.6	123.4	216	2.8
8	Fodder Crop	405.1	158.2	563.3	7.3
9	Left Out Area	186.6	91.1	277.7	3.6
	Total	**5654.7**	**2090.5**	**7745.2**	**100%**

4.2 FORESTS

The study area extends from sub-tropical to temperate conditions. The forest vegetation also varies accordingly both species wise as well as density wise. In study area some areas (i.e. in PA) had dense population and forest cover being thin to moderate and facing danger of degradation & extinction due to ever increasing pressure on them for food, fodder, & fuel.

4.2.1 Area

The area under forests was 8717.5 ha out of which major portion of forests existed in NPA with 6292.7 ha i.e. 72.2 percent of total forest area where as 2424.8 ha i.e. 27.8 percent of total area under forest existed in PA (Table-4.4)

Table No – 4.4

Forest Area (Year 2000) In Hects

S.NO	PARTICULARS	P.A	N.P.A	T.S.A
1.	Dense Forest	974 (18.6%)	4262.9 (81.4%)	5236.9 (100.00)
2.	Open/Moderate Forest	859.2 (36.6%)	1491.5 (63.4%)	2350.7 (100.00)
3.	Degraded forests	591.6 (52.4%)	538.4 (47.6%)	1130.00 (100.00)
	Total Area	**2424.8**	**6292.7**	**8717.5**

4.2.2 Species Wise Distribution

The detailed phyto sociological studies of the study area reveal that the tree stratum is represented by *Cedrus deodara* (*Deodar*), *Pinus roxburghi (Chir), P. Wallichania (Kail),* few scattered trees of *Abies pindow*, *Picea smithiana* (*Partha*l) etc., among the conifers *Cedrus deodara* dominates the upper reaches while *Pinus roxburghi* is the major species in the lower reaches of the study area. The other species noted around *Patnitop* during the field survey were as follows: -*Carex spp. Stipa brandsii, Fraggeria verca, Verascum thespis, Taraxum officinalis* (*fuldudoli*), *Oxalis carniculata, Arthrethion prinaisus, Brachypodium spp. Lespidzes cunerata, Voila pilosa, Medicago denticulata, Galium parviflora, Chinopodium vulgrae, Primula*

chinens, Trigonella spp. Plantago ovata, Polygonium, Polygonides, Narcissis poeticus, Arisema spp., Potentilla spp., Dryopteris spp., Aspleniun spp., Princepia utilis, Rubus nivius, Echinopisis spp., Rannuculus muricatus, Aconitiun spp., Hyderea helix, Stellaria media, Rosa moschata, Gerardiana hetetophylla etc. (Table-4.5)

Table No – 4.5

Species Wise Distribution (Year 2000) In Hect.

S.No	Area	Deodar	Chir	Kail	Fir	B.L	Blank	Total
1.	P.A.	397.7 (16.4%)	1246.6 (51%)	94.6 (3.9%)	29.1 (1.2%)	214.9 (10.1%)	441.9 (17.4%)	2424.8 (100.00)
2.	NPA	456.5 (9%)	3568 (56.7%)	327.2 (5.2%)	264.3 (4.2%)	959.5 (13.5%)	717.4 (11.4%)	6292.7 (100.00)
3.	TSA	1028.7 (11.8%)	4751 (54.5%)	409.7 (4.7%)	270 (3.1%)	1072.3 (12.3%)	1185.6 (13.6%)	8717.5 (100.00)

Note: B.L = Broad Leaved.

Few of the exotics can be seen at *Patnitop*, prominent among them are *Morus spp. (mulberry), Lonicera japonica, Populas spp. (Poplar) Salin spp.(Willow) etc.*

The Table-4.5 clearly shows that *Chir* dominates the species-wise distribution by occupying 54.5 percent of the total forests area. The Board leaved forests occupy second position with 12.3 percent of total forest area. The Blanks occupy nearly 13.6 percent of the total forest area, which is quite high.

4.2.3 Forest Classification

From the analysis of conventional data and satellite images procured from NRSA, Hyderabad, forests were categorized into three classes on the basis of crown density i.e.

1. Dense forests – Having Crown density 40 percent or more
2. Open / Moderate forest – Having crown density ranging between 10 percent to 40 percent.
3. Degraded forests – Having crown density below 10 percent.

The total forest area in these three classes is given in Table –4.4

From the Table-4.4 it is clear that 5236.9 ha of forest area was dense forests i.e. 60 percent of total forests were having crown density more than 40 percent. NPA had 81.6 percent of total dense forests whereas PA had only 18.4 percent of total dense forests.

Nearly 2350.7 ha of forests were open or moderate forests and they account for 27 percent (approx) of total forests. Here also NPA had 63.4 percent of total moderate forests and PA had only 36.6 percent, respectively.

The degraded forests had 1130 ha area with PA and NPA had 591.6 ha i.e., 52.4 percent and 538.4 ha i.e., 47.6 percent of degraded forest area, respectively (Table-4.4)

4.3 SCRUB AREA

The scrub area is categorised into three sub classes on the basis of green biomass density i.e.

a. Dense scrub area

b. Thin Scrub area

c. Degraded Scrub area

Dense scrub area has Green Biomass Density (GBD) of 40 or more than 40 percent. Thin scrub area has Green Biomass Density (GBD) from 10 percent to 40 percent and degraded scrub area has Green Biomass Density less than 10 percent.

From the analysis it can be concluded that 3595 ha of total study area was under dense scrub area i.e., 60.3 percent of the total scrub area. PA had roughly 5 times more dense scrub area than NPA with 82.9 percent and 17.1 percent share in total dense scrub area, respectively.

Thin scrub accounts for 1823.9 ha i.e.30.6 percent of total scrub area. In this category also PA has 77.2 percent area under thin scrub and NPA has only 22.8 percent area, which is nearly 1/3rd of thin scrub area under PA.

Degraded scrub area accounts for 9.1 percent of the total scrub area with PA having 77.8 percent and NPA had 22.2 percent of the total degraded scrub area (Table-4.6).

Table No – 4.6

Scrub Area (Year 2000) (Area In Hect.)

S.NO	PARTICULARS	P.A	N.P.A	T.S.A
1.	Dense Scrub	2978.7 (82.9%)	616.3 (17.1%)	3595.0 (60.3%)
2.	Thin Scrub	1408.4 (77.2%)	415.5 (22.8%)	1823.9 (30.6%)
3.	Degraded Scrub Area	419.5 (65.6%)	119.5 (22.2%)	539.0 (9.1%)
	Total Area			**5957.9** (100.00)

4.4 DRAINAGE SYSTEM

It is estimated that *Nallah's* and drains account for 2.9 percent with 729.9 ha of the total study area from which 390.5 ha is in PA and 339.4 is in NPA (Table –4.1).

4.5 COMPARISON OF LAND USE PATTERN OF CURRENT YEAR (2000) WITH BASE YEAR (1991)

From the analysis of the satellite images following comparisons regarding resource availability and their condition in the base year i.e. 1991 and the current year i.e. 2000 were made (Table –4. 7).

Table No – 4.7

Land Use Pattern Comparison Of Year 1991 And 2000

S.no	Particulars	1991	2000	Difference in (Ha)
1.	Total Forest Area	9769.6	8717.5	↓ 1052.1 (10.8%)
a)	Dense Forest	6156.4	5236.9	↓ 919.5 (14.9%)
b)	Moderate Forest	2773.6	2350.7	↓ 422.9 (15.2%)
c)	Degraded Forest	839.6	1130	↑ 290.4 (34.6%)
2.	Total Agricultural Area	8836.5	9347.9	↑ 511.4 (5.8%)
a)	Cultivable Land	7057.4	7745.2	↑ 687.8 (9.7%)
b)	Uncultivable Land	1779.1	1602.7	↓ 176.4 (6.5%)
c)	Irrigated Land	1478.4	1736.6	↑ 258.2 (17.4%)
d)	Unirrigated Land	7358.1	7611.3	↑ 253.2 (3.4%)
3.	Total Scrub Area	5352.7	5957.9	↑ 605.2 (11.3%)
a)	Dense Scrub	3448.7	3595	↑ 146.3 (4.2%)
b)	Thin Scrub	1515.5	1823.9	↑ 308.4 (20.3%)
c)	Degraded Scrub	388.5	539	↑ 150.5 (38.7%)
4.	Total Drainage System	795.3	729.9	↓ 65.4 (8.2%)

4.5.1 Forest Area

It was estimated that total area under forests decreased by 10.8 percent in the present year (2000) than the base year. The dense forests decreased by 14.9 percent whereas moderate forests decreased by 15.2 percent than the base year. The area under degraded forests in the current year have increased by 34.6 percent i.e. 290.4 ha from the base year.

From these figures it can be concluded that the immense pressure on forests for fuelwood, timber and fodder had led to their overexploitation and degradation in the later years.

4.5.2 Agricultural Area

The area under agriculture increased from 8836.5 ha in the base year to 9347.9 ha in the present year (2000) showing an increase of 511.4 ha which is 5.8 percent more than the base year. This increase in agricultural area was due to an increase in population size and lack of employment opportunities due to which majority of the people were dependent up agriculture for their livelihood. For increasing agricultural area degraded forest lands, wastelands, community lands etc were being used for cultivation purposes and due to it very little scope was left for regeneration and replenishment of degraded forests and wastelands.

The irrigated area has increased by 258.2 ha which is 17.4 percent of the base year's irrigated area, and cultivable lands increased by 687.8 ha which is 9.7 percent of the base year's cultivated area (Table –4.7).

4.5.3 Scrub Area

The total scrub area increased by 605.2 ha i.e.11.3 percent of the base year's total scrub area. Dense scrub area increased by 146.3 ha i.e., 4.2 percent than the base year's dense scrub area whereas thin scrub area increased in the current year by 308.4 ha which is 20.3 percent from the base year.

The degraded scrub area increased in the current year by 150.5 ha which is 38.7 percent of the base year's degraded scrub area (Table – 4.7).

From this analysis it can be concluded that the degraded forests were being converted into dense and thin scrub area therefore there had been an increase in both of these categories of scrub area in the current year as compared with the base year. The dense scrub area of the base year was being converted into thin and degraded scrub area in the present year hence it contributed to an increase in degraded scrub area also.

The increase in thin and degraded scrub area can be ascertained by the fact that intense pressure on land resources existed because of ever-increasing fuelwood and fodder demands of the local people in the study area.

4.5.4 Drainage System

The area under drainage systems in the current year decreased by 65.4 ha i.e. 8.2 percent of the base years area of drainage system (Table-4.7). This is mainly due to the fact that these areas are also now being converted into either agricultural land or scrublands in order to meet the biomass requirement of the people in the study area.

4.6 COMPARISON OF LAND USE PATTERN IN PA AND NPA IN THE YEAR 1991 & 2000

The descriptive comparison of the base year's land use pattern with current year's land use pattern showed that in the PA the area under forests in the current year decreased by 423.5 ha which is 4.3 percent of the total decline in forest area. Whereas in the NPA the decrease in forest area in the current year is estimated to be 628.6 ha which is 6.5 percent of the total decrease in forest area. (Table– 4.8).

The decline in dense and moderate forests area in PA is estimated to be 398.9 ha and 131 ha which is 6.5 percent and 4.7 percent of the total decline in the respective forests. Comparatively in the NPA dense and moderate forests area declined by 520.6 ha and 291.9 ha respectively which is 8.5 percent and 10.5 percent of the total decrease in dense and moderate forest area.

The degraded forest area in PA and NPA increased by 106.4 ha and 184 ha that is nearly 12.7 percent and 21.9 percent respectively of the total increase in the degraded area in the current year.

The total agricultural area in the PA increased by 105 ha which is 1.2 percent of the total increase in agricultural area whereas in the NPA this increase is estimated to be 406.4 ha i.e. 4.6 percent of the total increase in agricultural area.

The cultivable area increased by 223.4 ha and 464.5 ha for PA and NPA respectively showing an increase of 3.2 percent in PA and 6.6 percent in NPA of the total increase in cultivable area.

Area under irrigation also increased by 211.7 ha i.e. 14.3 percent in PA and 46.5 ha i.e. 3.1 percent in NPA respectively. The total scrub area in the PA had increased by 429.9 ha i.e., 8 percent of the total increase in the TSA's scrub area. Whereas in

NPA this increase was 175.3 ha i.e., 3.3 percent. The dense scrub area increased by 92.1 ha in PA which was 2.7 percent of total increase in dense scrub area whereas this increase for NPA was estimated to be 54.2 ha i.e. 1.6 percent respectively.

The degraded scrub area in the PA had increased by 113 ha i.e., 29.1 percent increase in the current year from the base year. In NPA this increase was 38.7 percent of total increase in degraded area respectively.

The drainage system in the PA decreased by 17.5 ha i.e., 2.2 percent decrease than the base year, whereas in NPA this decrease was estimated to be 47.9 ha or 6 percent decrease than the base year. The agricultural area in NPA has increased manifolds than PA and the scrub area has increased more in PA than NPA (Table-4.8).

SOIL EROSION

In the present study soil erosion is found to be widely prevalent in the study area due to reasons like very steep slope of the area, faulty methods of cultivation (agriculture), deforestation, overgrazing of the scrub lands and poor vegetative cover etc. The soil erosion varied in its extent and intensity at different places of the study area.

The extent and magnitude of erosion in the TSA is estimated according to the methodology adopted by the Directorate of Soil Conservation based on parameters like:

a. Loss of Top Soil

b. Slope

c. Gully Erosion

d. Landslides and Landslips

e. Stream Bank Erosion

f. Land use etc

On these parameters the soil erosion is measured in terms of six (6) Erosion Intensity Classes from E.I -1 to E.I -6, indicating intensity of erosion problem of the study area in ascending order (Table-4.9).

The land under E.I class 6 was considered to be beyond conservation and regeneration, whereas Soil under E.I class 3, 4 and 5 required immediate attention for redemption of soil so that it could be saved from further deterioration resulting in ultimate loss of it. From the Table –4.9 it can be concluded that nearly 2.13 percent of total area was under E.I class I and it could be conserved or reclaimed by using vegetative measures like selecting right crapping pattern in the area, growing cover crops, steep cropping mixed cropping etc.

A total of 2266 hectares i.e. nearly 9.2 percent of land in the total study area was under E.I class II in which PA was having 941 hectares of land and NPA 1325 ha. The land under E.I classes II, IV and V were nearly 6842 ha, 8032 ha and 5946ha, respectively. These classes collectively had nearly 84.1 percent of the total area under them and this area needed an immediate conservation with vegetative and mechanical methods, so as to save them from further deterioration.

The land under E.I class V is only 676 ha i.e. nearly 2.73 percent of the total area and it is very difficult to reclaim such lands.

Table: 4.9 : Soil Erosion Intensity Classes (in ha)

Class	**PA**	**NPA**	**TSA**	**% age**
E.I	258	269	527	(2.13%)
E.II	941	1325	2266	(9.15%)
E.III	4040	2802	6842	(27.64%)
E.IV	4599	3433	8032	(32.44%)
E.V	3918	2028	5946	(24.02%)
E.VI	554	122	676	(2.73%)
Nullah beds	206	158	364	(1.47%)
Total	**14516**	**10237**	**24753**	**(100.00)**

Conclusion

From the results obtained after the broad analysis of Land Use/Cover from Satellite images of the study area, it can be safely concluded that there had been considerable change in Land Use pattern in the Current year when compared with the Base year. The forest cover has decreased considerably in the Current year which is a matter of serious concern as the study area in already facing problems of Land slides and Soil Erosion. Moreover, forest lands are being converted into agricultural lands leaving very little scope for their rehabilitation as agricultural lands are more prone to Soil Erosion problems. The Scrub area in the study area has also increased, which is quite concerning as the study area falls under Udhampur district, having more than 17 percent of its total geographical area under wastelands.

Chapter V: CARRYING CAPACITY OF THE STUDY AREA

Carrying capacity of an ecosystem (watershed in the present study) represents the highest population of any species (number of people and animals in this case) that the ecosystem can sustain over an indefinite period of time. The carrying capacity of the study area was calculated in two phases. In the first phase production capacity of natural resources was calculated in the study area in terms of :-

a. Fuelwood in MT/yr.
b. Fodder in MT/yr.
c. Foodgrains in MT/yr.
d. Timber in Cu.ft./yr.
e. Resin in K.L./yr
f. Water in K.L./yr.

The production capacity of resources in both the areas i.e. PA & NPA as well as for both the years i.e. the base year (1991) and current year (2000), was estimated. Then in the second phase this production capacities of resources in terms of fuelwood, fodder & foodgrain was divided by per household requirement (for fuelwood), per cattlehead requirement (for fodder), per person requirement (for food grains) to estimate the number of households, cattleheads and persons that can be supported by available production capacity. Estimation of carrying capacity will help in estimating the number of huiman beings and animals that can be supported by the natural resources of this area in a sustainable manner for an indefinite period of time. Moreover, it would also help in finding out the extent of existing burden on natural resources for various goods and how this had led to their over exploitation and finally degradation.

Certain goods produced from natural resources like Resin and Timber, estimation of carrying capacity was not possible as resin was the raw product used by industries and hence not required by local population whereas in case of timber it was not possible to estimate the per household per year requirement. Inspite of these limitations of the study the production capacity for these two products was estimated in both the areas, for both he years and from the change in their production level

during two different period we would try to establish its relationship with the condition of natural resources in the study area.

5.1 FUELWOOD PRODUCTION CAPACITY (FPC) YEAR- 2000

The production capacity of fuelwood had been calculated by the set standards of forest Department of the J&K government. These standards are fixed on the basis of capacity of the resources to supply fuelwood in a sustainable manner in metric tonnes (M.T) per year per hectare basis.

