Common Property Resource Management in Haryana state, India: Analysis of the Impact of Participation in the Management of Common Property Resources and the Relative Effectiveness of Common Property Regimes

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Declaration

I hereby declare that this thesis has been composed by me and the work is my own.

Date: 16.12.1997 Pasumarthy Venkata Subhash Chandra Babu

Dedication

To
My Parents

Mr Pasumarthy Sreenivasa Rao
Mrs Pasumarthy Durga Devi

Abstract

Common lands in Haryana State, India have suffered severe degradation, continuous erosion and are becoming transformed to open access regimes due to increasing population pressure. This has resulted in environmental damage on a wide scale and reduced welfare of the inhabitants of the region. Realising the enormity of the problem and the critical need to initiate action for greening the common lands, the government and the people came together to establish a participatory planning and development process at the village level.

The purpose of this thesis is to examine the effectiveness of participation in managing common property resources. This was undertaken in two phases, firstly through analysis of empirical social and biological data, and secondly through the development of a mathematical model. Specific hypotheses addressed were: i) it is possible to define specific circumstances wherein the common property protects the natural resource base effectively; ii) there exists a level of complimentarity between common property resources and private property resources in the case study area; iii) that socio-economic and cultural factors favour converting open-access regimes to common property rather than to private property.

People's participation level was estimated after conducting a survey of 15 villages in Haryana. The survey results are used to examine institutional development and the government's role as an enabler in establishing the common property regime. The results of the case study, show that clear benefits may be derived from common property regimes, are used to examine institutional development at the village level. A composite resource condition index is developed in order to measure the success of village institutions. The mechanisms and processes involved in assisting local people to establish common property regimes are also discussed. A mathematical programming model incorporating household dynamics and their interactions with both common property resources and private property resources is developed and scoping studies are conducted to analyse the impact of participation in the management of common property resources and the relative effectiveness of common property regimes.

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Contents

Abbreviations

AP	Aravalli Project
CF	Conservator of Forests
CPR	Common Property Resource
CSO	Central Statistical Organisation
DFO	Divisional Forest Officer
FAO	Food and Agricultural Organisation
FCA	Forest Conservation Act
FD	Forest Department
FSI	Forest Survey of India
GOI	Government of India
ha	hectare
HFD	Haryana Forest Department
ICAR	Indian Council of Agricultural Research
IFA	Indian Forest Act
LF	Large Farmer
LINDO	Linear Interactive Discrete Optimizer
LL	Landless
LP	Linear Programming
LPG	Liquefied Petroleum Gas
m	million
MOEF	Ministry of Environment and Forests
NAEB	National Afforestation and Eco Development Board
NCA	National Commission on Agriculture
NCAER	National Council for Applied Economic Research
NIN	National Institute of Nutrition
NRDMS	Natural Resource Data Management Systems
NWDB	National Wasteland Development Board
PFM	Participatory Forest Management
PGA	Punjab Gram panchayath Act

PVCLRA	Punjab Village Common Lands Regulation Act
RCI	Resource Condition Index
rec.	reconciliation
RRA	Rapid Rural Appraisal
SF	Small Farmer
SI	Success Index
SOI	Survey of India
SPWD	Society for Promotion of Wasteland Development
TBU	Tropical Bovine Unit
TERI	Tata Energy Research Institute
TL	Total Land
VFC	Village Forest Committee
WB	World Bank

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Chapter - I

Introduction and study proposal

The welfare of any nation is directly related to the management and productivity of its environmental systems. As the population and demands grow, so landuse patterns change, the regulatory mechanisms that earlier maintained a balance between man and nature may begin to breakdown and the prudent use of natural resources comes under strain. It is of critical importance, that management systems be designed so that renewable natural resources are available in the long run on a sustainable basis.

1.1 Background

Common property resources continue to be a significant component of the land resources base for rural communities in developing countries such as India. This is prominent in the semi-arid and arid areas of Haryana. Despite significant contributions to the rural community, common property resources have suffered severe degradation, continuous erosion and are becoming transformed in to open access regimes due to increasing population pressure. For many villages in southern Haryana this has increasingly turned out to be the dual tragedy of environmental collapse and pauperisation of the already poor.

Southern Haryana consists of the oldest mountain range in India, the Aravallis. The Aravallis play a significant role in protecting the fertile Indo-Gangetic plains on their eastern side against invading sand drifts from the Thar desert. Increasing pressure from human and livestock numbers has taken a heavy toll of the vegetation leaving the Aravallis almost bare with consequent adverse environmental effects. This has resulted in reduced welfare of the inhabitants of the region, particularly the women, who have to travel long distances to collect firewood and fodder. Realising the enormity of the problem and the critical need to initiate action for greening the Aravallis, the government

and the people came together to establish a participatory planning and development process in 1990 at the village level.

Where the participatory process has resulted in establishing a common property regime in place of an open access system reversal of environmental degradation has been recorded together with improvement in welfare of local people. Mechanisms and processes involved in assisting local people to establish common property resource management are discussed in this theses.

During 1989-94 I was entrusted with the responsibility of initiating the participatory process and implementing the participatory development of village common lands in the southern region of Haryana state. This gave me an opportunity to understand the problems faced by the poor villagers and their desire to overcome the environment induced poverty. The origins of this study go back as far as 1989. The successes and failures of this first experiment, provided me with rich experience of exploring the building of institutions at the village level.

Common property resources such as village common lands covering 10% of the total geographical area of the Haryana state have a pivotal role in the subsistence economy of the state. They serve protection, production and conservation roles and most often these roles conflict with other activities of the growing population adversely affecting the sustainability of the resources. Sustainability assumes significance because of the dual economic problem i.e., costs of irreversible economic activity and the utility yielding roles of these resources.

Historically these common lands were managed by the traditional management methods by the villagers coupled with state control. In the post-independence period development was seriously influenced by the theories of economic growth placing emphasis on savings and investment in the labour surplus economy. The planned investment in the common property resources especially tree planting and fodder development was very limited in relation to the multiple demands to which the common property resources

were subjected. This probably explains the dualistic development paradigms of the times, which emphasised the rapid industrialisation of developing countries for their faster economic growth. However, the role of the primary sectors in the overall growth of the developing countries got a substantial boost with the coming of the Green Revolution.

In accordance with the trends of development policy, the policies adopted by the state towards the development of these common property resources has been modified to reflect the growing concerns of policy makers and the villagers and their changing needs and directions. Investment in the village common lands has several backward and forward linkages to a wide range of activities such as agriculture, industry, energy and soil conservation. Over the years many conservation and production oriented schemes have been implemented with mixed results.

The growing population pressure and the growing industry demands has meant that most of the primary forest tracts of the common lands have been converted into secondary and subsequently, degraded village forests. Since the 1980's there has been a marked shift in the policy towards conservation with the enactment of the Forest Conservation Act-1980 and the new National Forest Policy of 1988.

The recent policy shifts from the government changed the interventionist role in the development of these common property resources to a more decentralised and participatory approach involving the government organisations such as the Forest Department and the village subsistence users of these resources. The objective of the government investment in the development of common property resources is to meet the subsistence needs of the rural populations and the needs of conservation and rehabilitation. These initiatives have wide and varied influence on the economy with implications on sustainability through pecuniary externalities, property rights, pricing policy, equity and distributional consequences.

The research reported here examined the common property resources sustainable use and conservation and rehabilitation of the degraded common property resources through

institutional development at the village level. It also provides the scoping studies undertaken to forecast likely scenarios under different management options.

1.2 Hypotheses

The specific hypotheses addressed in this work were:

(i) it is possible to define specific circumstances wherein the common property protects the natural resource base effectively;
(ii) there exists a level of complimentarity between common property resources and private property resources in the case study area;
(iii) that socio-economic and cultural factors favour converting open-access regimes to common property rather than to private property.

1.3 Objectives

The general objectives of the research study were:

(i) to investigate the historic influence of socio-economic factors on the management of village common lands, with respect to planning and policies pursued;
(ii) to assess the extent of common property resource use, consumption patterns and the role of common property resources (CPR's) in the village economy;
(iii) to investigate the interventions and policy reforms necessary for improved utilisation and sustainable use of common property resources;
(iv) to encourage and develop appropriate institutional development in villages for better management of the common property resources;
and
(v) to prepare an analytical framework which will lead to the better management of common property resources.

1.4 Thesis Structure

The thesis is presented in 10 chapters. The contents of these chapters are briefly explained below.

Chapter-I: Introduction, background, objectives, hypotheses and theses outline are presented in this chapter.

Chapter-II: In this chapter a general view of India as a nation is presented in order to appreciate the national level situation. It's strengths and weaknesses are examined. The geographical features, climatic factors, socio-economic indicators, demography, land use, forests, fuel and fodder demands are presented.

Chapter-III: In this chapter natural resource management in India is discussed with a historical perspective with a view to further explain how traditional management of common property resources was taken away from the village communities and after the dismal failure of state management how the communities are being encouraged to take over the management of their natural resources is discussed.

Chapter-IV: In this chapter a brief description of the Haryana state is presented. In addition the case study area is introduced, and information on its location, demography, socio-economic characteristics, the environment, common property resources (CPR) are presented. Further, factors responsible for the degradation of common property resources, legal aspects concerning the village common lands and the current management scenario are also discussed and analysed in order to fully explain the current situation.

Chapter-V: In this chapter theoretical aspects of common property resource management are presented. Certain concepts relating to the CPR management are clarified. The theories that explain the theoretical issues in CPR management such as Garett Hardin's Tragedy of Commons, Game Theoretic Models and Olson's Logic of Collective Action are presented and discussed.

Chapter-VI: This chapter describes the approach and methods applied to generate the information required to test the hypotheses presented in Chapter I. Survey methodology and the methods used for analysing the village institutions and people's participation are

presented. A composite resource condition index is developed in order to measure the success of village institutions in managing their common property resources.

Chapter-VII: In this chapter the results of the case study, which show clear benefits deriving from common property regimes are presented. Mechanisms and processes involved in assisting local people to establish common property regime are also discussed.

Chapter-VIII: In this chapter the need for a mathematical programming technique for modelling the use of common property resources is explored. Linear Programming model construction is presented in order to conduct scoping studies, which would help in identifying the changes in the resource condition under different scenarios. Model validation/verification is also presented in this chapter.

Chapter-IX: In this chapter the linear programming model is used for conducting the scoping studies in order to determine the solutions under open-access and common property situations. Sensitivity analysis is also presented and the results discussed.

Chapter-X: In this chapter the conclusions from this research and suggestions for future research are presented.

1.5 Summary

This chapter introduced the study proposal and described the background context in which it is set. In the next chapter the national level situation of India is presented in order to provide further contextualisation of the study.

Chapter II

India - the Land, People and its' Natural Resources

In this chapter a general view of India as a nation is presented in order to appreciate the national level situation. It's strengths and weaknesses are examined. The geographical features, climatic factors, socio-economic indicators, demography, land use, forests, fuel and fodder demands are presented.

2.1. Location

India is a union of 25 states and 7 union territories. The country is divided into 462 districts, which are further subdivided into blocks and villages. India is a fast developing economy with growth rate of around 6% of GDP per annum. It has come of age in various fields of modern technology bringing the country self sufficiency in many spheres such as agriculture, science and technology etc. India has an area of 3,287,782 sq. km. stretching from 8^0 4' 28" to 37^0 17' 53" north latitude and from 68^0 7' 53" to 97^0 24'47" east longitude (see Figure 2.1). The country is endowed with a variety of types of forests. However her forests and village common lands are subjected to heavy biotic pressure; with less than 2% of total land area of the world, the country supports over 15% of the world's human population and 16% of the total livestock population (GOI, 1995).