Table 5.1 shows that present (2000) capacity of the study area was 11807.8 M.t/Year. Out of this fuel wood produced from the forests at the rate of .75 MT/Ha/Yr accounted for 55.4 percent of total fuelwood production capacity whereas agricultural lands accounted for 39.6 percent of total fuelwood production capacity. The shrub area provided only 5 percent of the total fuelwood production capacity in the study area.

Table: 5.1

Fuel Wood Production Capacity Of 2000 (MT)

PARTICULARS	**P.A**	**N.P.A**	**T.S.A**
Forest area @ .75 M.T/year/ha.	1818.6	4719.5	6538.1 (55.49%)
Agricultural area @ .50 M.T/year/ha.	3512	1162	4674 (39.6%)
Scrub area @10 M.T/year/ha.	480.6	115.1	595.7 (5%)
Total	**5811.2**	**5996.6**	**11807.8** (100%)

PA had fuelwood production capacity (FPC) of 5811.2 M.t/Yr., whereas NPA had fuelwood production capacity of 5996.6 M.t/Yr. The major share of FPC in PA was provided by agricultural land i.e. nearly 60.4 percent of total FPC, whereas in NPA major share in FPC was of forests, which was nearly 78.7 percent of the total FPC (Table–5.1).

The fuelwood deficit in the study area was met either from overexploitation of natural resources than their capacity to supply them in a sustainable manner or by use of some alternative sources of fuel (Table – 5.2). But from the table under reference it can be concluded that very few people in the study area were using alternatives of fuelwood because of high poverty level among locals. The alternative sources of fuel used by locals are given in Table-5.3. These are:

1. Only 15.3 percent of the total population in the study area were using Kerosene oil as a source of fuel.

2. Only 11.7 percent of total population in the study area was using LPG as a source of fuel.

3. Nearly 92 percent of total population used illegal electricity for fuel purposes in this area.

Therefore, the main pressure was on natural resources for mitigating the fuel needs of the study area. The forests cannot be expected to sustain this pressure for a very long time, rather it shall be in the fitness of things to generate huge fuelwood resources around the habitations, moreover, conservation and regeneration of degraded wastelands should also be started so as to ease pressure on existing resources.

Table-5.2

Sources Of Fuel Used By Locals In The Study Area

Source of fuel	PA	NPA	TSA
Kerosene Oil	26	20	46
	(17.3%)	(13.3%)	(15.3%)
L.P.G	23	12	35
	(15.3%)	(8%)	(11.7%)
Fuel Wood	150	150	300
	(100%)	(100%)	(100%)
Electricity	126	138	264
	(84%)	(92%)	(8.8%)

5.1.1 Fuelwood Situation In The Study Area

The fuel wood requirement of the study area was calculated from the primary data on consumption pattern, and then this average household requirement of fuelwood was multiplied with the total number of households in each PA and NPA to get the total fuelwood requirement of the total study area (TSA).

It was estimated that total fuelwood production capacity of the study area, i.e., 11807.8 M.t/Yr, was far below i.e. 9059.2 M.t/Yr than the actual requirement of fuelwood in the study area i.e. 20867 M.T/Yr. (Table –5.3). Fuelwood deficit of 53.3 percent exists in the PA and 28.9 percent in the NPA whereas overall fuelwood deficit in TSA was estimated at 43.4 percent of the total fuelwood requirement. From table 5.3 one can interpret that in PA the production falls too short than the requirement as in this area density of population is higher than NPA and moreover fuelwood production capacity was also low due to poor condition of natural resources in this area.

Table-5.3
Overall Fuel Wood Situation Year 2000 (In M.T/Yr)

PARTICULARS	PA	NPA	TSA
T. Fuel wood production capacity	5811.2 (49.2%)	5996.6 (50.8%)	11807.8 (100.00)
T. Fuel requirement @ 2.75 MT / household/year	12435.5 6624.3	8431.5 2434.9	20867 9059.2
Fuel wood Deficit	(53.3%)	(28.9%)	(43.4%)*

Note: *= % age of the Total Study Area.

5.1.2 Carrying Capacity In Terms Of Fuelwood

The present production capacity of the study area in terms of fuelwood is 11807.8 MT/yr which can support only 4294 household i.e. 56.6 percent of the total population of the study area @ of 2.75 MT/household/yr. As there were 7588 number of household in the study area therefore 3294 number of household i.e. 43.1

percent of the total household were a burden on the existing carrying capacity of the study area. Nearly 9058.6 MT/yr. Of fuelwood is required for supporting the needs of extra household and thus saving the natural resources from Overexploitation. (Table 5.4).

Table : 5.4

Carrying Capacity Of The Study Area In Terms Of Fuelwood (Year 2000)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Production in M.T.	5811.2	5996.6	11807.8
2.	No. of household that can be supported @ 2.75 MT/yr per household	2113 (46.7%)	2181 (71.1%)	4294 (56.6%)
3.	Household that create burden	2409 (53.3%)	885 (28.9%)	3294 (43.1%)
4.	Total No. of Households	4522 (100%)	3066 (100%)	7588 (100%)

The carrying capacity of PA in terms of fuelwood falls short by 2409 household which is 53.3 percent of total population i.e. the PA can support only 2113 household i.e. 46.7 percent from the total of 4522 household in this area. The carrying capacity of NPA in terms of fuelwood falls short by 3066 household as it can support only 2181 household i.e. 71.1 percent from the total of 3066 households.

5.2 FODDER PRODUCTION CAPACITY

Fodder Production Capacity of land resources had been calculated on the basis of the set standards of the Department of Forests J&K Government in a sustainable way (Table – 5.5). The total fodder production capacity was estimated to be 118563.8 M.t/Yr out of which 69.6 percent i.e. 82527.9 M.t/Yr was produced in PA and 30.4 percent i.e. 36035 M.t/Yr was produced in NPA.

The maximum quantity of fodder was produced by agricultural land i.e. nearly 70.2 percent of the total fodder production capacity (Table – 5.4).

Table-5.5

Fodder Production (Year 2000) In M.T.

Particulars	PA	NPA	TSA
Agricultural land: Total production (a) Irrigated@ 12m.t/yr/ha (b) Unirrigated@4.5 M.T/yr/ha Green fodder@ 50mt/yr/ha	63258.5 (76%) 18232.8 24770.7 20255.0	19996.6 (24%) 2606.4 9480.2 7910	3255.1 (70.2%) 20839.2 34250.9 28165
Forest Land@ 2.m.t/yr/ha	4849.6	12585.4	17435 (14.7%)
Scrub Land@ 3.m.t/yr/ha	14419.8	3453.9	17873.7 (15.1)
Total	**82527.9** **69.6%**	**36035.9** **30.4%**	**118563.8** **100%**

5.2.1 Fodder Situation In The Study Area

The total fodder requirement of the study was calculated by multiplying per animal per day requirement with the total number of animals in the study area. It was estimated that the total fodder requirement of the study area had been 322445.5 M.t/Yr, which was nearly 3.5 times more than the total fodder production capacity of 118563.8 M.t/Yr. A huge fodder deficit of 203881.7 M.t/Yr existed in the study area, which was generally met by overgrazing and over-exploitation of available natural resources. The largest deficit of fodder existed in NPA i.e. nearly 124532.7 M.t/Yr because fodder production capacity was very low in this area as compared to PA. NPA accounts for 61.0 percent of total fodder deficit whereas PA accounts for 39.0 percent of total fodder deficit (Table – 5.6). This fodder deficit could be met by effective management of the area under fodder crops, improvement in the carrying capacity of the forestlands as well as high pasture lands by regeneration and development of pasture lands.

Table-5.6

Fodder Situation In The Study Area (2000)

PARTICULARS	P.A	N.P.A	T.S.A
1) T. fodder Production Capacity in M.T/yr	82527.9	36035.9	118563.8
T. Fodder requirement in M.T/yr	161876.9	160568.6	322445.5
Deficit of fodder in M.T/yr	79349	124532.7	203881.7

5.2.2 Carrying Capacity In Terms Of Fodder

The present production capacity of fodder in the total study area is 118563.8 MT/yr. which can support or has carrying capacity of only 21956 cattle heads i.e. 63.2 percent of cattle population was exerting burden on the natural resources for fodder requirement in the study area which can result in further deterioration in their status and condition.

The carrying capacity in PA falls short by 14973 Cattleheads i.e. these Cattleheads were creating burden on the carrying capacity falls short by 22701 Cattleheads as with the existing production potential of this area, only 6673 i.e. 22.7 percent of Cattleheads out of a total 29374 can be supported (Table 5.7).

Table - 5.7

Carrying Capacity Of The Study Area In Terms Of Fodder (Year 2000)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Production in M.T.	82527.9	36035.9	118563.8
2.	No. of Cattlehead can be feeded @ 5.4 MT/yr	15283 (50.5%)	6673 (22.7%)	21956 (36.8%)
3.	Cattlehead that cause burden	14973 (49.5%)	22701 (77.3%)	37674 (63.2%)
4.	Total No. of Cattlehead	30256	29374	59630

5.3 PRODUCTION CAPACITY OF FOODGRAINS (Year 2000)

In the study area various food crops grown were maize, rice, wheat, cereals and millets, pulses, etc. The total foodgrain production (TFP) in the study area was estimated to be 6856.04 MT/Yr. The major food crop in the study area was maize and wheat and they contribute nearly 52.2 percent and 30.8 percent in the total foodgrain production of the study area. The TFP in PA was 5116.34 MT/yr. whereas in NPA it was 1739.7 MT /yr respectively. The main reason for this difference was difference in area under agriculture in these regions, and better irrigation facilities were available in the PA as compared to NPA (Table:5.8).

Table :5.8

Foodgrain Production Capacity in M.T. (Year 2000)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Maize	2770.68	810.7	3581.38 (52.2%)
2.	Rice	706.44	253.68	960.12 (14%)
3.	Wheat	1521	589.86	2110.86 (30.8%)
4.	Other Cereals & Millets	43.76	48.8	92.56 (1.4%)
5.	Pulses	74.46	36.66	111.12 (1.6%)
	T.F.P.	5116.34	1739.7	6856.04 (100%)

5.3.1 Carrying Capacity In Terms Of Foodgrains

The Production potential of the study area in terms of foodgrains was estimated to be 6856.04 MT per year which can carry or supported 35708 number of adults per year i.e. only 70.2 percent of total population. But as the total population of the study area is 50,846 persons and the rest 29.8 percent population was a burden on the present carrying capacity. In the PA the present TFP (i.e. 5116.34 MT/yr) could support 84.8 percent of the total population. Whereas in the NPA the TFP (1739.7 MT/yr) could only support 25.4 percent of the population respectively (Table: 5.9).

Table:5.9

Carrying Capacity Of The Study Area In Terms Of Foodgrains

S.No.	*Particulars*	*P.A.*	*N.P.A.*	*T.S.A.*
1.	Production in M.T	5116.34	1739.7	6856.04
2.	Population which can be supported with the TFP requirement @ 192kg/ person/yr	26647 (84.8%)	9061 (25.4%)	35708 (70.2%)
3.	Population that create burden	4772 (15.2%)	10395 (67.7%)	15167 (29.8%)
4.	Total Population	31419 (100%)	19456 (100%)	50846 (100%)

5.4 TIMBER PRODUCTION CAPACITY OF THE STUDY AREA

Timber production capacity of the study area was calculated by multiplying the total forest area (which is fit for timber production) by the set standard of Forest Survey of India (1998) i.e. 0.7 cu.m or 24.6 cu.ft timber per hectare per year. This includes both recorded as swell as unrecorded removals from forests. On the basis of above mentioned figures, one can calculate the timber production capacity of the study area which was estimated to be 15215.1 cu.ft/yr out of which 32.8 percent is produced from PA and 67.2 percent from NPA (Table –5.10). The forests for timber production mean only those forests, which are having timber-producing species. The timber production capacity is dramatically lower than the forests potential, which has been estimated to be 2 cu.m per ha/ per year by Forest Survey of India (1998). If this potential can be achieved, which is about three times the current production capacity it would bring considerable improvement in the economic as well as the environmental well being of the area, state and country on the whole.

Table-5.10: Timber Production Capacity Year 2000 (in Cu.ft)

PARTICULARS	PA	NPA	TSA
1) Area under forest (in ha)	2424.8	6292.7	8717.5
2) Area Under Timber Producing Species (in ha)	1768 ha	4616 ha	6384
3) Timber Production Capacity in cu.ft @ 24.6 cu . ft /ha/yr	43492.8 (27.6%)	113553.6 (72.4%)	157046.4 (100%)

5.5 RESIN PRODUCTION CAPACITY

The Resin production capacity of the study area was estimated on the basis of information provided by Department of Forest J&K Govt., regarding per plant production of Resin during a year. It was calculated that the Resin Production capacity of the study area was 3961.3 KL /yr. out of which 1101.8 KL/yr. was produced in PA and 2859.5 KL/yr. in NPA (Table 5.11). The Resin production capacity of a tree depends upon its age, health and climate of the area.

Table: 5.11

Resin Production Capacity (In Kiloliters)

PARTICULARS	PA	NPA	TSA
1) T.Forest Area	2424.8	6292.7	8717.5
2) T. Chir Forests	1236.6	3568	4804.6
3) T.Resin Prod. Capacity	1101.8	2859.5	3961.3
4) T. no. of Chir trees	1112940	2888349	4001310
5) T. no. of Resin producing trees	367270	953155	1320432

5.6 COMPARISON OF PRODUCTION CAPACITY OF CURRENT YEAR (2000) WITH BASE YEAR (1991)

A comparison of current year (2000) with the base year (1991) in respect to the carrying capacity of the study area is shown in Table – 5.12. From the comparison it was revealed that fuelwood production capacity decreased by 473 M.t. i.e. 3.9

percent, in the current year than the base year. The fodder production increased by 9934.2 M.t/ Yr in the current year than the base year due to an increase in the area under fodder crops. But the deficit of fodder had increased with an increase in livestock. Population was comparatively more than the increase in fodder production in the current year than the base year.

The agricultural production capacity has increased in the current year than the base year. The total food grain production capacity increased by 4.8 percent i.e. 314.54 M.t./Yr. The reason for increase in TFP is the increase in agricultural area by 5.8 percent in the current year than the base year and the awareness generated by the extension services of agricultural Department regarding Hybrid seeds, better forming practices etc. The increase in the fodder production from agricultural area is due to huge deficit of fodder existing in the study area and poor fodder production potential of forest and scrublands. A look at the cropping pattern of the study area in the base year shows that only 4.6 percent of total agricultural land was under fodder crops but due to increased shortage of fodder more and more area came under fodder crops and in the current year nearly 7.3 percent of the total agricultural area was under fodder crops The fodder deficit in the current year had increased from 197012.6 M.t/Yr to 203881.7 M.T./Yr i.e. an increase of 6869.1 M.t./Yr or 3.5 percent than the base year. (Table-5.12).

The timber production capacity had decreased by 8.7 percent i.e. 15220 cu.ft/yr in the current year than the base year. The major reason for this change was the considerable decrease in forest cover due to over exploitation of the forest for personal economic benefits over the past years. This had adversely affected not only their area but their condition also reducing their production capacity in terms of timber, resin and fuelwood. Resin production capacity also decreased considerably by 10.8 percent i.e., 478.2 KL per year in the present year than the base year. As resins were produced from Chir trees in the forest therefore decrease in forest cover had also affected their production potential significantly.

Table-5.12: Comparison Of Production Capacity In Study Area During 2000 & 1991

PARTICULARS	1991	2000	DIFFERENCE
Fuel wood Prod.. Capacity (MT/Yr)	12280.8	11807.8	473 (3.9 1%)
Fodder (MT/Yr)	94564.6	104498.8	9934.2 (10.5%)
Timber (Cu.ft./Yr)	174721.5	159501.5	15220 (8.7%)
Resin (KL/Yr)	4439.5	3962.3	478.2 (10.8%)
Agriculture TFP (MT/Yr)	6541.5	6856.04	314.54 (4.8%)

5.6.1 Comparison Of Production Capacity Of PA & NPA In Current Year With Base Year

A detailed comparison of the base year's carrying capacity of PA and NPA during the current and the base year revealed that:

The fuelwood production capacity of the PA decreased by 3.7 percent from the base year i.e. 222.2 M.t whereas for NPA this decrease was estimated to be 4.0 percent i.e. 250.8 M.t than the base year. This decrease in fuelwood production capacity was because of an increase in degraded areas and poor resource condition in the current year in comparison with the base year.

The fodder production capacity in the PA increased by 22262.9 M.t. i.e. 31.6 percent than the base year whereas this increase for NPA is 7756 M.t. which is 2.4 percent more than the base year's fodder production capacity. The increase in fodder production capacity can be attributed to the increase in agricultural areas under fodder crops, which has increased from 4.6 percent in 1991 to 7.3 percent in the year 2000. Moreover area under agriculture has also increased from 8836.5 ha in 1991 to 9347.9 ha in the year 2000.

The timber production capacity of the PA decreased by 4986.4 cu. ft i.e. 10.3 percent than the base year's capacity whereas in the NPA this decline was estimated to be 10228.7 cu ft. i.e. 8.3 percent than the base year's timber producing capacity.

The total foodgrain production of the PA increased by 35.34 M.t i.e. nearly 0.7 percent increase than the base year's total foodgrain production whereas in the NPA the TFA increased by 279.2 M.t. i.e. 19.1 percent increase than the base year's foodgrain production. This increase in foodgrain production capacity in PA as well as NPA is due to the increase in the area under agriculture and not due to increase in productivity level.

The overall carrying capacity of the PA and NPA had decreased in terms of fuelwood production, timber and resin production because of degradation of natural resources due to their over exploitation for meeting the ever increasing demand for these resources.