2.2. Relief

India can be divided into five distinct regions, the Himalayas, the Indo-Gangetic plains, the desert region, the central highlands, and the peninsular plateau.

The Himalayas: The presence of this mighty mountain range in the north is mainly responsible for the tropical climate of India. They protect the country from the cool Siberian winds. The region can be distinguished by the greater Himalayas, the lower

Himalayas and outer Himalayas (the Siwaliks). The outer Himalayas are fragile and prone to severe soil erosion and earthquakes. The Karakoram range in the North has an average altitude of 6000 metres above mean sea level (GOI, 1995).

Figure 2.1: Map of India showing it's location, states and union territories

The Indo-Gangetic Plains: This region extends from Rajasthan in the West to West Bengal in the East covering almost half of the geographical area of India. The plains

lying between the rivers Ganges and Yamuna are the most fertile and densely populated regions in the world.

The Desert Region: Towards the west of Indo-Gangetic Plains lie the Indian Desert in the states of Rajasthan and Gujarat. The Indo-Gangetic plains are protected by the invading sand dunes of the desert by India's oldest mountain range, the Aravallis.

The Central Highlands: This region separates northern India from Southern India. The mountain ranges of Vindhya and Satpura present in this region support the best forests and great ravine lands.

The Peninsular Plateau: This region consists of the central Deccan plateau and eastern and western ghats mountain chains parallel to the eastern and western coasts of the peninsula. Coastal plains in the east are the fertile delta regions of Godavari, Kaveri, Penna and Krishna rivers.

2.3 Rivers

The rivers in India are of three types. They are the Himalayan rivers, the rivers of Peninsular region and the rivers of the inland drainage basin. The Himalayan rivers are perennial and snow fed, where as the other types are seasonal. The Himalayan rivers include the famous Ganges, Brahmaputra and Yamuna. The important peninsular rivers are Godavari, Krishna, Penna, Mahanadi, Tungabhadra and Kaveri. The Luni is the important inland drainage basin river. It is non perennial and subject to flash flows during monsoons. Rising in Vindhya-Satpura mountain ranges in Central India the Narmada river flows across the country westwards and joins the Arabian Sea on the West, where as all other rivers in India flow eastwards and join Bay of Bengal on the East.

2.4 Climate

The country's climate varies from desert conditions to that of alpine conditions. Much of the country is tropical with subtropical and temperate conditions confined to the regions of Himalayas, and with hot desert conditions prevailing in the north western regions. Two types of monsoons are mainly responsible for precipitation. They are the south-western monsoon (June to September) and the retreating north-east monsoons. The south-western monsoons account for ninety percent of rainfall in the country whereas the retreating north-eastern monsoons are responsible for the remaining 10%. The south-western monsoons cover the entire country and influence the cropping patterns. The north-eastern monsoons cover some of the eastern and north-eastern parts of the country and provide rainfall during winter months.

Rainfall in the country varies from region to region. The desert areas in the north-west of India receive an annual rainfall as low as 250 mm and the north-east receives the highest rainfall with an average of 2500 mm. Rainfall in much of the country on an average varies from 500 mm to 2000 mm (GOI, 1993). The highest annual rainfall occurs in the north-eastern state of Meghalaya (Cherrapunji, 4500 mm). Ladakh region in the Himalayas is a rain shadowed region and a cold desert with an annual rainfall of less than 300 mm.

2.5 Socio-economic Characteristics

India has a rapidly increasing population of 947.9 million (1997 estimates). It is set to surpass the China's population by the year 2025 if the present growth trends continue over the first quarter of next century (World Bank, 1996). At present it is second to China in population numbers. The ever increasing population is the cause for continued poverty, unemployment, exploitation of natural resources and pollution etc. Table 2.1 shows the growth of population numbers in India since 1901. Barring a negative growth during 1911 to 1921 when a large number of people perished for variety of reasons such as famines, plague and other epidemics the population has been

growing continuously. Of late a declining trend in the growth rates could be noticed on account of increasing adoption of family planning methods (GOI, 1994). Spread of awareness of family planning methods through mass media and other educational programmes has been showing positive results.

Table 2.1: Growth of Population in India - 1901 to 1991

Year	Population	Decadal Growth in Absolute numbers	Decadal Growth Rate in Percentage
1901	238396327	-	-
1911	252093390	+13697063	+5.75
1921	251321213	-72177	-0.31
1931	278977238	+27656025	+11.00
1941	318660580	+39683342	+14.22
1951	361088090	+42420485	+13.31
1961	439234771	+77682873	+21.51
1971	548159652	+108924881	+24.80
1981	683329097	+135169445	+24.66
1991	844324222	+160995125	+23.56

Source: Census of India, 1991.

The birth rate fell from 33.9 per thousand people in 1981 to 28.5 per thousand people in 1993. At the same time death rate fell from 12.5 per thousand people to 9.2 over the same period. Infant mortality came down from 110 per thousand in 1981 to 74 per thousand in 1993 (Source: Registrar General of Births & Deaths, 1993) (Observer Research Foundation, 1995) (Table 2.2).

Table 2.2: Economic and Social Indicators of India

Population, 1991 (in millions)	844
GNP per capita, 1992 (US$)	310
Purchasing power parity (PPP) estimates of GNP per capita, 1992 (US$)	1210
PPP estimates of GNP per capita, 1992 (USA=100)	5.2
Average annual growth rate of per capita GNP, 1980-92	3.1
Life Expectancy at birth, 1992 (years)	59
Crude death rate, 1993 (per 1000)	9.2
Infant mortality rate, 1993 (per thousand live births)	74
Proportion of low birth weight babies, 1990 (%)	33
Crude birth rate, 1992 (per thousand)	29
Total fertility rate, 1992	3.7
Adult literacy rate (age 15+), 1992 (%)	52
Males	64
Females	39
Female-male ratio (ratio of females to males in the population), 1992 (%)	93
Female share of the labour force, 1990-92 (%)	29
Gross domestic savings as proportion of GDP, 1992 (%)	22
Gross domestic investment as proportion of GDP, 1992 (%)	23
Average annual growth rates of export, 1980-92 (%)	5.9
Net present value of total external debt as proportion of GNP, 1992 (%)	26
Total debt service as proportion of exports, 1992 (%)	25

Source: World Development Report 1994 & Dreze et al, 1995.

The proportion of people living below the poverty line has been continuously falling with increasing growth rates. 29.9 percent people were living under poverty line in 1987 compared to 37.4 in 1983 (Source: Planning Commission, Eighth Five-year Plan, 1992). According to a recent publication of World Bank (1997) India will be able to eradicate poverty if the present Gross Domestic Product (GDP) rate of over 6 percent

per annum continues until 2005. Another important aspect has been the increasing urban population. In 1901, 10.8 percent people were living in urban areas as against 26 percent people in 1991. This is mainly due to the migration of rural population to urban areas in search of employment. Even though the proportion of rural population is decreasing in proportion the absolute numbers of population living in rural areas increased substantially posing grave threat to the natural resources, for the supply of adequate fodder, fuelwood, timber and employment etc.

2.6 Livestock Scenario

India supports 16 percent of the worlds' cattle population with an area less than 2 percent of the world's land mass. The growth of livestock has been tremendous over the last four decades (Table 2.3).

Table 2.3: Livestock population in India, 1951-1982 (in million)

Category	1951	1956	1961	1966	1972	1977	1982
Cattle	155.30	158.65	175.56	176.18	178.34	180.14	190.79
Buffaloes	43.35	44.92	51.21	52.95	57.43	62.03	69.00
Sheep	38.43	39.42	40.02	42.02	39.99	40.91	48.07
Goats	47.08	55.41	60.86	64.59	67.52	75.62	94.72
Horses	1.51	1.48	1.33	1.15	0.94	0.91	0.93
Pigs	4.42	4.93	5.18	5.04	6.90	7.65	9.58
Camels	0.634.42	0.78	0.9	1.03	1.11	1.07	1.03
Others	1.30	1.10	1.15	1.15	1.11	1.21	1.82
Total	**292.02**	**306.52**	**336.21**	**344.11**	**353.34**	**369.54**	**415.94**

Source: NWDB, Government of India, 1990.

Most of the cattle and livestock are unproductive. Due to Hindu religious sentiments even if they are unproductive certain types of cattle are not culled. As a result these animals continue to increase in numbers and require feeding from already meagre

fodder resources. The increase in goat population in the recent years has been phenomenal. It has grown from 47.08 million in 1951 to 99.41 million in 1987. Goats are the most problematic animals as far as regeneration of forests is concerned. They trample and destroy young saplings and cause increasing environmental degradation in the country. With 16 percent of world's livestock population and less than 0.5 percent of its grazing lands, India faces a severe fodder shortage. Many of the stray cattle venture into agricultural crops or regenerating forests for grazing and damage them. Approximately 12.5 million ha. of land is under pasture and grazing for communal use. The number of animals grazed in forests has risen from 35 million in 1958 to 123 million in recent years.

2.7 Land Use

Since 1951 both human and livestock populations have been growing at an exponential rate. The sharp increase in human and livestock population, has put a great demand on natural resources and land. Consequently over exploitation has resulted in land degradation, which is estimated at 175 million ha. Although the area under agriculture increased to 56.76 percent of the total geographical area of the country as estimated in 1990-91 (Figure 2.2). Vegetative cover on village common lands and village forests shrank by over 30 million ha. From 1951 to 1991.

The area under cultivation is 56 percent in India where as it is less than 33 percent in most of the developed as well as developing countries. Land area under agriculture is 20 percent in USA, 10.8 percent in Japan, 29.2 percent in UK, 12 percent in China, 31.4 percent in Thailand, 31 percent in Italy, 4.8 percent in Canada, 5.9 percent in Australia and 14.3 percent in Nepal. (Singh, 1994).

The expansion of the cultivated area to more and more marginal lands, and the dependence of the people on the forest has increasingly changed the land use pattern in the country. Rapid urbanisation has also affected the land use. The urban population has been growing from 11 percent in 1901 to 25.6 percent in 1991. It is estimated that

by 2010 India will have nearly 392 million people or 33.7 percent of the total population living in towns and cities making it the world's largest urban population. (Source: Population Estimates, Planning commission, GOI, 1993). The fertile land becomes the casualty of industrialisation and urbanisation. Launching of mega projects and huge hydro-electric dams resulting in large areas under vegetation being submerged has also led to the shrinkage of area under forests.