The fodder production capacity had increased in the current year but due to substantial increase in the animal population the fodder requirement had also increased than the base year's fodder requirement, therefore the fodder deficit has increased from 197012.6 M.t in 1991 to 203881.7 M.t. i.e. an increase of 9.2 percent fodder deficit in the current year than the base year (Table-5.13). In PA the decrease in the quantity of fuelwood, timber and resin produced in the current than the base year was less as compared to the decreased in the carrying capacity in NPA.

5.7 Comparison Of Carrying Capacity Of The Current Year (2000) With The Base Year (1991)

Comparison of Carrying capacity of fuelwood, fooder and foodgrains between the base year i.e. 1991 and the current year i.e.2000 clearly showed that the carrying capacity in terms of foodgrains had increased by 4.8 percent of the base year but the burden on the carrying capacity due to increased population pressure ,had increased by 19.6 percent of the base year. Moreover the increase in the carrying capacity of foodgrains is due to increase in production which is because of increase in production which is because of increase in area under agriculture (Table5.14).

The carrying capacity in terms of fodder increased by 15.5 percent i.e. 294 Cattleheads in the current year but the burden or the cattleheads increased by 4.1 percent capacity which is quite high. The increase in carrying capacity of fodder in the current year, can be attributed to the increase in the production of fodder crops (Table 4.3). But this increase in production was unable to meet the actual requirement of the fodder in the study area and hence the burden on carrying capacity increased further. The carrying capacity of fuelwood in the study area decreased by 4 percent from base year due to decrease in the forest covers and poor conditions of resources, in the current year. This led to an increase in the burden on carrying capacity by 49.3 percent from the base year which is a matter of serious concern as the requirement for fuelwood had increased due to increase in population. During this period exerting more pressure on the natural resources for their products which would further deteriorate their conditions the years to come.

Table: 5.13: Comparison Of Production Capacity Of Project/ Non- Project Area

Particulars	**P.A**		**Difference**	**N.P.A**		**Difference**	**T.S.A Difference**
Year	1991	2000		1991	2000		
Fuel wood (Mt.)	6033.4	5811.2	222.2 (3.7%)	6247.4	5996.6	-250.8 (4.0%)	473
Fodder (Mt)	59770 10690 70460	72422.9 20300.0 92722.9	22262.9 (31.6%)	26679.6 5540.0 32219.6	32075.9 7900.0 39975.9	7756.3 (24.1%)	14506.6
Timber (cu.ft)	48479.2	43492.8	-4986.4 (10.3%)	123782.3	113553.6	-10228.7 (8.3%)	-15215.1
Resin (k.lit)	1294.3	1101.8	-192.5 (14.9%)	3145.2	2859.5	-285.7 (10.0%)	478.2
TFP (Mt.)	5081	5116.34	35.34 (0.7%)	1460.5	1739.7	279.2 (19.1%)	314.3

Table: 5.14 : Comparison of Carrying Capacity (1991 & 2000)

S.No.	*Particulars*	*1991*	*2000*	*Diff.*
1.	C.C in terms of Foodgrains	34071	35708	1637 (4.8%)
	Burden(in persons/yr)	12677	15167	2490 (19.6.%)
2.	C.C in terms of Fodder (in cattleheads/yr)	19015	21956	2941 (15.5%)
	Burden(in cattleheads/yr)	36178	37674	1496 (4.1%)
3.	C.C in terms of Fuelwood (in households/yr)	4472	4294	-178 (4%)
	Burden (in households/yr)	2206	3294	1088 (49.3)

5.7.1 Comparison Of Carrying Capacity Of PA And NPA During 1991 And 2000

The Comparison of carrying capacity of PA and NPA during the base year and current year clearly showed that the foodgrains situation improved in the current year due to increase in the production of foodgrains during this period. The increase in carrying capacity of foodgrains in the current year was 0.7 percent in PA and 19.1 percent in NPA than PA was because the area under agriculture increased more in NPA as compared to PA during this period.

The carrying capacity of fodder in PA increased in the current year by 17.1 percent from the base year whereas this increase was 11.8 percent for NPA respectively. The increase of carrying capacity of fodder was more area under fodder crops in PA than NPA as area under fodder crops in PA was more than NPA.

The carrying capacity in terms of fuelwood decreased in PA by 3.7 percent from the base year whereas this decrease for NPA was estimated to be 4.6 percent respectively. The main reason for this decrease was poor forest condition and regularly depleting fuelwood producing resources. The decrease in carrying capacity of fuelwood in PA was less as compared to NPA, the WD programme was one of the such reason behind this(Table: 5.15).

Table 5.15 :Comparison of Carrying Capacity in PA & NPA (1991 & 2000)

S.No.	Particulars	PA 1991	PA 2000	Diff.	NPA 1991	NPA 2000	Diff.	T.S.A. Diff.
1.	C .C in terms of Foodgrains (No.of persons/Yr)	26464	26647	183 (0.7%)	7607	9061	1454 (19.1%)	1637
2.	C.C in terms of Fodder (Cattleheads/Yr.)	13048	15283	2235 (17.1%)	5967	6673	706 (11.8%)	2941
3.	C.C in terms of Fuelwood (Household/Yr.)	13048	15283	2235 (17.15)	5967	6673	706 (11.8%)	2941

5.8 SITUATION OF THE WATER IN THE STUDY AREA

Water Requirement for the humans of the total study area was calculated to be nearly 466891 kilolitres per year, of which 216062 kilolitres per year was required by the human population of the project area and 250829 kilolitres per year kilolitres per year was the requirement of the human population of the non-project area. The total requirement of the annual population of the study area was nearly 496718 kilolitres per year of which the animal population of the project area required nearly 249176 kilolitres per year and 247542 kilolitres per year was required for population of the non-project area. Thus, the total requirement of the study area was nearly 963609 kilolitres per year of which 465238 kilolitres was the requirement of the project area per year and about 498371 kilolitres per year was the requirement of the human and cattle population of non-project area.

5.8.1 Availability Of Water Resources In The Study Area:

Different sources of water like springs, tap water, wells, ponds, tanks and *Nallahs* registered in the study area. The details of these resources are as under:

a) **Springs** (*Bowlis*): There were about 514 *Bowlis* registered in the study area of which 233 *Bowlis* remained functional throughout the year and the remaining 281 were seasonal in nature.

b) **Tap water**: Out of the 37 villages of the study area, 32 villages were having tap water facility and the remaining 5 villages were dependent upon natural resources for drinking water.

c) **Tanks**: There were 279 tanks of different capacities existed in the study area, out of which only 76 tanks were government made and 203 were private tanks.

d) **Ponds**: Nearly 141 ponds of different dimensions exited in the study area and only 62 were government made and villagers either made the remaining 79 collectively or individually for their personal uses.

e) **Nallahs:** Nearly 33 *Nallahs* exited in the study area, out of which 18 had water for full year and 15 of them were seasonal in nature

Table no. 5.16 shows that in 22 MWS i.e., nearly 73 percent of TSA, water for irrigation was not available therefore the agriculture was rain dependent and rainfed. Out of this total, nine MWS of the project area and thirteen MWS of non-project area had scarce water resources for irrigation purposes. The water availability in nearly five MWS i.e., 17 percent area of TSA was partial which means that water was available in certain areas during certain times.

Table: 5.16

Water Situation In The Study Area

	Water For Irrigation			**Water for human /animal Consumption**		
Particulars	**P A**	**NPA**	**TSA**	**P A**	**NPA**	**TSA**
Scarce	9 (60)	13 (87)	22 (73)	- (-)	2 (13)	2 (6.7)
Partially Available	3 (20)	2 (13)	5 (17)	2 (13)	5 (17)	7 (23.3)
Sufficient	3 (20)	- (-)	3 (10)	13 (87)	8 (70)	21 (70)
Total	**15 (100)**	**15 (100)**	**30 (100)**	**15 (100)**	**15 (100)**	**30 (100)**

Only three MWS (all in PA) had sufficient water for irrigation, which was nearly 10 percent of total watersheds. The water for human and animal consumption was found to be sufficient in 21 MWS i.e., 70 percent of total micro watersheds. Out of

these 13 MWS of PA and 8 MWS of NPA were having sufficient water for human /animal consumption.

Seven MWS were found to be having shortage of drinking water in some areas and during few months in a year. Project area had two and non-project area had five such MWS respectively. The acute drinking water shortage existed in two MWS in TSA and both of these MWS were situated in NPA and accounted for nearly 6.7 percent of the total micro watersheds.

Conclusion

Carrying capacity of an eco-system represents the highest population of any species that the eco-system can sustain over an indefinite period of time. Fuelwood deficit in the study area were met through the overexploitation of the forest resources whereas the main contributor to the fuelwood in PA was agriculture. In NPA forest had been overexploited. The increase in the carrying capacity were comparatively very less than the increase in the population in the study area and hence the actual requirement of the foodgrains and fodder in the present year was much higher as compared to the base year. Due to this burden on natural resources for these products had increased significantly in the current year. The carrying capacity in the terms of fuelwood had decreased in the current year as compared to the base year due to poor condition and availibility of resources producing them. The increase in carrying capacity in terms of foodgrains was due to increase in area under agriculture in this area but the carrying capacity of the NPA for fuelwood had decreased more as compared to PA. The WDP could be one of the reason for this difference.

Chapter VI: INVENTORY OF NATURAL RESOURCES IN THE STUDY AREA

Inventory of natural resources is the list of physical resources of an area along with their monetary value at a particular period of time.

Inventories of natural resources prepared at two different periods of time for a particular area represents the difference or change in the availability, condition and value of natural resources between those periods. Therefore for assessing the level of damage or degradation of natural resources of an area inventory preparation is one of the most practical, applied and useful concept as it helps in better planning regarding their conservation and utilization so that ecological balance of the area is maintained along with safeguarding the interests of local population of the area.

Inventory preparation, in the present study of the natural resources is done in two phases. In the first phase physical listing of all natural resources i.e., forests including trees of both timber producing and non timber producing species, land including forest land, agricultural land, scrub land etc. along with their production capacities in terms of fuelwood, fodder, timber, resin and agricultural production for a particular year is done.

Then in the second phase of inventory preparation valuation of natural resources, along with the value of resources produced by them in a particular year, is done. The use of financial prices for estimation of contribution of natural resources like forests in GDP has resulted in the under valuation of natural resources. This consequence of the under valuation are that:

1). Little interest was shown in caring for natural resources especially forests,

2). Weak voice for the forestry sector in the general policy dialogue and

3). Very low economic returns to the producers.

This has resulted in massive deforestation, conversion of forestlands into agricultural lands with its attendant environmental problems and little interest for sustainable resource management.

These traditional price policies in developing countries have worked against forest production, instead favouring agricultural and livestock production activities in the region. Such price distortions have decimated the area's natural resource base, including the forests.

Traditional price policies have consistently under valued, forest resources and other natural resources and have provided an erroneous picture of the real importance of the forest sector and its contribution to the economies of the nations. Such perverse policies have systematically undermined this resource ability to play the economic and environmental role they certainly deserve. Therefore better pricing systems and complete knowledge of price trends of natural resources is necessary and only way to conservation for its use in a sustainable manner. If natural goods and services from natural resources are priced appropriately the foundations will be in place for a major policy dialogue among sectors. The natural resources will finally play the economic role it truly deserves because the real dimension of its contribution will be understood, accounted for and taken into consideration when major economic policy decisions are made.

The detailed inventory preparation of the natural resources in the present year i.e. year 2000 is given below:

6.1 Physical Listing of Natural Resources

Physical listing of available resources and other resources produced on different types of lands is undertaken in the following manner: -

6.1.1 Forest Land

a. Total area under different types of forests and their soil type, topography and accessibility etc. were taken.

b. Total number of timber producing trees in different types of forests: This was estimated from the sample plots species distribution in different types of forests. Both mature and immature timber-producing trees were taken in this category.

c. Total number of non-timber producing trees in different types of forest was estimated from the sample plots laid.

d. Quantity of Resin produced: - The quantity of resin produced was estimated from the production of per mature tree per year from the sample plots and by multiplying this with the total number of mature resin producing trees of the area.

e. Quantity of Fodder Produced: The total quantity of fodder produced from forests was the fodder production capacity of the forests, which was discussed, in the previous chapter.

f. Fuel Wood Produced: Average quantity of fuel wood produced from different types of forests was used for estimating total fuel wood production from the forests.

6.1.2 Agricultural Land

a. Area under types of agriculture i.e. irrigated, unirrigated cultivable, uncultivable etc.

b. Total agricultural production including production of food grains, fodder crops, oil seeds, and vegetables etc.

c. Fuel wood produced: - Total quantity of fuel wood produced from agricultural land was taken from fuel wood production capacity of agricultural lands as discussed in the previous chapter.

6.1.3. Scrub Land

a. Area of scrub land according to different types of land use.

b. Fuelwood production from scrub land.

c. Fodder production from the scrub land during both the current (2000) and base (1991) years respectively.

Once physical listing of Natural resources and resources produced had been completed then their valuation in monetary terms was done according to the average current market prices existing in the area. The details of valuation are given below: -

6.2 VALUATION OF NATURAL RESOURCES

Valuation of natural resources is a very difficult task as there is no set pattern of valuation of natural resources in existence. Moreover no method is free from limitations because all ecological services like nutrient recycling, management and preservation of water cycles, regulation of micro climates, etc.can not be valued, and all goods produced are not transacted in the markets. Hence, serious deficiencies in the competitiveness of the market exist due to governmental interference through strict legislative measures.

In the present study valuation of natural resources like land, forests, trees, fuelwood, fodder, timber, resin and agricultural production is done on the basis of market prices for these resources existing widely in the study area.

The current year's average prices for valuation of natural resources were used for both the current year's inventory as well as base year's inventory so that comparison between both the years could be easily made.

6.2.1 Valuation Of Forest Area

It includes value of forest land, timber as well as non timber producing trees, fuelwood, fodder and resin produced

6.2.1.1 Valuation of Forest Land

Forest lands cover nearly 35.2 percent of the total study area and therefore it was one of the most important resource in itself. Though forest land were not bought or sold in the open market but its importance in the total valuation of resources cannot be neglected. Therefore, the opportunity cost of forest land on the basis of current prices of adjoining lands, was taken for its valuation. The valuation of only tangible

benefits derived from forest was done as estimation and valuation of intangible benefits from forests were beyond the scope of this study.

Table: 6.1
Valuation Of Forest Land (Year 2000) In Lakh

Particulars	P.A.	N.P.A.	T.S.A.
1. Dense Forests @ Rs.70,000 / ha	681.8	2984	3665.8
2. Moderate Forests @ Rs. 1,00,000 / ha	859.2	1491.5	2350.7
3. Degraded Forests @ Rs.80,000/ ha	473.3	430.7	904
TOTAL	**2014.3**	**4906.2**	**6920.5**

From Table –6.1 the value of total forest lands in the total study area were estimated to be Rs. 6920.5 lakh in the year 2000. The forest lands in the PA were valued at Rs. 2014.3 lakh and forest lands in NPA were valued at Rs. 4906.2 lakh , respectively.

The land under dense forests with an average price of Rs. 70,000/ha was having total value of Rs. 3665.8 lakh. The value of dense forest land in NPA was nearly 4.5 times more than dense forest lands of PA. The land under moderate forests with an average price of Rs. 1 lakh per hectare had a total value of Rs. 2350.7 lakh out of which moderate forests land under NPA had value almost double than the moderate forests lands of PA. The land under degraded forests with an average price of Rs. 80,000 per ha has a total value of Rs. 904 lakh. The value of degraded forest land in NPA had been Rs. 430.7 lakh which was less than the respective PA forest land valued at Rs. 473.3 lakh.

6.2.1.2 Valuation of Timber Producing Trees

The total number of timber producing trees was estimated from the sample plots laid and this percentage had been used for estimating the total number of timber producing species trees. Then in the second phase the total number of mature timber providing trees were estimated on the basis of the percentages derived from sample plots.

After calculation of mature timber providing trees on species wise basis, their valuation was done according to their market price existing in the study area i.e.,

a) For *Chir* tree @ Rs. 2000/plant

b) For *Deodar* tree @Rs. 5000/plant

c) For *Fir* tree @ Rs. 2000/plant

d) For *Kail* tree @ Rs. 3000/plant respectively.

According to the above mentioned method the value of timber providing trees in the total study area was estimated to be Rs. 172908 lakh out of which Rs. 136684 lakh of timber providing trees were available in dense forests, and Rs. 36224 lakh of timber producing trees were present in moderate or open forest of the study area in the year 2000(Table –6.2).

Table: 6.2
Valuation Of Timber Producing Trees In The Study Area
(Year 2000)

	Particulars	P.A.	N.P.A.	T.S.A.	
	1	2	3	4	
A.	**Dense Forests:**				
	i) Land under dense forests (in ha)	974	4269.9	5243.9	
	ii) Area under Timber producing species (ha)	730.5	3197.2	3927.7	
	iii) Total no.of trees	1095750	4795800	5891550	
	iv) Number of Mature Timber producing tree	438300	1918320	2356620	
	a) Tree				
	a) Chir	254214	1112626	1366840	
	b) Deodar	100809	441214	542023	
	c) Kail	48213	211015	259228	
	d) Fir	35064	153465	1885	
	v) Valuation of trees (in Lakh)				
	a) Chir @ Rs 2000 /tree	5084.3	22252.5	27336.8	
	b) Deodar @ Rs 5000 /tree	5040.5	22060.7	27101.2	
	c) Kail @ Rs 3000 /tree	1446.4	6330.5	7776.9	
	d) Fir @ Rs 2000 /tree	701.3	3069.3	3770.6	
Sub- Total (I)			12272.4	53713.0	68985.5
	vi) No. of immature timber producing trees	657450	2877480	3534930	
	vii) Valuation in lakh @ Rs. 2000 per plant	1314	957549.6	70698.6	
	Sub- Total (II)	13149	57549.6	70698.6	
Total (I+II)		**25421.4**	**111262.6**	**136684.0**	
B.	**Moderate Forests:**				
	i) Land under moderate forests (in ha)	859.2	1491.5	2350.7	
	ii) Area under Timber producing species (ha)	619	1078	1697	
	iii) Total no. of trees	619000	1078000	1697000	
	iv) Number of Mature timber producing tree	123800	215600	339400	
	a) Tree				
	a) Chir	71804	137984	209788	
	b) Deodar	28474	34496	62970	
	c) Kail	13618	25872	39490	
	d) Fir	9904	17248	27152	

iv) Valuation of trees (in Lac)				
	a) Chir @ Rs 2000 /tree	1436.1	2759.7	4195.8
	b) Deodar @ Rs 5000 /tree	1423.7	1724.8	3148.5
	c) Kail @ Rs 3000 /tree	408.5	776.2	1184.7
	d) Fir @ Rs 2000 /tree	198.1	345.0	543.1
	Sub- Total (I)	3466.4	5605.6	9072.0
v) a)	No. of immature timber producing trees	495200	862400	1357600
b)	Valuation @Rs. 2000/plant (in lakh)	9904	17248	27152
	Sub- Total (II)	9904	17248	27152
	Total (I+II)	**13370.4**	**22853.6**	**36224**
G. TOTAL (A+B)		**38791.8**	**34116.2**	**172908**

In the PA dense forests had 438300 (approx.) number of mature timber producing trees of various species with a value of Rs. 12272.4 lakh whereas the NPA had 1918320 (approx.) number of mature timber producing trees with a value of Rs. 53713 lakh respectively. The number of immature timber producing trees was estimated from their percentage distribution in the sample plots and their valuation had been done at the rate of Rs. 2000 per plant which was the average market price existing in the area for such trees. In the PA moderated forests had 123800 (approx.) numbers of mature timber producing trees with a value of Rs. 3466.4 lakh respectively, whereas in the NPA the moderate forests had 215600 (approx.) numbers of mature timber producing trees with a value of Rs. 5605.6 lakh (Table-6.2). The number of immature timber producing trees in dense forests was estimated to be 3534930 in number with a value of Rs. 70698.6 lakh at the rate of Rs. 2000 per plant. Out of this value nearly Rs. 13149 lakh of trees were present in PA whereas Rs. 57549.6 lakh of timber producing immature trees in NPA respectively. In moderate forests of the total study area the total number of immature timber producing trees was estimated to be 1357600 numbers with a value of Rs. 27152 lakh at the rate of Rs. 2000 per plant. In the PA the value of immature timber producing trees in moderate forests was estimated to be Rs. 9904 lakh whereas in NPA it was Rs. 17248 lakh respectively. As the degraded forest had very few or no timber producing trees at all therefore the trees coming under degraded forests were valued with non-timber producing trees.

6.2.1.3 Valuation of Non Timber Producing Trees

The valuation of non- timber producing trees was done in the following manner: -

1. In the first step number of non-timber producing trees in different forest types were estimated from their percentage distribution assessed from sample plots.

2. In the second step number of immature trees of non-timber producing species were estimated on the basis of percentages of the sample plot.

3. Valuation of total number of non –timber-producing trees was done on the basis of average current market prices existing in that area.

Table: 6.3
Valuation Of Non-Timber Producing Trees
In The Study Area (Year 2000)

	Particulars	P.A.	N.P.A.	T.S.A.
A.	Dense Forests			
	i) Area under Non-timber producing Tree (in ha)	243.5	1072.7	1316.2
	ii) Total Number of Non-timber producing species (ha)	3652501	609050	1974300
	iii) Valuation (in Lakh) @ Rs 1000 / tree	3652.5	16090.5	19743
B.	Moderate Forests			
	i) Area under Non-timber producing Tree (in ha)	240.2	413.5	653.7
	ii) Total Number of Non-timber producing species (ha)	240200	413500	653700
	iii) Valuation (in Lakh) @ Rs 1000 / tree	2402	4135	6537
C.	Degraded Forests			
	i) Area under Non-timber producing Tree (in ha)	591.6	538.4	1130
	ii) Total Number of Non-timber producing species (ha)	147900	134600	282500
	iii) Valuation (in Lakh) @ Rs 1000 / tree	1479	1346	2825
	G.TOTAL (A+B+C)	**7533.5**	**21571.5**	**29105**

According to the above mentioned method valuation of non timber producing trees was done and it was estimated that in the forests that total value of the non timber

producing trees was Rs. 29105 lakh out of which trees in the dense forest had a value of Rs. 19743 lakh whereas in moderate and degraded forests it was Rs. 6537 lakh and Rs. 2825 lakh respectively.

In the PA the dense forests had nearly 365250 number of non-timber producing trees (approx.) with a value of Rs. 3652.5 lakh whereas in the NPA there were 1609050 non timber producing trees with a value of Rs16090.5 lakh, respectively.

In the PA the moderate forests had nearly 240200 number of non-timber producing trees with a value of Rs. 2402 lakh and in NPA there were 413500 number of trees with a value of Rs. 4135 lakh respectively. (Table-6.3) In the PA the degraded forests had 147900 of non-timber producing trees with a value of Rs. 1479 lakh whereas in the NPA there had 134600 trees of Rs. 1346 lakh value.

6.2.1.4 Valuation of Fuelwood Produced from Forests

The valuation of fuel wood forest in the study area was done according to average market price of fuelwood existing in the study area. Nearly 6538.1 Mt of fuelwood was produced from forests in the year 2000 and was valued at the average market price of Rs. 1500 per M.t and was estimated to be of Rs. 98.1 lakh of fuelwood in the study area. In the PA the forests produced fuelwood worth Rs. 27.3 lakh whereas in the NPA the forests produced fuelwood worth Rs. 70.8 lakh respectively (Table-6.4).

Table: 6.4

Valuation Of Fuelwood Produced From Forests (2000) In Lakh

Particulars	P.A.	N.P.A.	T.S.A.
1) Fuelwood Produced	1818.6	4719.5	6538.1
2) Valuation @ Rs 1500/ M.T.	27.3	70.8	98.1

6.2.1.5 Valuation of Fodder Produced from Forests

The fodder produced from forest lands was estimated to be 17435 M.t. for the year 2000 and was valued at an average market price of Rs. 1000 per M.t. to be Rs. 174.4 lakh (approx.). The forests of PA produced fodder worth Rs. 48.5 lakh where as the forests of NPA produced fodder worth of Rs. 125.9 lakh, respectively. The

fodder produced in the NPA was approximately three times both in quantity as well as in value from the fodder produced in the PA (Table-6.5).

Table: 6.5

Valuation of Fodder Produced From Forests (2000) in lakh

	Particulars	P.A.	N.P.A.	T.S.A.
1)	Fodder produced @ 2 M.T. / ha / yr	4949.6	12585.4	17435.0
2)	Valuation @ Rs.1000/M.t	48.5	125.9	174.4

6.2.1.6 Valuation of Resin Produced from Forests

The resin produced in the total study area from forests in the year 2000 was estimated to be 3961.3 Kilolitres out of which 1101.8 Kilolitres of resin was produced in PA and 2859.5 Kilolitres of resin in NPA respectively.

The value of resin at an average market price of Rs. 20,000/K.L. was calculated to be 792.3 lakh for total resin produced. The resin produced in the PA was estimated to be of Rs. 220.4 lakh whereas in NPA it was Rs. 571.9 lakh respectively. (Table-6.6).

Table: 6.6

Valuation of Resin (2000) in lakh

Particulars	P.A.	N.P.A.	T.S.A.
1) Resin Quantity Obtained in (K.L.)	1101.8	2859.5	3961.3
2) Valuation @ RS 20,000 / K.L.	220.4	571.9	792.3

6.2.2 VALUATION OF AGRICULTURAL AREA

It includes the valuation of agricultural land, crops produced, fodder produced and fuelwood produced from agricultural area.

6.2.2.1 Valuation Of Agricultural Land

The valuation of agricultural land was done on the basis of current year's average price existing in the study area. The market price for agricultural land varied according to its: -

a. Productivity;

b. Water availability i.e. irrigated/unirrigated;

c. Topography; and

d. Situation i.e., accessibility to agricultural land.

The average of different prices existing in the study area for agricultural land was taken as the average market price.

On this basis the agricultural land in the total study area was valued at Rs. 17093.1 lakh out of which Rs. 12678.9 lakh of agricultural land was in PA and Rs. 4414.4 lakh in NPA respectively.

The irrigated agricultural land valued at Rs. 2 lakh per hectare, amounted to Rs. 15490.4 lakh whereas unirrigated agricultural land was valued at Rs. 1 lakh per hectare, amounted to be Rs. 1602.7 lakh respectively. (Table-6.7)

Table: 6.7

Valuation Of Agricultural Land (2000) In Lakh

Particulars	PA	NPA	TSA
Irrigated land @ Rs 2,00,000/hec	11309.4	4181.0	15490.4
Unirrigated land @ Rs 1,00,000/hec	1369.3	233.4	1602.7
Total	**12678.7**	**4414.4**	**17093.1**

6.2.2.2 Valuation of Agricultural Products

The valuation of agricultural products in the year 2000 was done on the basis of the current year's average market prices for agricultural commodities existing in the study area.The total production of each commodity was multiplied with its rate on quantity basis.The value of total agricultural produce in the year 2000 was estimated to be Rs.837.3 lakh (approx.) Out of which the major contribution in this value was from the both major crops i.e. Maize & Wheat which was Rs. 179.1 lakh and 116.1 lakh respectively.

The agricultural production in the PA was comparatively much higher than NPA as the area under agriculture in PA was nearly three times the agricultural area in NPA (Table-6.8).

Table: 6.8

Valuation Of Agricultural Products (2000)

		Physical Listing			*Valuation in Lacs*		
		PA	**NPA**	**TSA**	**PA**	**NPA**	**TSA**
	CROPS						
1.	Maize	2578.4	1003.2	3581.6	128.9	50.2	179.1
2.	Rice	660.8	257.6	918.4	52.9	20.6	73.6
3.	Wheat	1520.1	591.3	2111.4	83.6	32.5	116.1
4.	Other Cereals & Millets	66.4	25.6	92.40	2.7	1.0	3.7
5.	Pulses	79.8	31.2	111.0	14.7	5.6	20.3
6.	Oil Seeds	62.4	24.0	86.4	5.0	1.9	6.9
7.	Vegetables	-	-	-	315.5	122.2	437.7
	TOTAL	**4967.9**	**1932.9**	**6900.8**	**603.3**	**234.0**	**837.3**

6.2.2.3 Valuation of Fodder Produced from Agricultural Land

The fodder produced from agricultural land was categorised into two groups: -

1. Green fodder i.e. produced from fodder crops like Berseem, Sweet pea etc.

2. Dry fodder i.e. produced from crop residue like Bhusa, Maize stalks etc.

The productivity of green fodder produced from fodder crops was estimated to be 50 M.t./ ha/ yr. Therefore the total green fodder produced from fodder crops in the total study area was 28165 M.t./Yr out of which 20255 Mt. was produced in PA and 7910 M.t in NPA respectively.

The dry fodder produced from crop residue in the total study area was estimated to be 55090.1 M.t./ Yr which included production of dry fodder at the rate of 12 M.t. /ha/yr for irrigated agricultural land and 4.5 M.t./ha/yr for unirrigated agricultural lands.

In the PA the quantity of dry fodder produced was estimated to be 43003.5 M.t./yr whereas for NPA it was 12086.6 M.t./Yr.

The valuation of green fodder was done at the average price existing in the study area i.e. Rs. 1000 per M.t. for the year 2000 and was calculated to be Rs. 281.65 lakh from the total study area. The green fodder worth Rs. 202.55 was produced in PA whereas in the NPA it was Rs. 79.1 lakh respectively.

The dry fodder produced was valued at an average price of Rs. 2000 per M.t. and was calculated to be Rs. 1101.8 lakh for dry fodder produced in the total study area. In the PA the dry fodder produced was also valued to be of Rs. 860.1 lakh whereas for NPA this value was Rs. 241.7 lakh respectively.

The total fodder produced (both dry and green) from agricultural lands had been estimated at Rs. 1383.5 lakh, out of which Rs. 1062.6 lakh worth of fodder was produced in PA and Rs. 320.8 lakh of fodder in NPA respectively (Table-6.9).

6.2.2.4 Valuation of Fuelwood Obtained from Agricultural Land

The total quantity of fuelwood produced from agricultural land was estimated to be 4674 M.t. in the year 2000, which was valued at an average market price of Rs. 1500 per M.t., to be Rs. 70.11 lakh. In the PA fuelwood produced by agricultural lands of worth Rs. 52.7 lakh and for NPA it was Rs. 17.4 lakh respectively. (Table-6.10)

Table: 6.9

Valuation Of Fodder Obtained From Agricultural (2000) In Lakh

Particulars	PA	NPA	TSA
Fodder Obtained from agriculture in MT			
1. From Fodder Crops @ 50 M.T. / ha	20255	7910	28165
2. From Crop Residue			
a)Irrigated Land @ 12 M.T. / ha	18232.8	2606.4	20839.2
b) Unirrigated Land @ 4.5 M.T. / ha	24770.7	9480.2	34250.9
Total	**63258.5**	**19996.6**	**83255.1**
Valuation (in lakh)			
1. G. Fodder @ Rs 1000 / M.T.	202.6	79.1	281.7
2. Dry Fodder @ Rs 2000 / M.T.	860.0	241.7	1101.8
TOTAL	**1062.6**	**320.8**	**1383.4**

Table: 6.10

Valuation Of Fuelwood From Agriculture (2000) In Lakh

Particulars	PA	NPA	TSA
1. Quantity Obtained (in M.T.)	3512.0	1162.0	4674.0
2. Valuation @ Rs 1500 / M.T.	52.7	17.4	70.1

6.2.3 VALUATION OF SCRUB AREA

It includes the valuation of land, fuelwood and fodder produced from the scrub area.

6.2.3.1 Valuation of Scrub Land

The valuation of scrub land was done on the basis of existing market prices for it for the year 2000. The value or price for scrub land varies according to its land use i.e.

pasture land, common land waste land etc, and on its type and condition i.e. productive, unproductive etc.

The value of scrub land in the TSA from the analysis is estimated to be Rs. 3713.4 lakh out of which Rs. 3030.2 lakh of scrub land is situated in PA and Rs. 683.1 lakh in NPA respectively (Table-6.11).

Table: 6.11
Valuation Of Scrub Lands (2000) In Lakh

Particulars	PA	NPA	TSA
1. Dense Scrub Lands @ Rs 80,000 / ha	2383	493	2876
2. Thin Scrub Lands @ Rs 40,000 / ha	563.4	166.2	729.6
3. Degraded Scrub Land @ Rs 20,000 / ha	863.9	23.9	107.8
TOTAL	**3030.2**	**683.1**	**3713.3**

The dense scrub lands were valued at an average price of Rs. 80,000 /ha and amounted to Rs. 2876 lakh in TSA whereas thin scrub lands were valued at an average price of Rs. 40,000 per hectare and it amounted to a total of Rs. 729.6 lakh. The degraded scrub lands estimated value was Rs. 107.8 lakh, at an average market price of Rs. 20,000 per hectares. In this category the value of land in PA was Rs. 839 lakh whereas in NPA it was Rs. 23.9 lakh only.

6.2.3.2 Valuation Of Fuelwood Produced In Scrub Areas

In the scrub area the quantity of fuelwood produced in estimated to be 595.8 M.t. /yr out of which 480.7 M.t. /Yr of fuelwood was produced from PA and 115.1 M.t./Yr was produced from NPA respectively. The valuation of this fuelwood at the average market price of Rs. 1500 per M.t. was estimated to be Rs. 8.9 lakh for the total scrub area and Rs. 7.2 lakh of fuelwood from PA and Rs. 1.7 lakh from NPA respectively (Table-6.12).

Table: 6. 12

Valuation Of Fuelwood From Scrub Area (2000)

Particulars	PA	NPA	TSA
Quantity of fuelwood obtained from scrub area (in M.t.)	480.7	115.1	595.8
Valuation @ Rs 1500 / M.t.	7.2	1.7	8.9

6.2.3.3 Valuation of Fodder Produced in Scrub Areas

The quantity of green fodder from the total scrub area was calculated to be 17873.9 M.t. per year and of this quantity 14419.8 M.t. per year of fodder was produced in PA and 3453.9 M.t. per year in NPA respectively. The total green fodder produced was valued at an average price of Rs. 1000 per M.t. and was estimated to be Rs. 178.7 lakh out of which Rs. 144.2 lakh of fodder was produced in PA and Rs. 34.5 lakh of fodder in NPA respectively (Table-6.13).

Table: 6. 13

Valuation Of Fodder Produces From Scrub (2000) In Lakh

Particulars	PA	NPA	TSA
1. Quantity obtained from in M.t.	14419.8	3453.9	17873.9
2. Valuation of Fodder @ Rs 1000 per M.t.	144.2	34.5	178.7

6.3 INVENTORY OF NATURAL RESOURCES IN THE YEAR 2000

The inventory of natural resources in the total study area was estimated to be of Rs. 232883 lakh out of which resources worth Rs. 65926.6 lakh were in PA and resources worth Rs. 129553.37 lakh in NPA respectively. The major contribution in the inventory of the study area was from forests lands and they constitute nearly 90.2 percent of the total inventory of resources of the study area in the current year. The forests in the study area had produced resources worth Rs. 209997.8 lakh. In addition to these resources forests were providing some other services, which cannot be measured and valued such as ecological benefits, wild life habitations and

aesthetic benefits to the society. Therefore forests are the most useful resources in the study area.