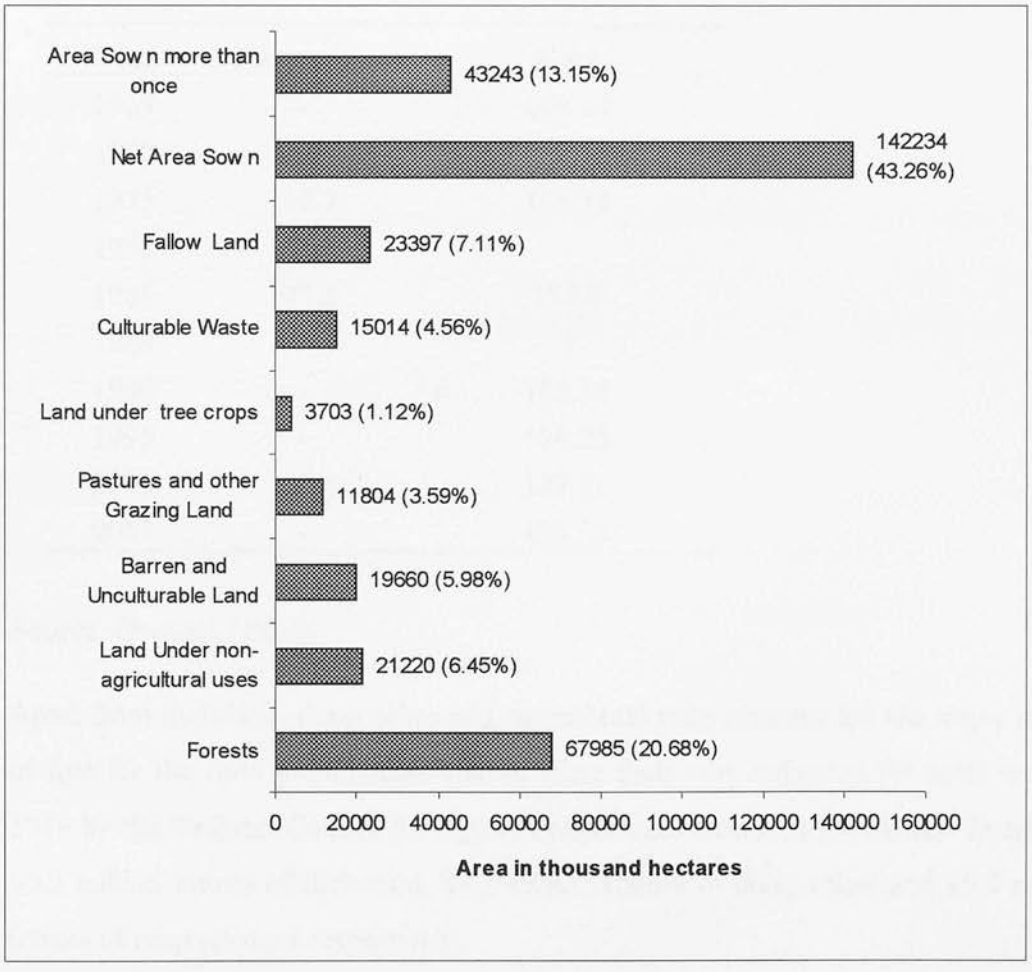

Figure 2.2: Land Use in India (1990-91)

Source: Directorate of Economics and Statistics, Ministry of Agriculture, (GOI, 1991).

2.8 Fuel wood demand

Fuelwood is the major source for cooking in rural as well as urban areas in India. Fuelwood demand in India and future projections from 1966-2005 were estimated by Natarajan (1989) and Kaul (1992) (Table 2.4).

Table 2.4: Estimated Demand of Fuelwood in million tonnes (1966 to 2005)

Year	Natarajan	Kaul
1965	-	109.44
1970	98.6	-
1975	108.7	131.72
1980	121.0	-
1985	133.3	154.0
1989	146.3	-
1990	-	165.14
1995	-	176.28
2000	163.0	187.42
2005	-	198.56

Source: Dwivedi (1994)

Apart from fuelwood, dung cakes and agricultural crop residues are the major source of fuel for the rural populations. Use of these fuels was estimated for rural areas in 1979 by the National Council for Applied Economics Research (NCAER). They were 93.3 million tonnes of fuelwood, 83.2 million tonnes of dung cakes and 36.7 million tonnes of crop residues respectively.

NCAER conducted a nation-wide survey of urban households 1978-79 and reported certain interesting facts. Households having an income of Rs. 18000 per annum used fuelwood for cooking and water heating. It was estimated that 90 percent of rural households and 75 percent of semi-urban households and 50 percent of households in the cities used fuelwood in traditional chulhas (wood burning stoves) for their day to

day cooking. Assuming an average consumption of 400 kg fuelwood per capita per annum the total consumption of fuelwood was estimated at 265 million tonnes in 1991. Out of this 39 million tonnes was used in urban areas. In India, large quantities of fuelwood are used during festivals and religious ceremonies. Fuelwood is also used for burning the dead bodies. Assuming that 400 kilo grams of fuelwood was required for burning a dead body a total amount of 2.7 million tonnes of fuelwood was required for cremation alone at the present crude death rates of 9.6 per thousand population. (Dwivedi, 1994).

2.9 Fodder Requirement and Availability

India has a large livestock population which is considered to be the root cause of most of the livestock related problems in the country. Almost half of India's livestock population could be regarded as surplus in relation to the fodder supply and a majority of it is of poor quality (Singh, 1994).

The assessment of demand and supply of fodder depends upon a number of factors, such as the methods of animal rearing and feeding, population and type of livestock, economic status of the people, extent and type of areas available for fodder production, types of fodder raised and climate etc. Table 2.5, presents the estimates of demand and supply made by various committees from time to time.

Table 2.5: Estimates of Demand and Supply of Fodder (in million tonnes)

Assessment Source	Year of Assessment	Dry Fodder		Green Fodder	
		Demand	Supply	Demand	Supply
Committee on livestock feed and fodder (1982)	1978-79	353	300	387	277
Agriculture Handbook	1980		231		224
National Commission on Agriculture (1976)	2000*	373	357	590	575
Committee on fodder and grasses (NWDB, 1988)	1985	780	441	932	250

* forecast based on projected livestock population

The fodder demand for the year 2000 estimated by the National Commission on Agriculture for the year 2000 are close to 2% body weight of the animal. Whereas the Committee on Fodder and Grasses took 3% of body weight as the maintenance ration in arriving at its estimates for 1985.

2.10 Forests

India is endowed with a wide variety of forests (Table 2.6). India's recorded forests are 77 million hectares (23 percent of the geographical area), but the actual cover shrank to 64.2 million hectares (19.52 percent) in 1993 (FSI, 1993).

Table 2.6: Forest Types of India

Type of Forest	Area in Sq. Km.	Percentage
Tropical Wet Evergreen	51249	7.94
Tropical Semi-Evergreen	26749	4.14
Tropical Moist Deciduous	236749	36.68
Littoral and Swamp	4046	0.62
Tropical Dry Deciduous	186620	28.91
Tropical Thorn	16491	2.55
Tropical Dry Evergreen	1404	0.21
Sub Tropical Broad Leafed	2781	0.43
Sub Tropical Pine	42377	6.56
Sub Tropical Dry Evergreen	12538	1.94
Montane Wet Temperate	23365	3.62
Himalayan Moist Temperate	22012	3.41
Himalayan Dry Temperate	312	0.04
Sub Alpine and Alpine	18628	2.88
Total Forest Area	**645321**	**100**

Source: World Bank, 1993.

Large chunks of forests were diverted for non-forestry purposes by the government. These transfers normally took place to accommodate the demands of development projects. Realising the enormity of losing the forest cover the Government of India enacted the Forest Conservation Act-1980 making it mandatory for the state governments to obtain central governments' clearance before ordering diversion of forest lands for non-forest purposes. This has brought about an increase in forest cover in the recent past. It was also made obligatory for the state governments to bring compensatory afforestation on the equivalent areas lost due to diversion of forest land.

Forests form an important source of fuel and fodder for rural as well as urban communities besides meeting a range of other demands such as minor forest products, building materials and other artisanal raw materials etc. The increasing demand from them has put considerable strain on forests. The area under forests has been shrinking continuously since independence. Of late with an increase in efforts to green vast tracts of waste lands the forest cover in the country has been increasing (Table 2.7).

Table 2.7: Change in Forest Cover (in Square Km.) 1991-93

Category	1991	1993	Change
Dense Forest (Crown Density >40%)	385008	385576	+568
Open Forest (Crown Density 10-40%)	249930	250275	+345
Mangroves	4244	4256	+12
Total	**639182**	**640107**	**+925**

Source: Status of India's Forests, Forest Survey of India, 1993

2.11 Summary

In this chapter a general overview of the resource use in India has been presented. An attempt has been made to introduce to the subject background and the problems that confront India. In the next chapter natural resource management scenario in India has been presented. The policies followed in the past and the present have been discussed in order to explain how the traditional management of these resources was taken away by the successive rulers and after the dismal failure how the local communities are being encouraged to manage their natural resources in a sustainable manner.

Chapter III

India - Its' Forest Resource Management

For several centuries forests in and around the villages in India have been managed by village communities, who were generally of the view that the forests belonged to them and that they belonged to the forests. Well being of forests and natural resources was considered as essential for the very existence of the communities. Forests and natural resources were revered and whatever was required was taken from them and the ecosystem was never disturbed permanently. When this symbiotic relationship was disturbed by the take-over of the management of these resources by the successive rulers then came the alienation of people from their natural resources and led to their degradation consequently resulting in an alround poverty.

In this chapter natural resource management in India is discussed with a historical perspective with a view to further explain how traditional management of common property resources was taken away from the village communities and after the dismal failure of state management (CSE, 1985) how the communities are being encouraged to take over the management of their natural resources is discussed. This chapter is presented in four phases, namely, ancient period, medieval period, colonial period and post-independence period.

3.1 Ancient Period

The ancient holy books such as Rigveda, Manusamhita, Mahabharata etc. mention the thick forests around which the ancient Indian culture flourished (Sen, 1966). In fifth century BC Lord Buddha exhorted in his preaching, " the forest is a peculiar organism of unlimited kindness and benevolence that makes no demands for its sustenance and extends generously the products of its life activity. It affords protection to all beings offering shade to even the axeman who destroys it". In order to prevent people from felling the living trees king Ashoka (fourth century BC) made the permission of the

palace mandatory if living trees were to be felled. This was the first attempt at regulating the use of natural resources (Mobbs, 1941). There after the rulers encouraged people to clear forests for practising agriculture in order to increase their tax revenues by imposing tax on agricultural production.

3.2 Medieval Period

India's riches attracted successive invasions from central Asia during this period. The Muslim invaders were not interested in the conservation and management of forests (Sharma, 1990). Some of them had interest in raising some aesthetic plantations on roadsides. Since the rulers in this period were keen to extend the area under agriculture further forests were cleared. This process continued as successive Muslim rulers were interested in increasing their tax revenues. However, they never disturbed the forest and natural resources that were in the proximity to a majority of the village communities and that the rural populations enjoyed an unrestricted supply of forest produce and the people were better off because there was more forest and less cultivation (Moreland, 1920). As the mighty Mughal empire started weakening, in particular after Aurangzeb's rein several small kingdoms numbering approximately 600 emerged. The rulers of these kingdoms never exercised any control over the management of natural resources even though forests and other natural resources remained the state property. They were never demarcated and no restrictions were placed on their usage, except reserving certain forests as game reserves for the kings (Tiwari, 1985). During this period certain trees were reserved and declared as royal trees. A royalty was collected from people, who wanted to fell them.

3.3 Colonial Period (1700 - 1947)

During this period the East India company, which began to control vast amounts of the country attempted further exploitation of forests. The former Inspector general of India, Ribbentrop (1900) wrote. "our early administrators, occupied with the building up of an empire, probably never thought of the important part the forest have played,

play now and will forever play in the household of nature, or the immense influence they exercise on the physical well being of the country, while as a necessity for the people and as a revenue yielding property, they were considered insignificant". In general the earlier British rulers followed the native rulers policy of reserving certain valuable timber trees such as teak (Stebbing, 1921). They however never interfered with the local traditions, and the lifestyle of the village communities and were only interested in the expansion of their empire. They were least interested in disturbing the freedom of village communities in managing their natural resources.