The valuation of agricultural lands and products was estimated to be of Rs. 18984.3 lakh out of which Rs. 14109.5 lakh worth of goods and resources were present/produced in the PA which was nearly 74.3 percent of total value of resources and products of agricultural lands. In the NPA the goods/resources, produced/present were valued to be of Rs. 4874.8 lakh only.

The value of resources/products, present/produced in the scrub areas were estimated to be of Rs. 3900.9 lakh out of which only the PA accounted for nearly 81.6 percent as maximum area under scrub lands was present in PA. The NPA had resources/products in the scrub area worth Rs. 719.3 lakh (Table-6.14).

Table:6.14

Inventory Of Natural Resources In The Study Area (Year 2000)

Physical listing				**Valuation (in Lakh)**		
1. P	PA	NPA	TSA	PA	NPA	TSA
A. Forests						
1. Land (ha)	2424.8	6292.4	8717.5	2014	4906	6920
Timber Producing Trees (No)	1714750	5873800	7588550	38791.8	134116.2	172908
Non-timber Production	75335	2157150	2910500	7533.5	21571.5	29105
Fuelwood Prod. (M.T)	1818.6	4719.5	6538.1	27.3	70.8	98.1
5. Fodder Prod. (M.T)	4849.6	12585.4	17435	48.5	125.9	174.4
6. Resin (K.L.)	1101.8	2859.5	3961.3	220.4	571.9	792.3
Sub. Total				48635.5	161362.3	209997.8
B. Agriculture						
1. Land (in ha)	7024	2323.9	9347.9	12678.9	4414.4	17093.3
2 Fuelwood (M.T)	3459.5	958.8	4418.3	52.7	17.4	70.1
3. Crop prod. (M.T)	4967.9	1932.9	6900.8	315.6	122.2	437.8
4. Fodder Prod. (M.T.)	63258.5	1996.6	83255.1	1062.3	320.8	1383.1
Sub Total				**14109.*5***	**4874.8**	**18984.3**
C. Scrub Area						
1. Land (in ha)	4806.6	1151.3	5957.9	3030.2	683.1	3713.3
2. Fuelwood (M.T)	480.7	115.1	595.8	7.2	1.7	8.9
3. Fodder (M.T)	14419.8	3453.9	17873.9	144.2	34.5	178.7
Sub Total				3181.6	719.3	3900.9
Grand Total				**65926.6**	**166956.4**	**232883**

6.3.1 Comparisons Of Inventories For The Base Year (1991) And The Current Year (2000)

The increase in the monetary value of agricultural lands and scrub lands along with their products in the current year as compared to the base year, was far below the decrease in the monetary value of forest lands and its products. Therefore the increased monetary benefits from agriculture and scrub lands by sacrificing forest lands, was no substitute as the value of forest resources in the TSA in the year 2000 was found to be less than the base year's inventory of natural resources by Rs. 37046.5 lakh. The PA had decreased natural resource value of Rs 14595.2 lakh whereas NPA had decreased natural resource value of Rs. 23365.4 lakh respectively in the current year as compared to the base year.

Comparisons of inventories for the base year (1991) and the current year (2000) shows that major decrease in the value of inventories was due to the decrease in the value of forests and its resources. Decrease in the forest area was due to because of large-scale deforestation and overexploitation of forest resources for human and animal needs. This poses a serious threat to environment and can result into ecological imbalance if something is not done immediately to restore the lost and degraded status of forest resources.

The value of goods produced from forest sector in the TSA decreased by nearly Rs. 39856.1 lakh in the current year from the base year, which was nearly 16 percent of the base year. (Table-6.15).

The decrease in the value of forest and its resources in the PA was estimated to be Rs. 15406.4 lakh whereas for NPA this decrease was estimated at Rs. 24449.7 lakh respectively.

The increase in the value of agricultural land and products in the TSA was estimated at only Rs.1579.6 lakh, which was 9 percent increase from the

base year value. In the PA the increase in the value of agriculture land along with its products in the current year from the base year were estimated to be Rs. 602.2 lakh whereas for NPA this increase was of Rs.977.4 lakh respectively from the base year.

The increase in the value of scrub lands along with its products in the current year was estimated at Rs. 1230 lakh out of which Rs.209 lakh of increase was from PA and Rs. 106.9 lakh worth of increase was from NPA as compared to the base year.

Conclusions

Inventory preparation was done in two phases where physical listing of forest resources including tress of both timber producing and non timber producing species, land including forest land, agricultural land and scrub lands alongwith their production capacities in terms of fuelwood, fodder, timber, Resin and agricultural products for a particular year was done. Comparison of inventories showed that monetary value of agricultural lands and scrub lands has increased by sacrificing forest lands. The decrease in the value of inventory in the current year was due to large scale deforestation and overexploitation of forest resources which had led to decrease in their value over the years.

Chapter VII : MANAGEMENT OF NATURAL RESOURCES

From the comparison of land use/land cover pattern of the study area during two different periods i.e. year 1991 & 2000,it was quite concerning that such drastic changes in the area under forest lands had taken place. Also the area under agriculture and scrub lands had also increased which in very undesirable as the study area falls in Udhampur district of J&K which already has more than 17 percent of its total geographical areas under waste lands (as reported by NRSA Hyderabad). Moreover, the Carrying Capacity of the study area was far below than their actual requirement of resources produced by natural resources in the study area, putting immense pressure on the natural resources leading to their overexploitation and degradation. The seriousness of this problem can be judged from this fact that the total study area of 24753.2 ha has approximately 20792.7 ha of land i.e., nearly 84 percent area under different soil erosion intensity classes (III, IV and V). These soils had poor nutrient availability and production potential, making them more liable to soil erosion and degradation. Therefore, these soils require immediate attention for their conservation and rehabilitation. In the total study area 7611.3 ha i.e., 81.4 percent of agricultural land is unirrigated or rain fed, resulting in limited or reduced production and under exploitation of land resources. Moreover, the water situation in the study area was also pathetic as on the one hand nearly 60-70 percent of the total annual precipitation in the study area is lost as run-off whereas on the other hand many areas have no water for irrigation or drinking purposes.

Therefore, the immense pressure in these resources can be somehow eased by effective management of these resources with stake holder's co-operation and participation. An Integrated Wasteland Development Project for Chenani Watershed (Udhampur district) was formulated by J&K Forest Department during the year 1990 and was started as a centrally sponsored scheme with the help of NWDB, in 1992. The Chenani Watershed Development Project was executed in 30 micro watersheds drawn from 24589 ha of Chenani Watershed, Udhampur district with financial implication of 229.50 lakh for:

A. Conservation of ecologically fragile area of 3300 ha.
B. Regeneration and development of degraded forests in this degraded area.

The Watershed Project implemented in this area was of very small scale i.e. covering only 3300 ha (out of 27453.0 ha of total watershed area) for a period of five years only i.e. 1992-1997. But this Micro-Watershed Development improved the existing management situation of natural resources in the study area and provided many tangible and in-tangible benefits. The measure of intangible benefits from this project was beyond the scope of this study therefore, only tangible benefits that followed due to effective management are given below:-

A. Conservation of Ecologically fragile area

Nearly 1300 hectares of ecologically fragile area was treated during the Project tenure, Out of this area 500 ha of land was afforested for fuelwood & fodder 400 hectares of land was used for pasture development, 200 hectares of land was planted with various agro-forestry horticultural tree and rest of 200 ha is planted with shrubs, grasses and legumes to conserve moisture and to control erosion (Table 2).

B. Regeneration and development of degraded forests

For regeneration and development of degraded forests nearly 2000 ha of land requiring immediate attention was taken up. Natural and artificial regeneration was practised in 1000 ha and 500 ha respectively nearly 500 ha of land was planted with shrubs, grasses and legumes for providing land cover to degraded lands (Table - 7.3).

7.1 CLOSURE FORMATION

Species of Perennial grasses grow in eroded and degarded areas when gullied areas are closed to all kinds of biotic interferences, soil and water losses progressively decreases and there is a marked quantitative and qualitative improvement in the yield of grasses. Hence, during the project period nearly 3270 ha of area was converted into closures with fencing of 699731 rft, to check infiltration of humans and animals thus saving forestland from further encroachment and deterioration (Table – 7.2)

7.2 SOIL AND MOISTURE CONSERVATION

For the protection, conservation and regeneration of soil and moisture in the study area various mechanical as well as vegetative measures were adopted. Some of the important are discussed below :-

7.2.1 Mechanical measure

Mechanical measures essentially consist of construction of mechanical barriers across the direction of the flow of water to retard or retain the runoff and thereby reduce soil and water losses. In addition to protection, some mechanical protection were also necessary as the situation was grave and most of the area was highly vulnerable to soil erosion. As the study area had hilly terrain with high slope and according to law of falling bodies the erosive of runoff water increases by 4 times when the slope is doubled and its capacity to carry the same quantity of material increases by 32 times (as it varies with the fifth power of the velocity of water). Therefore, on steeper slopes the erosive power of water does not get added but gets multiplied several times. The mechanical adopted in the project area are as follows:-

a. **Formation of DRSM**: In order to absorb and slow down the flow of run off water to reduce soil erosion 14821 cu.m of work under Dry Rubble Stone Masonary (DRSM) was done.

b. **Construction of Stone Crates**: - In order to check the rapid flow of water about 160 crates measuring Seven hundred and seventy three (773) cu metric have been constructed (Table no.1)

7.2.2 Vegetative Measures

Due to high initial cost, continuous maintenance and high level of skill required for the construction of mechanical structures, vegetative measures are considered to be the best option for conservation of Natural resources. Vegetative measures like planting trees, grasses, contour farming, mulching, strip cropping mixed cropping etc. not only provide protection to agricultural lands from soil erosion but also help in increased and continuous production of fodder and fuelwood through out the year.

Beside mechanical measures, intensive plantation was done in this area during the project period (i.e. 1992-97)

(a) **Plantation of Trees** : To rehabiltate and regenerate the degarded forest in the study area various species of fast growing trees were planted. Total of 12,42,188 trees were planted which were raised in nurseries spread over 2.5 ha. The survival rate in plantation is estimated to be 51.8 percent, which is quite good considering the mountainous terrain of this area. These tress grown will not only help in improving the present status of forest in this area but will also help in betterment of environment with various ecological benefits in the year to come.

Table – 7.1
The Percentage of Species Planted in Watershed Area

S.No.	Name of the Plant Species	Percentage Distribution
1	Robinia	91.00
2	Mulberry	0.94
3	Chir	0.75
4	Oak	0.48
5	Hoper	1.36
6	Bamboo	1.69
7	Apple	0.47
8	Ulnus	1.36
9	Salix	0.95
10	Others	1.00
Total		100

Source: Evaluation Report of the Agricultural Finance Corporation Ltd., Mumbai- 1998

The Table clearly shows that species like Robinia followed by Bamboo, Hoper and Ulnus formed the major percentage of the trees planted.

b) **Patches Grown**: - To improve the percolation and permeability of rain water soasto protect the soil from its splashing and dashing action , patches of Red clover, Grasses and Deodar were planted in all 2,63000 patches were planted. Species wise description is given in Table no.2. These patches of grasses will not only help in holding or saving soil from erosion and degradation but will also improve the soil structure and texture by adding various nutrients to it .Moreover, these grasses will also provide valuable Fodder for the livestock population of this area in the future.

7.3 PEOPLE'S PARTICIPATION

People's cooperation and participation with effective management is a pre-requistic for the success of any WDP. People's participation in a watershed development and management programme is crucial for their successful, sustainable and cost effective implementation. Local communities formed help in resource conservation and development programmes in various ways like Sharam Dan (voluntary labour), Kulhadbandi (ban on tree felling), Charai bandi (Ban on grazing), and maintanence of newly created assests during the development projects.

The people living in the project area were involved in the project activities like formation of closures, protection of plantations, management of common property resources. For these purposes forest protection committee's were formed in 7 villages in the project area. In the next few paragraphs details of various economic benefits that the local people derived from the WDP are given.

But the people's cooperation and participation cannot be ensured unless they are benefited directly and immediately from project activities. Farmers are not interested in long-term gains from any project and are not willing to sacrifice, especially if they are living on the margin of subsistence. The poor cannot stop grazing their animals in the highly degraded and overgrazed common lands for the sake of their conservation when their lives depend on the animals. Therefore in order to provide immediate benefits to the local people dependent upon natural resources directly or indirectly, there is an urgent need for increasing the carrying capacity of the area, which helps in providing economic benefits to the locals and thus ensures their cooperation and participation in conservation and development of natural resources.

7.4 EMPLOYMENT GENERATION

For forestry developmental works nearly 17601.5 man days of skilled work and 214156.5 man days of unskilled work or in all 231758 man days of total work as generated during the project period and mostly locals were major beneficiaries of these employment opportunities. This has not only provided economic benefits to the local population but has also ledto their population led to their participation which will help in generating feeling of responsibility and belongingness for the assest created during the WDP.

7.5 USUFRUCTS OF THE PROJECT

These benefits will directly help in improving the carrying capacity of the study area alongwith the socio economic conditions of the people.

a. **Grasses Harvested**: - During the project nearly 2964 beneficiaries harvested 6848 qtls of grass from the various closures made by project authorities.

b. **Fuelwood Collected**: - A total of 2227 qtls of fuelwood was collected by the locals from the closures during the project period.

Better availibility of fodder and fuelwood had provided additional opportunity for subsidaries source of income like Basket making, rearing of silk worm, collection of honey, growing of mushrooms, collection of morshella and increased production of milk and its products.

a) **Fruits**: - Nearly 20 qtls of *Anardana* was collected by locals from the fruit trees planted during the project period and this will help in improving the economic conditions of the people in the years to come.

b) **Acquisition of Fuel Saving Devices**:- To ease pressure on forest for fuelwood, 1100 fuel saving devices were given free of cost to the locals, in which 700 Smokeless *Chullah's*, 2 gobar gas plants, 1 solar light had been installed in villages so as to publicise the non conventional energy sources and to ease pressure on conventional energy sources. People were also provided pressure cookers for better fuel efficiency in this area.

In short the various activities or works undertaken during this Project period i.e. 1992-97, which had improved the existing management situation of the natural resources in the study area have been given in the form of tables i.e. 7.1 & 7.2 respectively.

Table – 7.2
Physical Achievements During The Period (92-97)

S.No	Item of Work	Total
1	Area Closed (Ha)	3270
2	Fencing in rft (Four stands)	699731
3	DRSM (Cu.m)	15,167
4	Plantation of Trees (No's)	12,42,188
5	Patches: -	
	Red clover	2,36,000
	Grasses	8,000
	Deodar	19,000

		2,63,000

6	Tending of trees (No, s)	72,000
7	Laying down crates	
	No's	106
	Area (cu. m)	772.69

Table – 7.3
Components Of Workdone During The Project Period

S.No.	Component of Work	Work Done
A	Conservation of Ecological fragile Areas	
1.	Afforestation of fuel wood & fodder	500 hectares
2.	Pasture Land Dev.	400 hectares
3.	Promotion of Agro forestry, Horticulture and Sericulture etc.	200 hectares
4.	Planting of shrubs grasses, legumes, trees etc.	200 hectares
5.	Soil and Moisture Conservation	18726.71 cum 1300 ha + 18726.71 cum.
B)	Regeneration and Dev. of degraded forests Area	
1.	Promotion of Natural Regeneration	1200 hectares
2.	Artificial Regeneration	500 hectares
3.	Planting of shrubs, grass legumes, trees etc.	500 hectares
4.	Promotion of fuel saving devises.	1100 numbers 2400 ha & 1100 nos.

Table 7.2 showed the details of the physical achievements of the WDP whereas Table 7.3 indicates the various components of work done during the project period.. The activities performed during this project have not only generated awareness among the local population regarding effective management of natural resources through people's co-operation and participation but have also helped in improvement of the status and conditions of the natural resources in this area. The major ecological and environmental benefits of the WDP from newly planted tree species, grasses grown and various mechanical measures would be seen in the years to come.

Chapter VIII : POLICY IMPLICATIONS

On the basis of the this study it can be safely concluded that over the past ten years i.e. from year 1991 to 2000, large scale deforestation and overexploitation of natural resources beyond their natural capacity to rehabilitate themselves, has resulted in enormous change of land use pattern greatly disturbing the environment and ecological balance of the study area. The conversion of different categories of forest lands into agriculture lands has left little scope for their reclamation and rehabilitation, resulting in large scale soil erosion from the study area as agriculture lands are more prone to erosion problem.

Faulty methods of land use and traditional agriculture in this area have resulted in low production and productivity levels, low income for farmers, wastage of soil nutrients, which has negatively affected the quality of soils over the years.

The inefficient use of scrub lands and common property resources (CPR's) has resulted in under production from these resources and making no improvement in their status in rural economy.

The production capacity of natural resources has also suffered due to their poor condition. The carrying capacity of forests in terms of fuelwood, fodder, timber and resin has decreased significantly over the past ten years. The carrying capacity of agricultural lands has increased but not in the same proportion as the area under agriculture has increased. Moreover, the increase in agriculture production cannot justify the loss or decrease in the forest production capacity in any way i.e., either economically or environmentally.

The production capacity of scrub lands has increased in terms of fodder and fuel wood but this increase is due to increase in the area under scrub lands and not due to an increase in their productivity potential. Therefore, this increase in scrub area is a matter of great concern as the study area falls in Udhampur district, which already has more than 17 percent area under wastelands.

The inventories of natural resources made for the year 1991 and 2000 showed significant decrease in the value of natural resources in the current year due to poor

resources condition and production level. The value of agricultural productions, and goods produced from scrub lands have increased in the current year's inventory but the huge decrease in the value of forest resources has resulted in overall decrease in the value of natural resources of the study area in the current year.