As the empire began to expand, the need for timber for ship building also increased. With an intention to estimate the available teak timber the forestry commission was established in 1800 AD in the Malabar region. This commission was also entrusted with the mandate to make regulations for felling of trees. Accordingly unauthorised felling of teak trees was stopped and royalties for felling increased substantially.

In 1806, a serving police officer was appointed as the first Conservator of Forests of Malabar region in order to increase the supply of timber for the Navy. The conservator had wide ranging powers and interfered with the established customary rights of the local communities and eliminated their rights to use the forests. This process alienated the people from the natural resources they had been using and protecting from times immemorial to fulfil their basic needs. As the elimination of private rights of communities in the forests grew the discontent against the rulers spread across the entire region. The East India Company quietly abolished the post of Conservator of Forests in 1823 with a view to maintain cordial relations with their subjects. Thus the policy of one extreme of strict control to the other of no control resulted in people losing the trust and authority they had in managing the natural resources. Sir Dietrich Brandis (1897) wrote, "This first attempt at forest management was a dismal failure, an act of injustice which cannot be condemned too severely: originally started in order to secure permanent supply it degenerated into an attempt to establish, without regards to private property rights, a government monopoly".

However, as the demand for timber increased the post of Conservator of Forests was recreated in 1847. In 1855 the first major policy document, known as the Charter of Indian Forestry was issued. this policy document laid down the principles of forest management and a notification issued by the then Governor General Lord Dalhousie declared that the timber standing in the forests was state property and that the village communities had no rights whatsoever in them.

In 1864, Sir Dietrich Brandis was appointed as the first Inspector General of Forests to implement "the Charter of Indian Forestry". Even though there was a mention of population pressure on forests the charter did not recommend any specific measures to meet the bonafide demands of the local people, who were dependent upon them for their basic needs. The first Indian Forest Act was enacted in 1865, subsequently replaced by a more comprehensive Indian Forest Act of 1878. Consolidation, demarcation and reservation of forests was provided for in the forest act. Forests were classified as Reserved Forests, Protected Forests and Village Forests. The ownership over the reserved forests rested solely with the government with very little rights and concessions to local people, which were recorded. Protected Forests were also the government property but there were rights and concessions given to local people in order to meet their bonafide demands for fuelwood, fodder and timber.

Village Forests were the property of local communities, the government only having rights over certain kinds of trees. The Indian Forest Act 1878 states " the local government may from time to time assign any village community the rights of government to or over any land which has been constituted as a reserved forest land may cancel such assignment - all forests so assigned shall be called village forests". Thus the customary rights of the people over their natural resources were extinguished and a portion of the common property resource was classified as village forests and a majority of the forests came under the sole proprietary control of the government. The Indian Forest Act 1927 placed even more stringent punishments for violators.

With this the alienation of people from their common property resources became absolute and people started feeling insecure over the use of the resource. The loss of control over their common property resources brought about an indifferent attitude towards these very resources which people respected and cared for several centuries (Sharma, 1990). With stricter controls over the use of reserved forests and protected forests people were left with only the village forests to meet all their requirements of fodder, fuelwood and grazing of their cattle. This led to the degradation of village forests from primary forest tracts to secondary and subsequently to degraded waste lands in many parts of the country. Since not much could be extracted from the village forests, people started exploiting the Protected Forests and Reserved Forests owned by the government illegally. Thus the owner, protector of these common property resources became an illicit feller and poacher and when caught faced with penalties and imprisonment for meeting his basic needs.

3.4 Post Independence period

The post independence period was no different from the colonial era. The government went ahead with still more stringent controls extending the legal provisions of state laws to even the areas under private control prohibiting felling of certain types of trees standing on the private lands (Sharma, 1990).

National Forest Policy, 1952

The first national forest policy was adopted in 1952. It recognised the importance of forests and placed an emphasis with the national perspective rather than appreciating the needs of the local people. It specified forests as the foster mother of agriculture and placed more emphasis on agriculture and bringing more areas under reserved forests.

The policy proposed the classification of forests on functional basis as:

a. protection forests

b. national forests

c. village forests

The management of village forests was entrusted to panchayaths (an elected village council) in order to meet both present and future needs of the local people. Even though the National Forest Policy of 1952 recognised the concept of village forests the main thrust of it remained creation of reserved forests for national needs.

National Commission on Agriculture, 1976

National Commission on Agriculture (1976) was entrusted with the responsibility to look in to the forestry situation in the country and to come up with suggestions for meeting the multiple demands to which the forests were subjected to. The commission recommended the classification of the forests in to three types. They are:

a. protection forests

b. production forests

c. social forests

The protection forests were to protect the hills, river banks, sea shores and other important areas such as catchments of watersheds etc. The production forests were to be essentially commercial forests comprising valuable timber bearing stands and occurring in ecologically stable regions. The social forests were to be the village forests, canal sides, road sides and railway line sides meant to meet the demands of

the local people, such as fuelwood, fodder and small timber. The emphasis was to bring the denuded areas and wastelands under tree cover so that pressure on reserved forests and protected forests was reduced.

Social Forestry

A number of social forestry projects were launched in the late 1970's and early 1980's by various states. The results of these projects have been mixed since the village communities were either ignored in their implementation or benefit distribution mechanisms could not be worked out properly. It was perceived as a programme thrusted on the people, who were also least interested in protecting these plantations since they were unsure of reaping the benefits from them. Nevertheless social forestry projects while meeting several basic needs of the local people certainly eased pressure on government forest to some extent and brought general awareness towards planting and protecting trees. The benefits of these social forestry projects could not be ploughed back into creation of further assets in the form of increased plantation activities since participation of local people was not ensured in the implementation of these projects.

National Forest Policy, 1988

A new National Forest Policy was adopted in 1988. It stated that the first charge on forest produce were the people inhabiting in and around the forests (GOI, 1988). Supply of fuelwood, fodder and small timber for the rural people was placed as one of the basic objectives. It also called for involving the village communities and non governmental organisations in the regeneration, management and protection of degraded forests. In order to ensure people's participation it also suggested sharing part of the proceeds with the village community from the sale of trees at the time of their maturity, as well as non timber forest products for subsistence use.

Participatory Forest Management

The national forest policy 1988 brought a new era in forest management in India with the emphasis on people's participation in afforestation of forests and common lands. This process is commonly known as Participatory Forest Management (PFM). All the lessons drawn from the strengths and weaknesses of the earlier social forestry projects formed the basis for designing these efforts. Apart from that non-governmental agencies were also involved in eliciting the people's participation with a view to strengthen the joint management effort so that the scarcity of forest products (Table 3.1) is addressed and a solution to the demand and supply of forest products could be found.

Table 3.1: Demand and Supply of Forest Products in India

Product	**Estimated Demand**	**Silviculturally Available Biomass**	**Gap**
Fuelwood (million cubic metres)	230	40	190
Fodder (million tonnes)	882	434	448
Industrial Timber (million cubic metres)	27	12	15

Source: Forest Survey of India, 1987.

The success of some of the participatory forest management efforts, which had substantial involvement of local populations, such as the Sukhomajri project, Haryana, the Arabari experiment in West Bengal and similar projects in Gujarat and elsewhere in India convinced both the people and the Forest Departments across the nation of pursuing the participatory forest management in the 1970's and early 1980's (SPWD, 1992). India's 129.58 million hectares of wastelands can be brought under

participatory forest management for improving the rural resource condition (Table 3.2).

Table 3.2 Estimates of wastelands in India (million hectares)

State/Union Territories	Non-Forest Degraded Area	Forest Degraded Area	Total
Andhra Pradesh	7.682	3.734	11.416
Assam	0.935	0.795	1.730
Bihar	3.896	1.562	5.458
Gujarat	7.153	0.683	7.836
Haryana	2.404	0.074	2.478
Himachal Pradesh	1.424	0.534	1.958
Jammu and Kashmir	0.531	1.034	1.565
Karnataka	7.122	2.043	9.165
Kerala	1.053	0.226	1.279
Madhya Pradesh	12.947	7.195	20.142
Maharashtra	11.560	2.841	14.401
Manipur	0.014	1.424	1.438
Meghalaya	0.815	1.103	1.918
Nagaland	0.508	0.878	1.386
Orissa	3.157	3.227	6.384
Punjab	1.151	0.079	1.230
Rajasthan	18.001	1.933	19.934
Sikkim	0.131	0.150	0.281
Tamil Nadu	3.392	1.009	4.401
Tripura	0.108	0.865	0.973
Uttar Pradesh	6.635	1.426	8.061
West Bengal	2.177	0.359	2.536
Union Territories	0.889	2.175	3.604
Total	**93.691**	**35.889**	**129.580**

Source: National Wasteland Development Board, 1990.

3.5 Summary

In this chapter the historical aspects of forest resource management in India were presented in order to explain the current management efforts at involving the people to manage their natural resources. As to how traditional management of common property resources was taken away from the village communities and after the failure of state management how the communities are being encouraged to take over the management of their natural resources has been discussed. With this national scenario in the background the present case study area and related parameters are presented in the next chapter.

Chapter - IV

Common Property Resource Management in Southern Haryana

In this chapter a brief description of the Haryana state is presented. In addition the case study area is introduced, and information on its location, demography, socio-economic characteristics, the environment, common property resources(CPR) are presented. Further, factors responsible for the degradation of common property resources, legal aspects concerning the village common lands and the current management scenario are also discussed and analysed in order to fully explain the current situation.

4.1. Location of Haryana State

The state of Haryana is one of the 25 states of the Indian Union and was created in 1966 when it was formed from the Punjab. Haryana encircles the union territory of Delhi from North, West and South. Haryana also has borders with Rajasthan in the South, South-West and West, Punjab on the North, Himachal Pradesh on the North-East and Uttar Pradesh on the East.

4.2. Socio-economic Characteristics of Haryana

With its 44,212 sq. km. area it is one of the smaller states of Northern India. The population according to the 1991 census is 16.464 million, of which 78% live in the rural areas. The population grew by 80.7% from 9.11 million in 1967-1968 to 16.464 million in 1991. 75.37% people live in rural areas while 24.63% live in urban areas. Of the total rural population only 33% is literate and 19.75% belongs to the lowest, so called scheduled castes (GOH, 1995). Literacy rate in the southern area is as low as 5% among male adults and almost nil among the female adults, especially in the Mewat area. The state literacy rate was 55.85% as against the national average of 52.21% in 1991. Of the scheduled caste population (3.25 million) 20.15% are literate,

which is slightly lower than the national average of 21.38% (Census of India, 1991) (GOI, 1994). The proportion of workers in the total population was 28.66% for the entire state as against the national average of 34.18% (1991). This includes main workers and excludes marginal workers. Population growth has been one of the major concerns in the state. It has been growing at an alarming rate but of late it has started slowing down due to the adoption of family planning methods, media campaigns and better education to limit the family size.

Table 4.1. Growth of Population in Haryana 1961 - 1991.

Year	Population	Absolute Growth	Decadal Growth Rate
1961	7590500		
1971	10036900	2446400	+32.22
1981	12922600	2885700	+28.75
1991	16463600	3541000	+27.40

Source: Census of India, 1991.