From this study it is also concluded that in the PA, where watershed development programme (WDP) was launched (1992-97) by Forest Department, J& K Government, the decrease in the area under forest and its production capacity was less when compared with NPA of the study area. The area under agricultural lands had increased by only 105 ha in PA as compared to NPA where this increase was estimated to be 406.4 ha (Table -4.8). Moreover, the people of PA area had been benefitted from this WDP in different ways like getting employment opportunity, awareness about natural resources, improved agricultural production, improved cropping pattern and overall increase in income level. Certain shortcomings were also found in the implementation and management of WDP in the PA .The details of WDP in terms of activities and targets achieved in this area are given in Annexure B of this report.

Therefore, on the basis of above conclusions drawn from the present study and the shortcomings of the WDP in the study area, some recommendations for future policy implications and framing the future Watershed Development Projects for the conservation and reclamation of natural resources along with an increase in the benefits derived by the local population from natural resources.

Detailed recommendations are given below:

8.1 LAUNCHING MORE WATERSHED DEVELOPMENT PROGRAMME

More watershed development programmes on micro watershed basis should be launched in these areas. With people's participation, involvement of Panchayati Raj Institutions, Local User Groups and NGO's along with institutional support from different levels viz., the union government, the state, the district and block level should be ensured to make the programme more participatory interactive and cost effective. Convergence of various rural development programmes in around the watershed could be ensured to promote holistic development of watersheds. For its continuous success, the programme should be economically efficient, financially

viable, technically feasible and socially acceptable while ensuring equity. Regular and routine monitoring of environmental parameters is important as environmental enhancement increases the creditability and acceptability of the programme. Some other steps, which would help in effective and efficient implantation of watershed development programme, are:

8.1.1 Coverage Of The Area

The main focus of such programmes should be on rainfed, remote inaccessible areas inhabited by weaker sections like tribal, SC's, ST's etc. the selection of micro watershed should be on the basis of degree of fragility, run off proneness, semi-aridity, level of environmental degradation etc.

8.1.2 People Participation

To make the programme people centred and people driven, awareness and confidence building is necessary .For making the programme a peoples programme, they should be Sensitised, empowered and involved in the programme. Local community leaders and stakeholders should necessarily be motivated about conjecture use of resources and assets created during the programme. The stakeholders should be involved at different stages of programme activities i.e. from planning and implementation of activities to maintenance of newly created assets. For sustainability to ensure active participation of landless and other weaker sections of the society alternative income generations, employment opportunities in watershed development activities, management of common property resources (CPR's) should be entrusted to these groups to give them a sense of responsibility and belonging as well provide them suitable economic incentives on a continuing basis. Some entry point activities like repair of school building, village temple or mosque etc. would also help in winning people's confidence.

8.1.3 Funding of WDP

Funds should be mobilised through different sources i.e. State Government, Central Government, Multilateral Financial Institutions, International Financial bodies. Timely procurement of funds should be ensured along with regular increase in them, for the success of WDP.

Since farmers in rainfed areas are generally poor therefore credit through various institutional sources should be provided for improving farm productivity through increased input use. This will help to strengthen linkages and spin off benefits. The mobilisation of funds from these beneficiaries should be in the form of family labour, transport facility, inputs to various activities in water sheds. Such participatory resource mobilisation should be ensured to promote sustainability, accountability and operational efficiency.

8.1.4 Technology

Experience gained in implementation of watershed programmes during the last two decades should be utilised for identifying economically efficient, locally acceptable low cost technologies, like construction of water harvesting structures, ploughing across slopes and along contours for checking soil erosion, field bunding and mulching which help in situ moisture conservation and prevention of run-off, adoption of scientifically best suited crop rotation, cover cropping, mixed cropping for improving soil moisture and reducing soil erosion. Various economically viable and ecologically upgraded enterprises like horticulture, api-culture, sericulture, sivli-culture can be undertaken on waste lands or common property resources, which will not only improve their condition but will also provide enhanced economic returns.

8.1.5 Miscellaneous Steps

Some other steps other than those discussed above are required for success of WDP like meticulous planning and close monitoring should be maintained to prevent time and cost over runs. Appropriate management structures should be developed to trigger responsibility, accountability and efficiency. All governmental agencies like Ministry of Agriculture, Rural Development, Environment and Forests, Planning and Programme implementation NGO's, Multilateral Financial Institutions should have integrated approach for holistic development of the water shed rather than working with different set of objectives and focussing on one or two sectoral activities leading to confusion and mismanagement of development programme for such areas.

8.2 INCREASING ACCOUNTABILITY OF WDP

The maintenance of quality audit of each activity in WDP should be done so as to make the financial transactions transparent, verifiable and debatable. Attainment of physical and financial targets alone should not be the basis of performance for WDP. Routine monitoring through scrutiny of regular periodical reporting of progress, there is need of think tank at central and state level for identifying important issues that require quick studies to provide feedback to policy makers and help them in deciding the course of action.

For increasing the efficiency and accountability of WDP's, reports regarding corruption in watershed development projects should be scrutinised for example in May 1995 India Today, issue of an article " Erosion by Corruption" where soil conservation officials were caught red handed fudging records which mention cases of leakages and fudging of records as also with every monsoon soil conservation work tends to get washed away opening up several channels for siphoning off of public money in one state. In another case reported by Hindustan Times in July 28, 1996, where 90 percent of Rs. 500 crore allocated for WDP, had been misused. Therefore concerted efforts should be made to promote transparency and increase people's confidence in such programmes. The need for transparency and accountability becomes more important in view of huge funds involved for watershed development programmes.

8.3 SPREADING AWARENESS AMONG LOCALS

The success of any conservation and developmental programme for natural resource can not succeed without active people's participation but before demanding cooperation and participation, people should be made aware about the role and importance of natural resources and their present condition in the area concerned. The awareness building measures include film shows in watershed villages, community visits to model watersheds/research watersheds, publication and distribution of non technical literature to farmers, participatory extra mural activities etc.

This measure help in generating awareness among locals, along with confidence on WDP activities and thus forms the basis of their participation and cooperation in

WDP like *Sharamdaan* (Voluntary Labour), *Kulhadbandi* (ban on tree feeling), *Charaibandi* (ban on grazing) etc.

8.4 TRAINING AND CAPACITY BUILDING OF STAFF

The importance of training for different levels of functionaries within the participatory watershed development programme should be done. The training with focus on theoretical and technical topics with orienting training to actual tasks that are likely to be performed by the respective cadres or institutions/organisation should be given knowledge and skills do not get internalised and liberated into action or behaviour unless opportunity for repeating and practising what is learnt is not provided during training.

Moreover learning takes place better when trainees get opportunity to respond, interact, perform and practice. Therefore any innovative programme requiring substantial change from top-down to participatory approach and process there is need for training programmes to focus more on ideas, attitudes, behaviour, conviction and dedication. The training of staff can be divided into various categories from top to bottom level as given below: -

8.4.1 Training Of State And District Level Officials

Training of state level officials (Commissioner, Ministry of Rural Development) and district level officials (Collectors, Project Directors etc) should be done by integrating formal training with informal training. Emphasis in this training programme should be given not only on technical and disciplinary aspect of watershed development but also on various tasks, problems and issues which these officials are likely to face in administering and monitoring watershed development programmes. The newly devised most efficient procedure for facilitating, encouraging and strengthening the participatory process should be taught to these officials.

8.4.2 Training Of PIA's (Project Implementation Agency)

The PIA's hold important responsibility, for initiating watershed projects in villages. There are two categories of PIA's operating in our country i.e. Governmental Organisation PIA's and Non Governmental Organisations PIA's. Both these PIA's

work independently or generally competitively. If they can cooperate and work jointly in larger interests, it can result in better implementation of WDP.

Both these PIA's need to take training in both technical and social aspect for improving efficiency in implementation of WDP's.

8.4.3 Training of WDT's (Watershed Development Team)

The key functionaries in the participatory watershed development are the WDT members who are supposed to carry the full burden of field inter actions and activities working in partnerships with people and unfolding the participatory process in watershed villages. Most of them are young inexperienced and poorly paid. Training of WDT members is not just a matter of preparing them for various subjects/topics on watershed. It is a matter of preparing their mind, attitude and behaviour because it is through them that new grassroot institutions will take shape and their capacity in planning and implementing various programmes activities will emerge. They need to be sensitised about importance of sustainability, participatory approach and process as opposed to the existing top-down process, importance of gender and equity, importance of establishing good relationship and partnership with people, the difficult social dynamics in village setting in which they have to work etc. The success of the programme depends upon their management and technical ability but more so on their social and communication ability for rapport/awareness building, community mobilisation and capacity building.

8.4.4 Training of Self Help Groups (SHG's) and User's Group (UG's)

The real challenge of community mobilisation and capacity building is at the grassroot level, in the villages unless the stakeholders and beneficiaries are not involved in programme activities, sustainability remains doubtful. Therefore involvement of SHG's and UG's or volunteers in planning, implementing and maintaining the assets, should be promoted.

Capacity building methods, procedures and activities for village institution will have to be qualitatively and quantitatively different from capacity building for PIA's or WDT's for example lectures are of little value and literary material are virtually redundant. Therefore main emphasis for training of SHG's or UG' should be on (i)

learner oriented training, (ii) Participatory appraised and learning methodologies (PRA's, games and visual) (iii) Awareness building through dialogue, cultural performances and campaigns, (iv) Exposure visits to learning related sites, (v) lateral learning from experienced villages, (vi) Opportunities to repeatedly practice the task/skill, (vii) Involvement of key locals participants in learning exercises and communications, (viii) Sharing experiences and participatory evaluation (Progressive learning from trials and experience).

8.5 INCREASING CARRYING CAPACITY OF THE AREA

The carrying capacity of the watershed area can be increased by different measures on different types of lands for example: -

8.5.1 Forest Lands

The production capacity of forest lands in terms of fuel wood can be increased by growing more fuel wood providing species on the forest lands. Effective closure formation for restricting the entry of humans and animals, growing of perennial grasses like Napier grass, can help in improving the fodder production of forest lands.

8.5.2. Agricultural Lands

The production capacity of agricultural lands in terms of foodgrain, can be increased by adopting improved scientific methods of cultivation, intensive use of inputs, mixed cropping, intercropping etc. The production of fuelwood from agricultural lands can be increased by adopting agro-forestry practices i.e., growing of trees on the borders of fields or in blocks along with crops.

The fodder production from these lands can be increased by adopting overlapping system, relay cropping and grass legume mixtures. The overlapping cropping system evolved by taking advantage of the growth periods of different species. This system ensures a uniform supply of green fodder throughout the year. Whereas in relay cropping three or four successive fodder crops are grown in succession thereby increasing the fodder production per unit area.

8.5.3 Scrub Lands

The carrying capacity of scrub lands can be increased by efficient use of these lands by local communities for example: - Common lands can be used for fodder production, village ponds for pisciculture, and lands with low productivity for growing of trees including fruit trees. Thus by using common property resources efficiently the fodder and fuelwood situation can be improved. Moreover use of cheap local technologies for reclamation of wastelands will result in appropriate exploitation of these wastelands.

The management and technological practices for development and enhancing the productivity of these degraded non arable lands can be categorised into three heads:

i) **Ecological Management :** This will include steps like protection from grazing by fencing, control of weed and bush growth on these lands, reseeding of the area with better species of grasses and legumes and fertilization of these soils will help in enhancing the production capacity of these lands.

ii) **Utilisation Management :** Proper utilization of pasture land in scrub lands can be achieved by controlled grazing, rotational grazing, rotational deferred grazing and by harvest management. This will help the plants in development of root systems of good varieties of grasses and legumes.

iii) **Silvi Pastoral System of Management:** The practice of growing fodder cum fuel trees in association with grasses is known as Silvi Pastoral System. This method has been recognised as low cost input of technology for utilization of vast non-arable lands for mitigating the biomass requirement along with serving in the reclamation and conservation of the land resource.

8.5.4 Other measures

Some other measures for increasing the carrying capacity of the study area in terms of fuel and fodder requirement are recommended like.

a. **Reduction in Animal Population: -** Only high milk yielding, stronger and heavy work animals etc., should be kept and useless animals should be discarded.

b. **Fodder Conservation:** - As the production of fodder is seasonal and time bound therefore during peak seasons its availability is in access whereas scarce during lean periods. The best way to regulate the supply of palatable a nutritive fodder during lean periods is by conserving the surplus fodder in the form of silage and hay. Silage is the product obtained by packing fresh fodder in a suitable container and allowing it to ferment under anaerobic conditions, with out under going much loss in nutrients. Where as hay is the conversion of green fodder in dry forms without affecting quality of original matter.

c. **Use of Tree Tops:** - During lean periods of spring and summers tree tops can be used for feeding the live stocks. The young leafy succulent material of trees is highly nutritive and rich in crude protein and minerals. They serve as concentrate and lopping of the tree contain some substances, which quickly bring animals into reproduction phase. Some important trees used for animal feeding are *Sesbania, Kubabul* etc.

d. **Use Of Alternatives Of Fuelwood: -** Alternatives of fuelwood like kerosene oil, LPG etc should be made more popular in the area.

e. **Use Of Renewable Sources Of Energy: -** Use of solar cookers, solar lights, gobar gas plants should be promoted for mitigating the demand of fuel sources, which will also help in reduction of pollution in these areas.

f. **By Auction Of Forest Products: -** The fodder and fuelwood produced by forests should be collected by forest staff and auctioned to village cooperative will help in checking illegal entry into forests lands and this will help in increasing the carrying capacity of forest lands.

8.6 STRICT LEGISLATIVE MEASURES

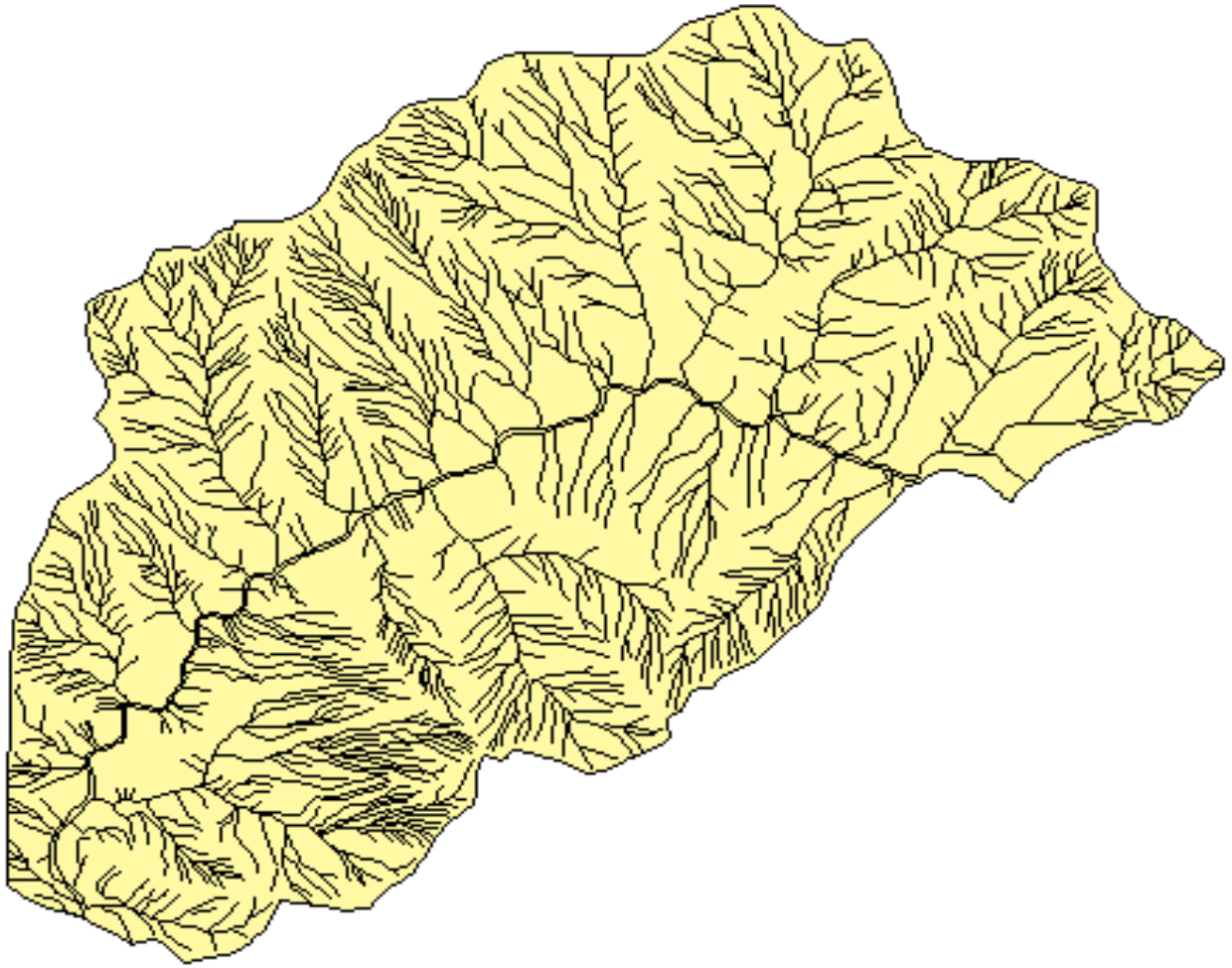
Gandhiji has once said that " The mother nature has sufficient to meet people's need but not people greed".

The conservation and reclamation of natural resources in any area cannot be ensured if strict legislative measures are not taken against persons found to be guilty of breaking the rules and regulations. These measures would help in checking illegal felling of trees, illegal encroachment on forest lands, theft of forest products etc. This will not only keep check on people's greed but will also help in stopping further degradation of forests due to these menaces.