The per capita income of the state in 1991-92 is 3456 Indian Rupees at 1980-81 prices. The per capita income of the southern Haryana is almost half of the average income of Haryana. The share of the agricultural sector, including forestry and fisheries, in the state income declined from 65% in 1970-71 to 41% in 1986-87. The state's endowment with the natural resources such as minerals and forests is meagre compared to the other Indian states. Haryana has the lowest proportion of its geographical area under the forest cover at 3.86%, which is significantly below the national average of 23%. Food grain production went up from 3.97 m. tonnes in 1967-68 to 9.559 m. tonnes in 1990-91 while consumption of fertilisers went up from a mere 6.31 kg./ha to 114.39 kg/ha by 1991-92. The area under high yielding varieties of food grains increased from 0.141 m. ha to 2.673 m. ha between 1967-68 to 1992-93.

Pressure of the population combined with the favourable agro-economic factors have led to the expansion of agriculture to areas formerly under the forest cover. Availability of fodder for the increasing livestock population and of the fuelwood has suffered as a result. However, in Haryana attention has been paid by the state government to improve the development of the forest resources right from the time of the creation of the state. The efforts of the government in raising trees on government and community owned land increased the percentage of forest area from 3.09 to 3.86 between 1966-67 to 1987-88, adding some 350 sq. km. of the forest area (GOH, 1995). Environmental considerations such as stabilisation of sand dunes, reclamation of saline and alkaline soils, soil conservation and increasing the tree cover in general have been major factors in the state's reforestation programmes. Other economic factors are also important factors during the reforestation efforts. These include: improving the availability of fodder for livestock, and fuelwood both for the household and industries and improving the availability of wood for construction and for the wood based industries like the paper mills.

4.3. Management of Common Property Resources

Common Property Resources are broadly defined as those resources in which a group of people have co-equal use rights, specifically rights that exclude the use of those resources by other people. Individual members in the group of co-owners is typically conferred by membership in some or other group, whose central purpose is not the use or administration of the resource, such as village or tribe etc. (Magrath, 1989)

Common property resources such as village common lands covering 10% of the total geographical area of the Haryana state have a pivotal role in the subsistence economy of the state. They serve protection, production and conservation roles and most often these roles conflict with other activities of the growing population adversely affecting the sustainability of the resources. Sustainability assumes significance because of the dual economic problem i.e., costs of irreversible economic activity and the utility yielding roles of these resources.

Historically these common lands were managed by the traditional management methods by the villagers coupled with state control. In the post - independence period development was seriously influenced by the theories of economic growth (such as the Harrod - Domar model) put forward in 1951 placing emphasis on savings and investment in the labour surplus economy. The planned investment in the common property resources especially tree planting and fodder development was very limited in relation to the multiple demands to which the common property resources were subjected. This probably explains the dualistic development paradigms of the times, which emphasised the rapid industrialisation of developing countries for their faster economic growth. However, the role of the primary sectors in the overall growth of the developing countries substantially got a boost with the introduction of the Green Revolution.

In accordance with the trends of development policy, the policies adopted by the state towards the development of these common property resources has been modified to reflect the growing concerns of policy makers and the villagers and their changing needs and directions. Investment in the village common lands have several backward and forward linkages to a wide range of activities such as agriculture, industry, energy and soil conservation. Over the years many conservation and production oriented schemes have been implemented with mixed results.

Public investment in the common property resources has been limited in comparison to other primary sectors like agriculture. The growing population pressure and the growing industry demands has meant that most of the primary forest tracts of the common lands have been degraded into secondary and subsequently, degraded village forests. Since the 1980's there has been a marked shift in the policy towards conservation with the enactment of the Forest conservation act -1980 and the new National Forest Policy of 1988.

The recent policy shifts from the government changed the interventionist role of the public investment in the development of these common property resources to a more decentralised and participatory approach involving the government organisations such as the Forest Department and the village subsistence users of these resources (Poffenberger, 1990; Palit, 1991; SPWD, 1992; Malhotra et al, 1989 and Saxena, 1990). The objective of the government investment in the forestry operations of common property resources is to meet the subsistence needs of the rural and urban populations, requirements of the industry and the needs of conservation and rehabilitation. The public investment initiatives have wide and varied influence on the economy with implications on sustainability through pecuniary externalities, property rights, pricing policy, equity and distributional consequences.

In the following sections the present case study area is described. The contribution of common property resources to the village economy, the factors responsible for the degradation of common property resources and legal aspects concerning the management of common property resources are discussed.

4.4. Location of the Case Study Area

The present case study area covers the five southern districts of Aravalli Hills area, which is the most backward region of the Haryana state. This area falls within the semi arid zone. Most of the basic needs especially fodder and fuelwood requirements are met from these hills by the people inhabiting this environmentally hostile region. It is an area comprising 146000 ha. of village common lands spread over 5 districts, Gurgaon, Faridabad, Rewari, Mohindergarh and Bhiwani.

4.5 Climatic Factors

The greater part of the Aravalli area falls in the semi arid zone. The climate falls under the drought class of hot, dry and tropical type. It is characterised by high temperature and moisture deficiency almost throughout the year except for a brief

monsoon period from July to September. Even during monsoons, long spells of dry weather creates serious conditions of drought. The proximity of the Great Indian Desert (The Thar) adds to the already prevalent difficult climatic conditions in most parts of Bhiwani, Mohindergarh and Rewari Districts.

4.5.1 Temperature

There is a prolonged hot period lasting from March to middle of July. The hot winds from the adjoining areas of Rajasthan Desert cause further desiccation in the area. Temperature in June rises up to 47^0 Celsius. The average minimum temperature during winter is around 7^0 Celsius. During December and January the temperature falls still further to below freezing. the lowest recorded temperature is -2^0 C (HFD, 1988). The low temperature causes damage to plants by frost, mostly in the low lying areas. The lack of soil combined with wide variation in the temperatures brings in the harsh climatic conditions for the survival of trees. Most of the trees endemic to this area shed their leaves during hot months and remain in a state of dormancy until the onset of monsoon rains.

4.5.2 Rain fall

The Aravalli area is characterised by low rain precipitation. The rainfall pattern shows wide variation from year to year and in a cyclic manner. A good rainfall may occur once in 3-4 years. Rains are extremely erratic in volume, place and time. The number of rainy days in a year is 23 to 56 in a year. Average annual rainfall varies from 337 mm in Tosham in Bhiwani district to 781 mm in Faridabad District. Rain fall increases from south-west to north-east. 80% of the rainfall occurs during south-west monsoon (July to September) (HFD, 1988). Winter rains during February and March are also common. Winter rains are also more erratic and insufficient for raising agricultural crops.

4.5.3 Relative Humidity

There is marked variation in the values of relative humidity of different months. The relative humidity is lowest (up to 39 percent) during the summer months and highest (up to 86 percent) during the monsoon months of August and September (HFD, 1988).

4.5.4 Wind Velocity

The Aravalli area is subject to high velocity winds from March to August. The wind speeds vary throughout the year and dust storms up to 125 km. per hour have been recorded. These storms are responsible for severe wind erosion in the hills as well as for the formation of aeolian deposits in the vicinity of the hills. Mean wind velocity varies from 2.0 km per hour in January to 10.0 km per hour during the months of May and June (HFD, 1988). Hot winds and high velocity dust storms are quite common during the months of May and June and sometimes westerly wind velocities of more than 50 km per hour are recorded. The hills are subjected to severe desiccation by the dry winds and severe drought conditions prevail which inhibit plant growth.

4.6 Physiography

The Aravalli Hills extend as a continuous range in Gurgaon and Faridabad districts and in the form of isolated and detached hills in Mohindergarh, Rewari and Bhiwani districts. The hills can be divided into the following four physiographical forms based on their erosion.

a) Eroded hill slopes

b) Table lands on hill tops

c) Alluvial deposits in the foot hills

d) Aeolian deposits

The relative distribution of the extent of various topographic zones varies in different parts of the area. For example, the table lands are more or less absent, in Mohindergarh, Rewari and Bhiwani districts. Their occurrence is more predominant in Faridabad and Gurgaon districts. The physical characteristics of different physiographical forms are described below.

a. Eroded Slopes

About 70% of the total area of the hills are badly eroded lands with slopes varying from 15% to 70% or more. There are vertical rocky cliffs at certain places. Uncontrolled grazing and removal wood has resulted in the loss of vegetation on these slopes which accelerate the run-off. There is hardly any infiltration of rain water most of it being carried away as surface run-off. Soil depth varies from 5 cm to 15 cm. The crystalline rocks are hard to disintegrate. The dry climate coupled with low water table is responsible for slow rate of weathering. Deposits of deep soils are met with between bouldery outcrops or in depressions. The high degree of erosion and poor cover do not permit any improvement in soil conditions. Almost 20% of the area is covered by bare rocks. Natural tree and grass species struggle to survive by sending their roots through rock crevices. The table lands on hill tops provide soil conditions more favourable for tree growth. The aeolian deposits are largely stable having a partial vegetation cover. Fresh sand deposits are met with on tops of these sandy hillocks. Deep alluvial loamy deposits are met with in some areas of Gurgaon, Faridabad and Mohindergarh districts at the foot of the hills.

b. Table Lands on Hill Tops

Along the longer hill ranges in Faridabad and Gurgaon districts, and very rarely in the isolated hills of Mohindergarh, Rewari and Bhiwani districts flat lands or rolling table lands occur. Rocky outcrops are frequently found in the area. Natural depressions in the area are used to collect water for the use of animals. Soil condition in these table lands is better and these support vegetation and grasses. Soil depth varies from 20 to 60 cm. with a mixture of partially decomposed parent material and boulders.

c. Alluvial deposits in the Foot Hills

The process of erosion and water action created alluvial deposits in the foot hills. These formations are frequent in the Faridabad and Gurgaon districts. These are at a higher level than the adjoining plains but merge with them. The land is undulating with slopes varying from 10% to 30%. with a fair quantity of rocky out crops at places. The excess run-off from the hills passes through these deposits resulting in deep gully formations. The soil is fairly deep and contains calcium carbonate nodules at lower levels.

d. Aeolian Deposits

The presence of arid sandy plains in the vicinity of the hills combined with high velocity of the winds has resulted in the formation of aeolian deposits. The wind borne particles of silt and sand settle near the hills due to the reduction in velocity brought out by the physical obstruction of the hill ranges. Aeolian deposits. are frequently found on the leeward side but occasionally on the windward side also. Most of these deposits are now in a stabilised form, but there are fresh deposits present on some older formations.

4.7 Geology

The Aravalli ranges are the oldest mountain range of India and are supposed to have come into existence during the close of the Dharwar era (Archean system) by ridging up the marine sediments by an upheaval. Renewed upheaval occurred in the mountain chain during early Palaeozoic period (HFD, 1988). The ranges rise to the level of 1200 - 1500 metres above sea level. In Haryana the Aravallis extend from the borders of Delhi extending further in Faridabad and Gurgaon districts to the border of Rajasthan state in the south-west and rise up to 652 m above mean sea level. The hills are discontinuous often surrounded by sandy or alluvial plains. In the districts of Mohindergarh, Rewari and Bhiwani the hills are more isolated and extend up to Khanak village in Bhiwani, which is the western limit of the Aravallis in Haryana. The Haryana Aravallis are a combination of Delhi and Alwar systems in geological terms. Rock formations comprise Alwar quartzites constituting quartzites and granite, ferrugeneous quartzites, slates, lime stones and marble. The Delhi system is characterised by a great variety and abundance of igneous intrusions and more intense grade of metamorphosis than older Aravallis. They contain 50% brown tourmalines besides an appreciable quantities of colourless mica and limonite.

The geological formations in Aravallis contain minerals of economic importance. Valuable building materials like marble and sand stone are available. Mining of marble and slates on commercial scale is being carried out in Mohindergarh and Rewari districts. In almost all the districts quarrying of building stones has been going on with damaging effects on the environment. The total area of quarries is about 2950 ha. (HFD, 1988).

4.8 Soil

The soil depth and texture varies according to the topographic zone. On the hill slopes, soils are eroded, shallow and marked with conspicuous bare rocks. Soil texture varies from sandy loam to sandy. The clay content is slightly high (18-20%) in

geological formations containing slates and lime stones in Mohindergarh districts. p^H varies from 7.2 to 8.4, while the organic carbon content in the soil varies from 0.02% to 0.47%. The availability of Phosphorus varies from 4.5 kg/ha. to 56 kg/ha. Electrical conductivity of the soils varies from 0.11 to 0.47 milli mhos/cm (HFD, 1988).

4.9 Hydrology

There are no permanent rivers in and around Aravallis. The most important seasonal river is Sahibi which rises in the Jaipur district of Rajasthan state and passes through Rewari and Pataudi areas. During rains the river comes down with great force often flooding the sandy banks. The river bed is 1 km wide. Kasavati river also rises in Jaipur district of Rajasthan and passes through Rewari. The Indori rises near Nuh and joins the Kasawati. The streams occurring in this area are characterised by flashy flows with heavy movement of sand and silt. The flood waters of Sahibi river spread over a vast region of Gurgaon, Mohindergarh, Rewari and Rohtak districts often causing heavy damage to crops. These floods also recharge the underground water table and help irrigate the crops in rainfed area. Kotla lake in Ferozepur area is the biggest natural lake having a total area of 20 sq. km. During rains water accumulates in many low lying areas of Gurgaon district because of poor drainage caused by calcium carbonate pan formation near the surface. The water in these lakes and ponds is often found to be saline.

Ground water in the foot hills is generally found at more than 15 m depth. In Faridabad water is found at lesser depths (6 m-10 m). The quality of the ground water is generally good in Faridabad and Gurgaon districts. Saline and sodic-saline waters are found in Mohindergarh, Rewari and Bhiwani districts.

4.10 Forest Types

The natural flora of the case study area has been classified as Northern Tropical Thorn Forests (Champion and Seth, 1968). This type is further divided into Northern Tropical Dry Deciduous and Northern Tropical Moist Deciduous Thorn Forests. At certain places in the hills soil variations give rise to edaphic climax types of Northern Tropical Dry Deciduous Thorn Forest type and its degradation stages. The Northern Topical Moist Deciduous Forest type is absent in this area.

The Northern Tropical Thorn Forests contain almost pure patches of *Acacia senegal* in association with *Acacia leucophloea, Salvadora oleoides, Zizyphus* species, *Capparis* species etc. This type often merges with the degradation forms of Northern Dry Deciduous Thorn type or degradation forms like *Zizyphus* scrub.

The Northern Tropical Dry Deciduous Thorn type of Forests have pure *Anogeissus pendula* stands and are found on quartzites along the slopes of hills or flat table lands. The degradation stage of this type mostly contains *Acacia senegal* and shrub type of *Anogeissus pendula* due to excessive grazing by goats. This is considered to be the last stage of this species before the complete elimination from this locality. Other tree species include *Acacia leucophloea* and *Wrightia tinctoria.*

Anogeissus pendula forests still survive in a few patches in Gurgaon, Mohindergarh, Rewari and Bhiwani districts. In other areas there are scattered or malformed trees of the degradation stage in mixture with *Acacia senegal.* The climax type vegetation stand of *Anogeissus pendula* are found in shallow reddish brown soils in quartzite formations on hill slopes or ridges.

Anogeissus pendula form pure crops (90%) with 0.8-1 density, with average height of about 6 meters, branching at a height of 1.5 metres from the ground level. Main associates in the first and second stories are *Acacia senegal, Acacia leucophloea, Butea monosperma, Bauhinia resimosa, Holoptelia integrifolia, Wrightia tinctoria,*

Cassia fistula (rarely), *Salvadora oleiodes* (fringes), *Cordia myxa and Ehretia leavis.* Along the banks of streams, species like *Syzigium* and *Phoenix sylvestris* are occasionally found. Among small trees/shrubs are *Grewia tenax, Grewia flavescens, Rhus mysorensis, Maytenus emarginata, Diospyros cordifolia, Zizyphus mauritiana, Zizyphus numularia, Capparis decidua, Capparis zeylanica, Adhatoda vasica, Nerium odorum* (along streams). *Tephrosia purpurea, Indigophera* species. There are very few climbers found in the area. The most important climber is *Mimosa hamata,* while *Vallaris heyni* is found in climax vegetation. Important species of grasses are *Cenchrus ciliaris, Cenchrus setigerus, Dicanthium annulatum* and *Erianthus* species. Tree species like *Sterculia urens, Mitragyna parviflora* have also been noted in more moist situations in Faridabad and Gurgaon districts. *Azadirachta indica, Ailanthus excelsa* and *Acacia nilotica* are found where soil depth is better, mostly on the foot hills.

4.10.1 Vegetation types on the eroded hill slopes

Anogeissus pendula (shrub form) along with *Acacia senegal, Acacia leucophloea, Wrightia tinctoria, Butea monosperma* and *Salvadora olieodes* are the common species. *Prosopis juliflora* (introduced or run in wild) is found in pure patches on the lower hills.

Among the shrubs are *Grewia tenax, Capparis zeylanica, Lantana indica, Zizyphus numularia* and *Adhatoda vasica. Opuntia* species are found occasionally in Gurgaon and Faridabad districts. Among the annuals / herbs are *Achyranthes aspera* and *Ocimum americanum*. Important grass species found include *Cenchrus ciliaris, Dicanthium annulatum* and *Heteropogan contortus.* In the Aravalli hills of Mohindergarh and Rewari districts metamorphic rock formations viz. marble and slate are found along with quartzites. The slopes of the hills are steeper and weathering of rocks is slower due to the arid conditions. The main difference in vegetation is the presence of *Euphorbia caducifolia,* and *Commiphora wightii* on ridges especially on calcium containing soils.

In Bhiwani district, the distinct feature is the absence of *Anogeissus pendula, Acacia senegal and Commiphora wightii.* Other associates are *Acacia leucophloea, Azadirachta indica* and *Salvadora oleiodes.* The density of vegetation is 0.1-0.3. The height of the trees varies from 2-3 metres.

Important shrubs include *Grewia tenax, Maynetus emarginata, Capparis decidua and Lantana indica.* Important grass species are *Cenchrus ciliaris, Cenchrus setigerus, Iselima laxum, Aristida adensionis, Heteropogon contortus* and *Andropogon laniger.*

4.10.2 Vegetation on Aeolian deposits

Common trees occurring on stabilised sand deposits are A*cacia senegal, Acacia leucophloea, Azadirachta indica, Strebelus asper, Holoptelia integrifolia, Salvadora Oleiodes, Balanites aegyptica, Tecomella undulata, Ailanthus excelsa* and occasionally *Prosopis juliflora, Anogeissus rotundifolia* are found on the foot hills. The tree density is very low. Important species of shrubs are *Acacia jacquemontii, Zizyphus mauritiana, Zizyphus numularia, Maytenus emarginatus, Lycium barbatum, Ricinus cummunis, Calligonum polygonoides, Ephedra foliata, Aerua tomentosa, Aeruva javanica* and *Capparis* species.

Creepers belonging to cucurbitaceae are quite common. *Aristolochia bracheata* and *Cuscuta reflexa* are the climbers found in this type of lands.

Important grasses are *Erianthus munja, Cenchrus ciliaris, Cenchrus setigerus, Heteropogon contortus, Andropogon laniger* and *Cynodon dactylon.*

4.11 Extent of Common Lands

The present case study area is an area of 146000 ha. of common lands belonging to 293 villages bordering the Aravalli Hills in the districts of Faridabad, Gurgaon, Mohindergarh, Rewari and Bhiwani. The low Aravalli hills, the oldest mountain chain in India, reach from Rajasthan into the southern Haryana. The destruction of the vegetative cover of the communal lands of these villages by humans and livestock has caused accelerated erosion and contributed to the poverty of the rural population (Kaul and Srivastava, 1993). The common lands of the area belonging to these villages provide most of the fuel and fodder requirements of the cattle and live stock numbering 278,423 in an area of 40,335 ha. The average stocking rate is estimated to be 1 Tropical Bovine Unit (TBU) for 0.3 ha., which is much higher than the prescribed levels of 1 TBU for 3 or 5 ha in a year with average annual rainfall (Haryana Forest Dept., 1988).

According to a recent survey conducted by Bokil (1993) the proportion of common lands to total area of the villages ranges from a low of 2% to a high of 81%, with the average being 26%. The average person to common land ratio is 17.3 with the ratio widely fluctuating between 1:1.4 to 1:127. This clearly indicates the existing pressure of population on most of the common lands.

4.12 CPR's and their Contribution to the Village Economy

Common property resources are an important natural resource for rural communities in developing countries such as India because they continue to be a significant component of the land resource base of these communities. This is more prominent in the semi-arid and arid tropical areas of India (Jodha, 1992).

In the arid areas of Haryana common property resources contributions are mainly employment, income generation, food supply, water, fibre, fuel wood, fodder, grazing by the cattle and live stock and several other associated backward and forward

linkages such as development of handicrafts and other cottage industries etc. and other social and economic contributions include drainage, recharge of the ground water, improvement of micro-climate in the village and sustainability of the farming systems etc. Though traditionally common lands have provided a number of products, at present they are mainly used as a source of fuelwood and fodder. The proportion of poor depending on the common property resources for fuel, fodder and food items ranges from 40% to 80% in the villages of Haryana. A survey reported by Bokil (1993) shows that the poor and landless families (about 30%) were more dependent upon the common lands for fuelwood. The other sections of the population, especially farmers collect fuelwood from their own lands and in addition use cow dung cakes for their fuel needs. The distance travelled for collecting fuelwood varied from 1 to 6 km.

4.13 Degradation of Common Property Resources

Despite their significant contributions to the rural community common property resources have been undergoing severe degradation, continuous erosion and are becoming transformed into the open-access resources (Jodha, 1992). Although CPR's contribute greatly to rural populations, the potential of involving these people in the equitable and participatory development has been continuously ignored by the policy makers, researchers, planners etc. There have been some development interventions in the village common lands but in the main these have been half hearted and did not involve systematic planning for participatory development. This has meant that although these areas have received technological inputs and financial support they continue to be degraded. The tragedy of the commons is used to justify the adoption of incorrect methodology. In Haryana's, village common property resources include village forests, pastures, waste lands, thrashing grounds and dumping grounds for agricultural crops and for storing cow dung etc., village ponds and small streams and rivers and their banks etc. Common property resources play an important role in assuring the livelihood of the rural poor. The breakdown of the traditional common property resource management systems not only causes environmental harm as the

resources are severely degraded under open-access regimes, but social harm because the poor can no longer depend on them. For many villages in the semi-arid and arid zone of Haryana this has increasingly turned out to be the common tragedy of environmental collapse and pauperisation of the already poor. Further conversion of the common property resources into open-access regimes is profoundly detrimental to socio-economic development and environmental enhancement.