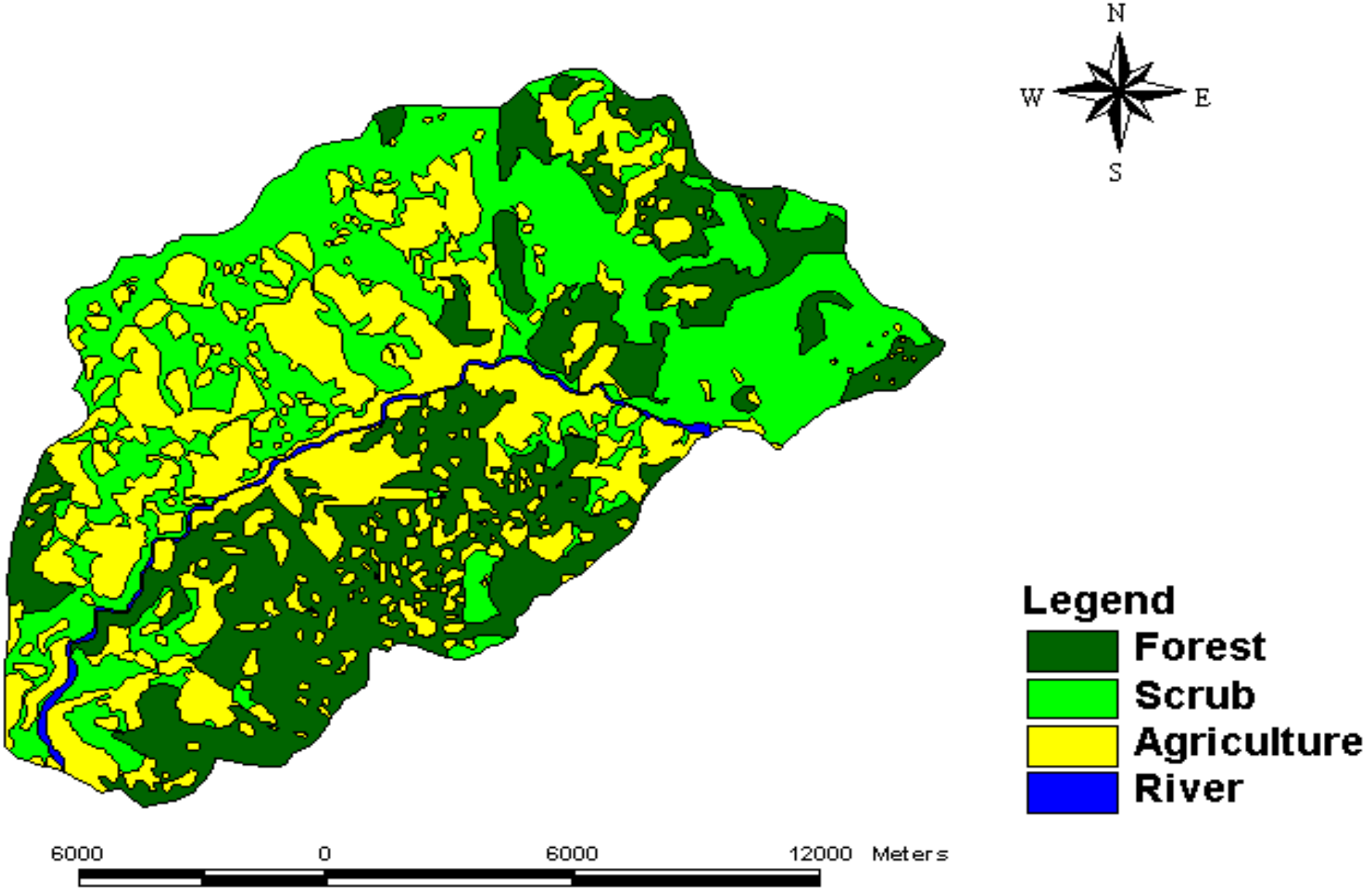
8.7 INCENTIVES FOR LOCAL POPULATION

The basic aim of WDP's is the conservation and reclamation of natural resources along with improvement in the social, economic condition of the local population. These aims can be achieved by providing benefits/ incentives of WDP's to the local population in the form of employment opportunities in programmes activities, supply of non conventional sources of energy to these locals, improving the awareness and management capacity through training of locals, increased returns from agriculture due to improved resource utilization, creation of assets like closures, water harvesting structures, soil erosion controlling structures, fodder, fuelwood from forest closures. These steps will not only help in improving the economic and social status of local people of the study area but will also encourage them for cooperating and participating in WDP’s. As success of any WDP depends on people's participation and cooperation therefore, this step will help in success of other WDP’s in future.

Drainage Map Of Cheneni Watershed

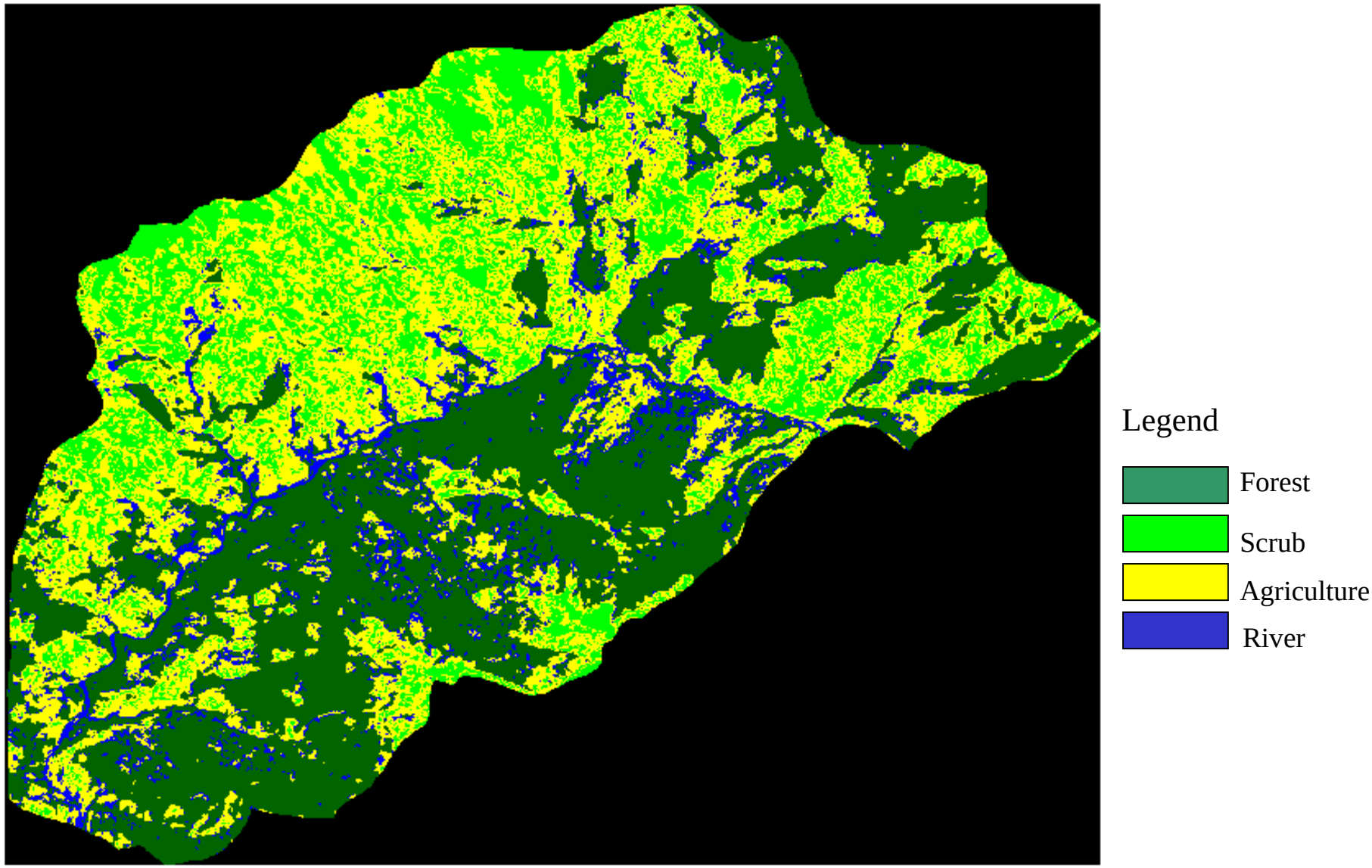


Landuse/Land cover Map of Cheneni Watershed



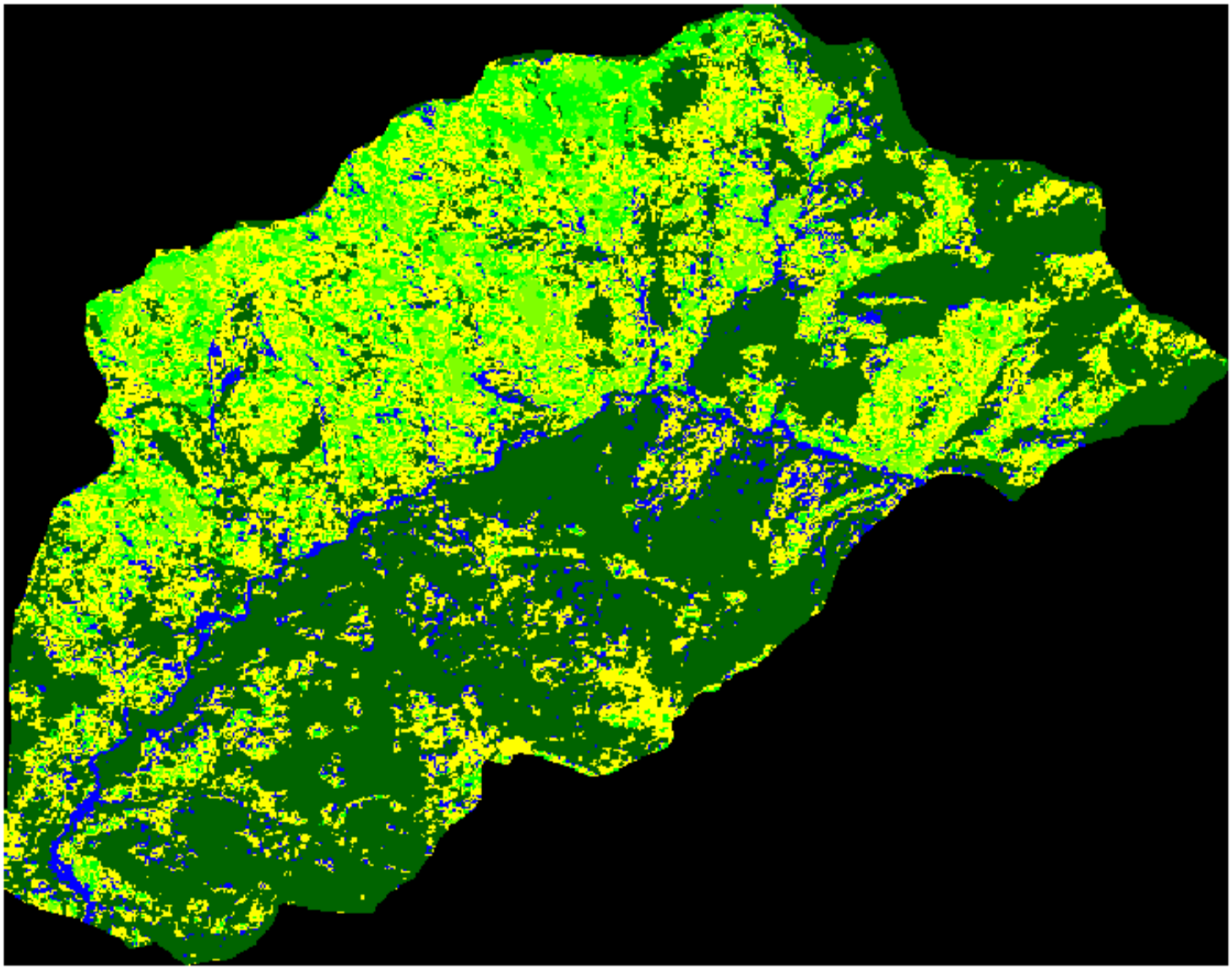
LANDUSE/LAND COVER MAP OF CHENENI WATERSHED

(CLASSIFIED FROM SATTELITE IMAGE OF 2000)

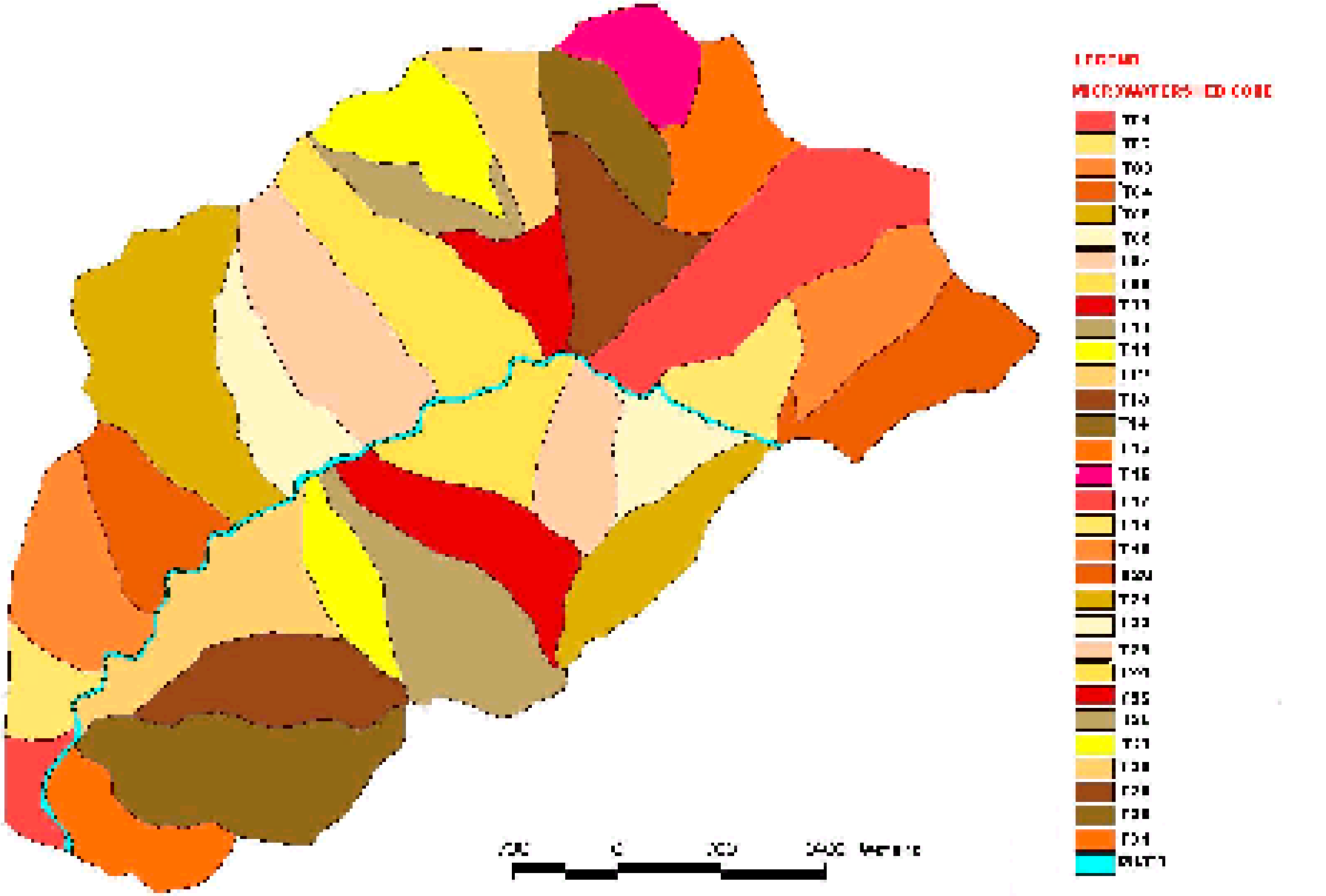


LANDUSE/LAND COVER MAP OF CHENENI WATERSHED

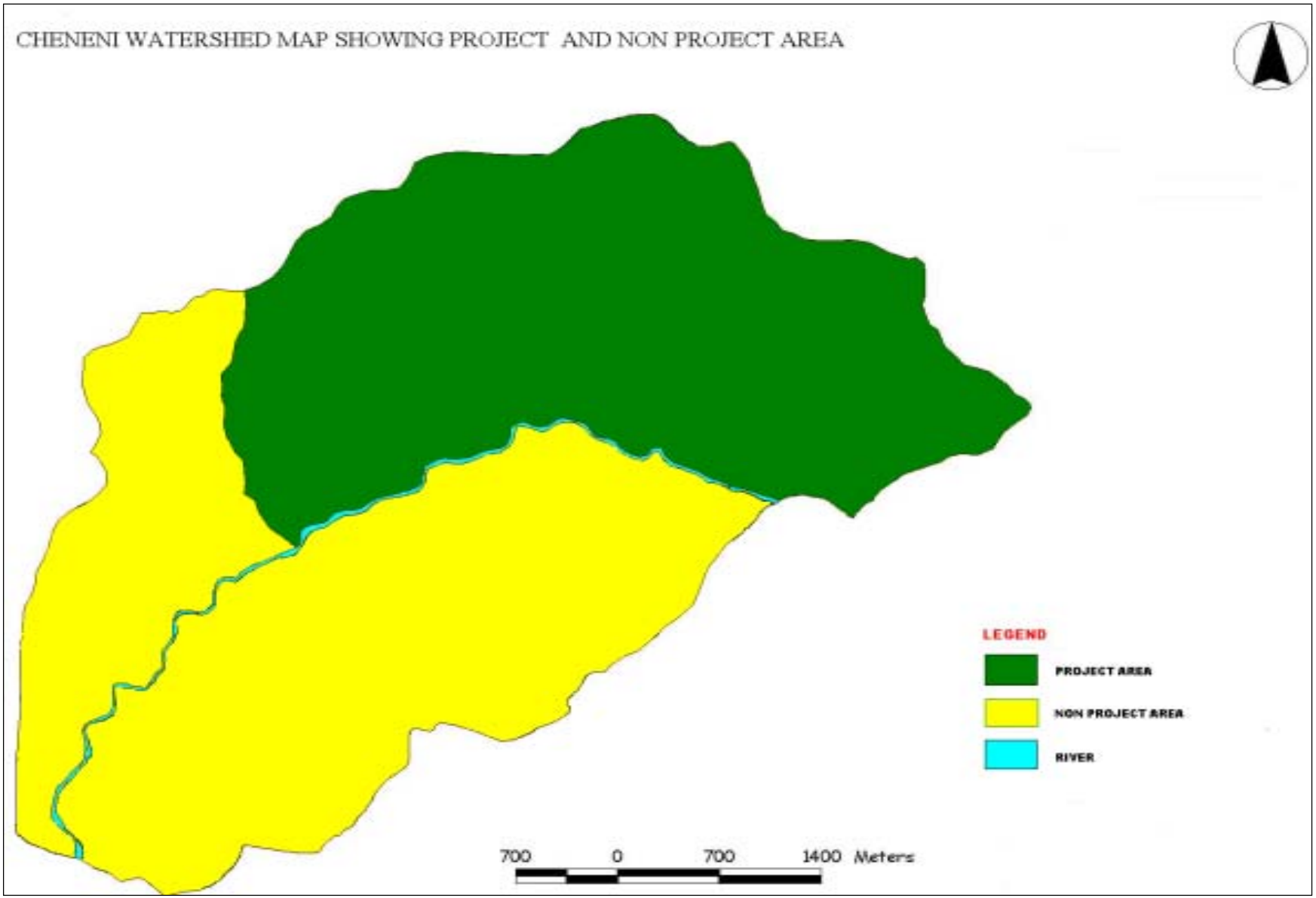
(CLASSIFIED FROM SATTELITE IMAGE OF 1992)