4.14. Causes of Degradation

Three major factors can be identified as contributing to the degradation of common property resources in Haryana. These are:

i. Decline of Productivity: Due to continuous management under an open-access regime the common property resources have become degraded because villagers have exploited them without considering maintaining their asset. This has been compounded by increasing demands from a rapidly increasing human and livestock population.

ii. Weakened Social Organisation: Traditional village-based authority systems have in the past regulated user access to the common property resources and enforced users' obligations relating to investment for the conservation and development of the village common property resources. Villagers used to respect their village elders and contribute to the upkeep of the common lands and other natural resources. Any violations of restrictions were met with stiff penalties. The advent of the modern law and courts has destroyed the authority village organisations had in dealing with abusers of communally accepted distribution mechanisms. The success of the traditional common property regimes in the past in many cases was due to the result of low levels of demand for resources, i.e., in the absence of economic scarcity. Although elected village councils, named village panchayaths still exist they seldom exercise their authority in dealing with the common property resources mainly

because they are neither authoritarian nor bold enough to take measures which would anger their constituents (Jodha, 1992).

iii. Privatisation: The introduction of land reforms after independence initiated changes in the status and management pattern of the common property resources. Some of the common lands were distributed to the landless people, who converted them to agricultural use(Jodha, 1992). Informal partitioning, and in some cases encroachments by some powerful individuals also contributed to the decline in area under common ownership followed by appropriation and formal privatisation. Again most of this land has been put under agriculture but because these lands were already poor in nutrients, yields from these lands have been very poor. Another form of privatisation has been the acquisition by other agencies such as public works department and irrigation departments in the name of public interest.

4.15 Rehabilitation of Common Property Resources

In a way, rehabilitation of common property resources is less of an investment and technological problem and more of a resource management problem. Impacts of investment and technology may prove short lived unless management and usage aspects of the common property resources are effectively handled. In most areas, even natural regeneration itself can make common property resources more productive, provided it is permitted through the controlled and regulated use of the resources. However, this cannot happen unless common property resources are converted from open-access to true common property regimes. In practical terms, this means re-establishing and enforcing usage regulations and user obligations.

At an aggregate policy level, this could be facilitated by legal and administrative provisions which would give not only legal sanction to adequate usage practices, but would also empower local communities to implement such provisions. Some of these provisions in terms of a mandate to village panchayath already exist. These provisions concerning legal and administrative aspects have been discussed in the following

sections. Still there are certain elements which could be integrated into workable strategies for management. The focal point of such strategies can be the organisation of the common property resource user groups, who have a stake in them. This means establishing participatory development and planning processes aimed at reversing the degradation of these common lands.

4.16 Legal Aspects of the CPR Management and the Current Management Scenario

The basic requirements of any democratic society is the existence of strong, decentralised local self government systems, which can control the use of resources for the good of the local communities. A characteristic feature of the agrarian situation in India has been the existence of village panchayaths functioning as local self governments as an integral part of the rural communities. Realising this, and also the requirements of a democracy, the founders of the Indian constitution made it a duty of all states to sustain and encourage the functioning of the panchayathiraj system in all rural areas (through Article 40 of the constitution); they also mandated that the common material goods of the villages be used for the common good (through Articles 39(b) and (c) of the constitution). These are the most general and basic guidelines defining the legal policy as regards to the village level community set-ups.

As a sequel to the article 40 of the constitution all the states passed panchayath acts assigning important functions and resources to the panchayaths so as to make them proper self-sufficient units for the development of villages. The Punjab Gram Panchayath Act, which applies to Haryana, was enacted in 1952 with the same motivation. The Punjab Gram Panchayath Act states that:

Section: 16. It shall be the duty of the panchayath to: (w) plant and preserve trees (on common land).

Section: 22. The Gram panchayath may by general order to be published in the manner prescribed: (i)regulate such matters as may be necessary for the general protection of standing crops and trees on common lands and the planting of such trees.

Section: 80. There shall be a Gram Fund for each panchayath and the same shall be utilised for carrying out the duties and obligations imposed on the panchayath.

The Punjab Village Common Lands(Regulation) Act similarly prescribes:

Section: 2. The panchayath may make use of the land in shamilat deh (common lands) vested in it under the act, either itself or through another, for any one or more of the following purposes:

(vii) Tree plantation or any other purpose related to the forestry.

Section: 14. Utilisation of the income from the shamilat deh: The income derived by a panchayath from the occupation of land in shamilat deh vested in it shall be utilised for the benefit of all inhabitants of the village, as laid down in the Punjab Gram Panchayath Act, 1952 and for the improvement, maintenance and management of the shamilat deh.

The legislators of the acts have realised that special functional committees or groups will be required for tasks at the village level. Panchayath Acts of every state provide the legal framework for such functional committees, and also special powers to the panchayaths to regulate the work and income of such committees. This framework is specified in the Punjab Gram Panchayath Act in the following section:

Section: 33.

(1) The gram panchayath shall for the discharge of its administrative functions and other duties appoint functional sub-committees and local committees.

(2) The functional sub-committees shall strengthen the panchayaths by assisting them with suggestions at the stage of planning and help in the execution of development work.

(3) In case a sabha area is constituted of more than one village shall have a local committee consisting of panches of the village and co-opted members of the village, which will look after the development of the village and will be considered as the functional sub committees for the purposes.

The institutional rules in the village panchayaths are influenced by the Punjab Gram Panchayath Act, 1952. This statute together with the Punjab Village Common Lands Regulation Act, 1961 forms the framework for the rules that villagers devise to manage their village common lands.

Land tenure is not a major problem in Haryana. Common lands, as panchayath lands are clearly delimited under these acts and their title of ownership is also clear due to the fact that mutation* of all such lands has been completed in favour of the panchayaths by the Government of Haryana in 1966. The village common lands are managed by the village forest committees, which act as the executive committees of the village panchayath.

The land use and benefit sharing amongst the users rests with the panchayath (vide sections 4(1) and 4(2) of the Punjab Village Common Lands Act, 1961). The administrative control over this asset, in terms of external inputs belongs to another

* Mutation is a process by which changes in the title of ownership of a particular property are altered.

party. The Revenue Department through the Block Development Officer, Sub-divisional Officer and the Collector; (Sections 7 of the Punjab Village Common Lands (Regulation) Haryana amendment Act, 1991.

Section 3(2) of the Punjab Village Common Lands Rules, 1964 gives panchayaths powers to lease out the common land for agricultural and cultivation purposes. The panchayath has also the power to pass a resolution to allow a legally bonafide agency like the Forest Department to enter into an agreement for management and development of its village common lands (vide section 22(1) of the Punjab Gram Panchayath Act, 1952). The net effect of the operation of these two types of rules has been that under the resolutions passed by the panchayaths for afforestation purposes the land is temporarily transferred for afforestation and management by the Forest Department.

The Forest Department has provided the institutional framework for the constitution of the village forest committees by the panchayath entrusted with the sole objective of management and development of village common lands. The assumption is that the smaller committees with the specific job of undertaking the assigned tasks will be administratively easier to handle than the larger panchayath bodies, which are already busy with number of other works concerning the village. The Forest Department has no *locus standi* to impose any such committees on the panchayath or the village people. Legally this can only be done by the village panchayaths themselves, the Revenue Department and the Governor. As such the Village Forest Committee's (VFC) can neither generate nor keep village funds independently, nor take rural credit, bank loans or other development funds from the Government unless authorised by the Panchayath.

This non-statutory status of the committees raises various legal questions about their social relationship with the panchayath bodies. The committee cannot dictate terms to the panchayath for benefit sharing from the common lands. The lands are vested in Panchayaths and they have the powers for distribution, and moreover since all the

villagers have rights to share from the commons, under the law, the committee cannot exclude benefits to free riders or to those who are deemed to have worked less than the work allotted to them. The relationship of the panchayaths with that of VFC's can be expected to be cordial since the sarpanch (chairman) of the panchayath is also the chairman of the VFC and most of the panches (elected members of the panchayath) are members of the VFC. Though legally all decisions are taken by the panchayath with regards to enforcement, management and development of the village common lands, the VFC's aid the village panchayath in fulfilling these objectives.

4.17 Summary

In this chapter the socio-economic characteristics of southern Haryana are presented along with the details of natural resources, vegetation, geology, climatic and other factors responsible for the degradation of common property resources, the efforts of the government in providing an institutional framework in order to re-establish community regulated access management system in place of an open-access situation have been discussed along with the legal aspects that govern the management of the common lands. Some of the theoretical aspects relating to the common property resource management, which explain various aspects of CPR management are presented in Chapter V for conceptual clarity and analysis.

Chapter V

Theoretical Aspects of Common Property Resource Management

In this chapter theoretical aspects of common property resource management are presented. Certain concepts relating to the CPR management are clarified. The theories that explain the theoretical issues in CPR management such as Garett Hardin's Tragedy of Commons, Game Theoretic Models and Olson's Logic of Collective Action are presented. These three theories have defined the ways at viewing the problem.

5.1 Concept of Common Property

'Property', as applied to natural resources, is a primary social institution both because of its own importance and also because several important secondary institutions, including taxation, credit and tenancy, are derived from it. 'Property', refers to a bundle of rights in the use and transfer (through selling, leasing and inheritance etc.) of natural resources. Different rights may be distributed in various combinations among natural and legal persons, groups and several publics, including the many units of the government (Ciriacy-Wantrup, 1975).

The term 'common property' as defined by Ciriacy-Wantrup and Bishop (1975), refers to the distribution of the property rights in resources in which a number of owners are co-equal in their rights to use the resource. This means that their rights are not lost through non-use. It doesn't mean that the co-equal owners are necessarily equal with respect to the quantities of the resource they use over a period of time. This definition refers to the right to use the resources, but not to transfer them. Heirs of a common owner become co-owners themselves only through their membership in the group, tribe or village. Common property is not 'everybody's property'. The concept implies that potential resource users who are not members of a group of co-equal owners are excluded. The concept 'property' has no meaning without this feature of exclusion of

all who are not either themselves or have some arrangement with owners to use the resource in question.

All common property resources share two important characteristics. First, exclusion (or control of access) of users to these resources. Secondly, each user is capable of subtracting from the welfare of other users. Hence common property resources are defined as 'a class of resources for which exclusion is difficult and joint use involves subtractability' (Feeny, 1990). Use of the term 'common property' has been controversial. This is because of the differences at the philosophical basis of traditional views as opposed to the western scientific resource management. The contemporary western view is that property is either private or it belongs to the state. In this view resources which are not amenable to private appropriation are called 'common property'. Common property in this sense does not mean that the resource is owned collectively by a group; it means that it is not owned by anyone but belongs to everyone as defined in US law in 1985 (Stevenson 1991). This definition states that such resources are basically open-access and freely available to any user. According to another view, common property should be restricted to communally owned resources - that is, those resources for which there exist communal arrangements for the exclusion of non-owners and for allocation among co-owners. The concept of common property in this second sense is well established in formal institutions such as the Anglo-Saxon common law and the Roman law (Ciriacy-Wantrup and Bishop, 1975). It is also well established in the many informal institutional arrangements based on tradition and custom.