MICRO WATERSHED MAP OF CHENENI WATERSHED



CHENENI WATERSHED MAP SHOWING PROJECT AND NON PROJECT AREA



Annexure: 4.1

Land Use Pattern In Hectares (Year 1991)

PARTICULARS	PA	NPA	TSA
1) Agriculture	6919 (78.3%)	1917.5 (21.7%)	8836.5 (35.7%)
2) Forests	2848.3 (29.2%)	6921.3 (70.8%)	9769.6 (39.5%)
3) Scrub Area	4376.7 (81.8%)	976 (18.2%)	5352.7 (21.6%)
4) Drainage System	408 (51.3%)	387.3 (48.7%)	795.3 (3.2%)
Total Area	**14552 ha**	**10202.1**	**24754.1**

Annexure: 4.2

Agricultural Land Available (Year 1991) In Hect.

PARTICULARS	PA	NPA	TSA
1) Total Agricultural land	6919	1917.5	8839.5
2) Cultivable	5431.4 (78.5%)	1626 (84.8%)	7057.4 (79.9%)
3) Uncultivable	1487.6 (21.5%)	291.5 (15.2%)	1779.1 (20.1%)
4) Irrigated	1307.7 (18.9%)	170.7 (8.9%)	1478.4 (16.7%)
5) Unirrigated	5611.3 (81.1%)	1746.8 (91.1%)	7358.1 (83.3%)

Annexure: 4.3

Cropping Pattern (1991) In Hect.

CROPS	PA	NPA	TSA
1) Maize	2480.5	603	3083.5
2) Rice	462	129.4	591.4
3) Wheat	1776.3	602.1	2378.5
4) Cereals & Millets	45.3	53.5	98.8
5) Pulses	117.9	52.1	170
6) Vegetables	66.7	4.6	71.3
7) Oilseeds	101.7	32.5	134.2
8) Fodder crops	213.8	110.8	324.6
9) Left out Area	167.1	38	205.1
Other Crops Total	5431.4	1626	7057.4

Annexure: 4.4

Forest Area (Year 1991) In Hect.

PARTICULARS	PA	NPA	TSA
1) Dense Forest	1372.9 (22.3%)	4783.5 (77.7%)	6156.4 (100.00)
2) Open/Moderate forest	990.2 (35.7)	1783.4 (64.3)	2773.6 (100.00)
3) Degraded forest	485.2 (57.8%)	354.4 (42.2%)	839.6 (100.00)
Total	**2848.3 (29.2%)**	**6921.3 (70.8%)**	**9769.6 (100.00)**

Annexure: 4.5

Species Wise Distribution Of Forests (Year 1991) In Hect.

Particulars	Deodar	Chir	Kail	Fir	Broad leaved	Blanks	Total
1) PA	455.4 (19.5%)	1318.8 (46.3%)	148.1 (5.2%)	48.4 (1.7%)	460.3 (14.4%)	417.4 (12.9%)	2848.3 (100%)
2) NPA	539.9 (7.8%)	3708.3 (54.3%)	491.4 (7.1%)	292.2 (3.5%)	1114.3 (16.6%)	775.2 (11.2%)	6921.3 (100%)
TSA	**1095.3 (11.2%)**	**5077.1 (52.00%)**	**639.5 (6.5%)**	**290.6 (3.00%)**	**1524.5 (15.6%)**	**1142.6 (11.7%)**	**9769.6 (100%)**

Annexure: 4.6

Scrub Area (Year 1991) In Hect.

PARTICULARS	P.A	N.P.A	T.S.A
1) Dense Scrub Area	2886.6 (83.7%)	562.1 (16.3%)	3448.7 (100.00)
2) Thin Scrub Area	1183.6 (78.1%)	331.9 (21.9%)	1515.5 (100.00)
3) Degraded Scrub Area	306.5 (78.9%)	82.0 (21.1%)	388.5 (100.00)
Total	**4376.7 (81.8%)**	**976.0 (18.4%)**	**5352.7 (100.00)**

Annexure : 5.1

Fuelwood Production Capacity (Year 1991)

PARTICULARS	PA	NPA	TSA
1) Forests Land @ 0.75 M.T/ ha/yr	2136.2 (29.2%)	5191 (70.8%)	7327.2 (100.00%)
2) Agriculture land @ .50 M.T/ha/yr	3459.5 (78.3%)	958.8 (21.7%)	4418.3 (100.00%)
3) Scrub Area @ .10 M.T/ha/yr	437.7 (81.8%)	97.6 (18.2%)	535.3 (100.00%)
Total	**6033.4** **(49.1%)**	**6247.4** **(50.9%)**	**12280.8 M.t** **(100.00%)**

Annexure - 5.2

Carrying Capacity Of The Study Area In Terms Of Fuelwood (Year 1991)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Production in M.T.	6033.4	6247.4	12280.8
2.	No. of household that can be supported @ 2.75 MT/yr per household	2194 (51.2%)	2278 (89.3%)	4472 (67%)
3.	Household that create burden	1933 (46.8%)	273 (10.7%)	2206 (33%)
	Total No. of Household	4127 (100%)	2551 (100%)	6678 (100%)

Annexure: 5.3

Fodder Production Capacity In M.T (Year 1991)

Particular	PA	NPA	TSA
1) **Agriculture Lands**			
A) Green Fodder @ 500 Qtls/ha/yr	10690	5540	16230 (15.8%)
B) Dry Fodder i) Irrigated Area @ 12 M.T/ha/yr	15692.4	2048.4	17740.8 (17.3%)
ii) Unirrigated Area @ 4.5 M.T/ha/yr	25250.9	7860.6	33111.5 (32.2%)
2) **Forest Land** @ 2 M.T/ha/yr	5696.6	13842.6	19539.2 (19%)
3) **Scrub Lands** @ 3M.T/yr/ha	13130.1	2928	16058.1 (15.6%)
Total (1+2+3)	**70460**	**32219**	**102679.6 M.t** **(100.00%)**

Annexure 5.4

Carrying Capacity Of The Study Area In Terms Of Fodder (Year 1991)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Production in M.T.	70460	32219.6	102679.6
2.	No. of Cattlehead that can be feeded @ 5.4 MT/yr	13048 (46.41%)	5967 (22.1%)	19015 (34.5%)
3.	Cattlehead that cause burden	15093 (49.5%)	21085 (77.3%)	36178 (63.2%)
	Total No. of Cattlehead	28141 (100%)	27052 (100%)	55193 (100%)

Annexure: 5.5

Agriculture Production Of Crops (In M.T/Yr) For The Year 1991

CROPS	PA	NPA	TSA
1) Maize	2728.6	663.3	3391.9
2) Rice	646.8	181.2	828.0
3) Wheat	1598.7	541.9	2140.6
4)Other Cereals & Millets	36.2	42.9	79.1
5) Pulses	70.7	31.3	102.0
6) Total Foodgrain Production	5081	1460.5	6541.5
7) Oilseeds	40.7	13.0	53.7
8) Fodder	5345	2770	8115

Annexure 5.6

Carrying Capacity In Terms Of Foodgrain In MT (1991)

S.No.	Particulars	P.A.	N.P.A.	T.S.A.
1.	Production in M.T.	5081	1460.5	6541.5
2.	Population which was supported by available Foodgrains	26464 (91.6%)	7607 (42.6%)	34071 (72.9%)
3.	Population that was creating burden	2426 (8.4%)	10251 (57.4%)	12677 (27.1%)
	Total Population	28890 (100%)	17858 (100%)	46748 (100%)

Annexure: 5.7

Timber Production Capacity (Year 1991)

PARTICULARS	PA	NPA	TSA
1) Area Under Timber Producing Spices (in ha)	1970.7	5031.8	7002.5
2) Timber Production Capacity in Cu.ft./year	48479.2 (28.1%)	123782.3 (71.9%)	17224.5 (100%)

Annexure: 5.8

Resin Production Capacity (In Kilolitres) In The Year 1991

PARTICULARS	PA	NPA	TSA
1) Total forest Area (in ha)	2848.3	6921.3	9769.6
2) Total Chir forest Area (in ha)	1452.6	3529.9	4982.5
3) Total number of Chir trees	1307340	3176910	4484250
4) Total number of Resin producing trees	431423	1048380	1479803.6
5) Resin Production Capacity (in K.L.) @ 3litre/Plant/yr	1294.3	3145.2	4439.5

Annexure: 6.1

Valuation Of Forests Land (Year 1991) In Lakh

Particulars	P.A.	N.P.A.	T.S.A.
1. Dense Forest land @ Rs.70, 000 / ha	961.00	3348.5	4309.5
2. Moderate Forest land @ Rs. 1,00,000 / ha	990.2	1783.4	2773.6
3. Degraded Forest land @ Rs. 80,000/ ha	388.2	283.4	671.6
TOTAL	**2339.4**	**5415.3**	**7754.7**

Annexure: 6.2

Valuation Of Fuelwood Produced From Forests (1991) In Lakh

Particulars	PA	NPA	TSA
1) Fuelwood Produced @ 0.75 M.t/yr/ha.	2136	5191	7327
2) Valuation of fuelwood @ Rs 1500 / M.t.	32	77.9	109.9

Annexure: 6.3

Valuation Of Fodder Production From Forests (1991) In M.T.

Particulars	PA	NPA	TSA
1) Fodder Production@ Rs.2 M.t/ha/yr.	5696.6	13842.6	19539.2
2) Valuation @ Rs 1000 / M.t.	57	138.4	195.4

Annexure: 6.4

Valuation Of Resin Produced From Forests (1991) In Lakh

Particulars	PA	NPA	TSA
Quantity of resin in K.L	1294.3	3145.2	4439.5
Valuation @ Rs. 20,000/-/K.L	258.9	629.0	887.9

Annexure: 6.5

Valuation of agricultural land (1991)

Particulars	PA	NPA	TSA
Irrigated land @ Rs.2, 00,000	10862.8	3252.0	14114.8
Unirrigated land @ Rs.1, 00,000/hec.	1487.6	291.5	1779.1
Total	12350.4	3543.5	15893.9

Annexure: 6.6

Valuation Of Fodder Obtained From Agriculture (1991) In Lakh

Particulars	PA	NPA	TSA
Quantity of fodder obtained			
Green fodder	10690	5540	16230.0
Dry fodder	40943.3	9909	50852.3
Green fodder @ Rs. 1000/M.t.	106.9	55.4	162.3
Dry fodder @Rs.2000/M.t	818.9	198.2	1017.1
Total	**925.8**	**253.6**	**1179.4**

Annexure: 6.7

Valuation of Fuelwood Obtained from Agriculture (1991) in lakh

Particulars	PA	NPA	TSA
Quantity of fuelwood obtained (in M.t)	3459.5	958.8	4418.3
Valuation @ Rs. 1500/M.t	51.9	14.4	66.3

Annexure: 6.8

Valuation of Agricultural Production (1991) in lakh

Crops	PA	NPA	TSA
Maize	136.4	33.2	169.6
Paddy	51.7	14.5	66.2
Wheat	87.9	29.8	117.7
Cereals & Millets	1.4	1.7	3.1
Pulses	12.6	5.6	18.2
Oil seeds	3.3	1.0	4.4
Total	293.4	85.8	379.2

Annexure: 6.9

Valuation Of Scrub Land (1991) In Lakh

Particular	PA	NPA	TSA
1) Dense scrub land @ Rs. 80,000/hec	2309.2	449.7	2758.9
2) Thin scrub land @ Rs. 40,000/hec	473.4	132.8	606.2
3) Degraded scrub land @ Rs. 20,000	61.3	1.6	62.9
Total	**2843.9**	**583.1**	**3427**

Annexure: 6.10

Valuation of fuel wood obtained from Scrub Land (1991) in lakh

Particulars	PA	NPA	TSA
Amount of fuel wood obtained (in M.t)	437.7	97.6	535.3
Valuation of fuel wood @ Rs. 1500/M.t.	6.6	1.5	8.1

Annexure: 6.11

Valuation Of Fodder Obtained From Scrub Land (1991) In Lakh

Particulars	PA	NPA	TSA
Quantity of fodder obtained (in M.t)	12210.6	2682	14892.6
Valuation of fodder @ Rs. 1000/M.t	122	26.8	148.9

Annexure: 6.12

Valuation Of Timber (1991) In Lakh

Dense Forest	PA	NPA	TSA
1) Area	1372.9	4783.5	6156.4
2) Area under timber providing species	1029.7	3588	4617.7
3) Total no. of trees	1544513	5382000	6926513
4) No. of mature timber producing trees	617805	2152800	2770605
a) Chir	333615	1162512	1496127
b) Deodar	166807	581256	748063
c) Kail	74137	258336	332473
d) Fir	43246	150696	332473
5) Valuation of Chir @ Rs. 2000/plant	6672.3	23250.2	29922.5
6) Valuation of Deodar @ Rs.5000/plant	8340.4	29062.8	37403.2
7) Valuation of Kail @ Rs. 3000/plant	2224.1	7750	9974.1
8) Valuation of Fir @ Rs. 2000/plant	864.9	3013.92	3878.8
Sub total (a)	**18101.7**	**63077**	**81178.7**
9) No. of immature timber producing trees	926708	3229200	4155908
10) Valuation **(sub total-b)**	**185342**	**64584**	**249926**
G. Total	**203443.7**	**127671**	**331104.7**

Annexure: 6.13

Valuation Of Timber (1991) In Lakh

Moderate Forest	PA	NPA	TSA
1) Area	990.2	1783.4	2773.6
2) Area under timber providing species	713.0	1284	1997
3) Total no. of trees	713000	1284000	1997000
4) No. of mature timber trees	142600	256800	399400
a) Chir	77004	138672	215676
b) Deodar	38502	69336	107838
c) Kail	17112	30816	47928
d) Fir	9982	17976	27958
5) Valuation of Chir @ Rs. 2000/plant	1540	2773.4	4313.4
6) Valuation of Deodar @ Rs5000/plant	1925.1	3466.8	5391.9
7) Valuation of Kail @ Rs. 3000/plant	513.4	924.5	1437.9
8) Valuation of Fir @ Rs. 2000/plant	199.6	359.5	559.1
Sub total (a)	**4178.2**	**7524.2**	**11702.4**
9) No. of immature timber producing trees	570400	1027200	1597600
10) Valuation (**sub total-b**)	**11408**	**20544**	**31952**
G. Total (a+b)	**15586.2**	**28068.2**	**43654.4**

Annexure: 6.14

Valuation Of Non- Timber Producing Trees (1991) In Lakh

Degraded Forest	PA	NPA	TSA
1) Area	4852	354.4	839.6
2) Area under non-timber producing trees	485.2	3544	839.6
3) Total no. of non-timber producing trees	121300	88600	209900
4) Valuation @ Rs. 1000/Plant	121300	88600	2099
(in thousand)			
Total (in thousand)	**1213**	**886**	**2099**

Annexure: 6.15

Valuation Of Non- Timber Producing Trees (1991) In Lakh

Dense Forest	PA	NPA	TSA
1) Area	1372.9	4783.5	6156.4
2) Area under non-timber producing trees	343.2	1195.5	1538.7
3) Total no. of non-timber producing trees	514800	1793250	2308050
4) Valuation @ Rs. 1000/Plant	5148	17932.5	23080.5
Total	**5148**	**17932.5**	**23080.5**

Annexure: 6.16

Valuation Of Non- Timber Producing Trees (1991) In Lakh

Moderate Forest	PA	NPA	TSA
1) Area	990.2	1783.4	2773.6
2) Area under non-timber producing trees	277.2	499.4	776.6
3) Total no. of non-timber producing trees	277200	499400	776600
4) Valuation @ Rs. 1000/Plant	2772	4994	7766
Total	**2772**	**4994**	**7766**

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