The distinction between the two concepts is crucially important with regard to the 'tragedy of the commons' model proposed by Hardin (1968) (see section 5.2). According to Hardin's model, common property resources are really open-access and resources held in common are doomed to over exploitation since each resource user places immediate self interest above the community interest. Thus they eventually become villain and victim of resource depletion. The Hardin model leads to the conclusion that common property resources should be either privatised or controlled

by the central government authority to ensure sustainable use. Hardin depicted the solution as 'mutual coercion, mutually agreed upon', and referred to governmental control and made no mention of the communal management. Many case studies indicate that resource users can, and in fact do co-operate. Valuable natural resources in many instances are never open-access but are managed under traditional rules governing use.

Differences over the use of the term 'common property' are likely to persist. One solution to this impasse over the use of the term 'common property' is to distinguish between the resource and the regime. This distinction between the resource itself and the property rights regime under which it is held is critically important (Bromley, 1985). In general, common property resources may be held within the three property rights regimes namely open-access, communal property or state property. Under the open-access regime access is free for all; resource use rights are neither exclusive nor transferable; these rights are owned in common but freely available to everyone (and therefore property to none). Under state property ownership and management control is held by the nation state or crown. Under communal property use, rights for the resource are controlled by an identifiable group. The defined group develops a series of rules concerning who may use the resource, who is excluded from using the resource, and how the resource should be used.

Ever since Garrett Hardin's influential article in 'Science' (1968) was published, the tragedy of the commons has become a common phrase amongst the economists and others concerned with environmental problems. Wherever there are multiple users of a natural resource this phenomenon has been applied and solutions were given as if the resource degradation in all the cases is due to over exploitation of the resource. Be it fisheries, grazing, air and water pollution, misallocation in oil and natural gas, abuse of village common lands and other public lands, ground water decline, and wildlife decline, population problems and other problems of resource misallocation. The tragedy of commons is explained below.

5.2 Garrett Hardin's Tragedy of Freedom in a Commons

The phrase 'tragedy of the commons' originated from a paper in 'Science' in 1968 written by the ecologist, Garrett Hardin (1968), but the argument behind it is derived from debates within the discipline of economics. Hardin drew his illustration from a pamphlet published by an English clergy-man Lloyd in 1833 during the Malthusian debate on the checks to population. More recently, very similar arguments have been put forward by Demsetz (1967) and others.

According to Garrett Hardin the tragedy of the commons develops in this way. In a pasture open to all it is expected that each herdsman will try to keep as many cattle as possible. Such an arrangement worked reasonably satisfactorily for centuries because population growth rate, tribal wars and poaching kept population levels of both men and animals below the carrying capacity of the land. While these factors remained in balance there was no problem but as pressure comes on the resource the inherent logic of the commons remorselessly generates the tragedy.

As a rational being, each herdsman seeks to maximise his gain. They ask, "What is the utility to me at adding one more animal to my herd". This utility has one positive and one negative component. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is +1. The negative component is a function of the additional overgrazing created by one more animal. Since, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision making herdsman is only a fraction of -1.

Adding the component partial utilities, the rational herdsman concludes that the only sensible decision is to add another head of cattle; and another, and another.... and so on. However if this is the conclusion reached by each and every herdsman sharing the commons, therein lies the tragedy. Each herdsman is locked into a system that compels him to increase his herd without any limit in a situation where the resource

endowment is limited. Ruin is the destination towards which all humans rush, each pursuing their own best interest in a society that believes in the freedom of commons. Freedom in a commons invariably brings ruin to all.

This free rider problem results when an individual shirks responsibility to the community. It is often argued that the incentive for this behaviour is logical from the point of "self interest". The tragedy of the commons is often used to describe this behaviour in which the private benefit of grazing an additional head of the cattle on a common range exceeds the private cost, because the costs of maintaining range quality can be shifted to the group as a whole (Hardin, 1968). The tragedy of over grazing results from each persons incentive to free ride regardless of the expected actions of others. Even if an agreement is reached that specifies that all will refrain from further grazing, the strict dominance of a free rider strategy makes such a contract unstable.

Hardin (1968) explicitly identifies the commons system he describes with that prevailing in England until the enclosure of common fields in the 18th and 19th centuries. He argues that enclosure was a necessary response to overgrazing. Hardin's description of the commons paints a picture of extreme instability and immediately raises the question of how such a system could last for a great length of time (around a thousand years in much of the Northern Europe) without leading to irreparable degradation. The actual commons were never open to all comers but were the property of a defined group, known collectively as 'commoners'. Within this group, there were clearly defined limits on the number of cattle each individual could graze on the common fields. These limits were varied in response to the changing seasonal conditions, a process known as 'stinting'. A detailed description of the operation of this common property system is given by Tawney (1912). Dahlman (1980) points out that common property was the preferred form of land management for grazing across northern Europe for centuries during the middle ages. Dahlman argues that this was not due to the ignorance of the peasants who used the land, but that it was economically rational. Then the question arises as to how these examples

are reconcilable with Hardin's "tragedy of commons". The common property systems of Switzerland, Austria, Germany, Irrigation systems of south Indian villages (Wade, 1987) have been successfully operating for centuries. The survival of common property institutions in all these above areas is linked to the limitation of entry. The inputs to Hardin's commons may increase until economic exhaustion of the resource occurs. In the common property systems that have survived, people have learned to limit use through co-ordinated management. There is no co-ordinated management in Hardin's commons because no identifiable group has been distinguished as the managers.

The class of resources that has been labelled "common property" should more accurately be divided into two subsets. The subset that experiences overuse should be labelled "open access resources", for it is the unlimited access that causes the tragedy. The subset that has succeeded in limiting the access and employed the joint co-ordinated management is true "common property resource". Authors like Demsetz (1967) and Anderson (1978) launching their reasoning from the assumption that all the commonly used resources are overexploited and conclude that there was only one solution i.e., private property. Private property, of course, is one solution to the open-access problem. A secure, exclusive right to resource extraction imparts the incentive to the user to utilise the resource at an optimal rate. The private property rights holder not only reaps the benefits but also incurs all the costs of additional resource extraction, and a balancing of these benefits and costs leads the user to an optimal extraction rate. Common property in which the group control over the resource leads to the balancing of benefits and costs, might also be a solution. The private property advocates refuse to recognise this possibility because of the belief that individual incentives to cheat will ruin the group solution. This position, of course, ignores the incentive that individuals have to collude. Through collusion the group can increase the size of the joint product that they divide. It is important to recognise that common property might provide a solution to the open access problem, because certain resource characteristics or social institutions may require a common property solution, whereas a private property solution might fail or be sub-

optimal. Runge (1981) has pointed out that some traditional societies have long depended on group use of a natural resource.

Open-access is an undesirable regime under which to exploit a natural resource, when extraction levels become intensive. The solution often given is to vest property rights. Common property also possess a set of property rights relationships designed to eliminate open access exploitation. The number of users is limited, each user understands how much of the resource to extract, and decisions about resource allocation are made by some group process. Property rights have been vested in this situation, and they may be adequate to prevent the Hardin's tragedy. In these situations there are enforcement mechanisms with which to punish those exceeding agreed extraction levels.

Thus, although private property can provide the incentives to attain proper resource allocation, it may not be the solution towards which all the allocation systems must move. Open access and common property are generally confounded with one another and common property is subsequently condemned as inferior to private property. The open-access and common property situations are discussed below in detail in the subsequent sections.

5.3 Open-access in Common Property

An open-access resource is a depletable fugitive resource characterised by rivalry in exploitation. It is subject to use by any person who has the capability and desire to enter into harvest or extraction of it and its resource base. Such extraction results in negative externalities.

The depletability of an open-access resource reflects not only that there is rivalry in exploitation but also that some use rate exists that reduces resource supply to zero. This is true both of strictly exhaustible resources, such as oil and minerals, and of renewable resources, such as fish and trees. Simple physical or economic exhaustion

can reduce the former's supply to zero and sufficiently high use rates can drive the resource to extinction by simply extracting faster than its capability to reproduce (Ciriacy-Wantrup, 1975 and Dasgupta, 1979).

There are two types of externality; symmetric and asymmetric. The symmetric externality is present in an open access resource in which each entrant to resource use imparts a negative externality to all producers, but similarly these other producers have negative externality effects on the new entrant. The externality is reciprocal or symmetric. Common examples include fisheries, wildlife, open grazing land, ground-water, unregulated woodlots and forests, and common oil and gas pools. The asymmetric externality occurs when production or consumption decisions of the economic actors enter the production or utility functions of others while the recipients of the externality do not cause any reciprocal effects: e.g. a smokey factory dirtying a nearby laundry.

5.3.1 Over Use

The common, non-economic definition of overuse is exploitation of the resource beyond carrying capacity or equivalently beyond its maximum sustainable yield (Hardin, 1968). According to Hardin an open-access grazing area can operate satisfactorily for centuries if it is used below its carrying capacity. That means social and economic problems arise only when use exceeds this level. However a number of neo-classical economists have been trying to substitute another definition for over exploitation. They point out that social policy should be to maximise net economic yield, which in general is not synonymous with maximising output, that is, it is not the same as utilisation at carrying capacity. Economists argue that any level of inputs beyond that which would maximise net return from the resource is over use. Game theoretic models, which explain the group behaviour under different scenarios are described below.

5.4 Game Theoretic Models

In this section the Prisoner's dilemma, the assurance game and the multi-person repeated games are presented in order to understand the group dynamics and to explain how individuals behave when confronted with different situations.

5.4.1 The Prisoner's Dilemma

The prisoner's dilemma can be shown to represent open access if we imagine two cattle owners who use a grazing area that is at its maximum economic yield. The assumption of a constant number of herdsmen (i.e., two) confines this model to the situation of limited user open access, i.e., a limited number of firms but open access towards inputs. Each grazer has a choice of either adding a head of cattle or not adding a head, and the grazers may not collaborate. Assume that the marginal revenue product for the grazing area is -£2 per animal, and that this is composed of -£6 in reduced output from other animals in both grazers' herds and +£4 in value from the animal added. Here we assume that the marginal revenue product to the grazing area -£2 and the value of the additional animal +£4 are net of costs of providing the animal, e.g., purchase price, supplementary feed costs, veterinary costs, etc. Assume identical players and individual herds, so that the loss in value of outputs from the existing animals from adding a head divides equally between grazers (i.e., -£3 each).

		HERDSMAN 2	
		ADDS	DOES NOT ADD
HERDSMAN 1	ADDS	(-2,-2)	(1,-3)
	DOES NOT ADD	(-3,1)	(0,0)

Figure 5.1 The Open Access Problem as a Prisoner's Dilemma

For simplicity assume these values are constant for the first two animals grazed beyond the optimum. Given these assumptions then Figure 5.1 gives the payoffs for the game.

If both herdsman '1' and '2' decide not to add an animal there will be no loss to either one; both payoffs are zero. If herdsman '1' adds, but herdsman '2' does not add, the former will gain the value of the additional animal less the costs he imposes on the rest of his own herd (£4-£3 = £1). Herdsman '1' enjoys a net gain, which is necessary, for otherwise he would not make this move in the absence of Herdsman '2's adding an animal. Herdsman 2's loss is greater here than in any other scenario, because he has not added an animal to offset costs imposed on him (£0-£3=-£3). This is the upper right hand box in the game. Reverse payoffs occur if Herdsman '2' adds a head while Herdsman '1' does not. This is the lower left hand box in the game; Herdsman '1' incurs his greatest loss while Herdsman '2' faces his sole chance for gain. Finally if both add a head of cattle, losses to each are moderate because they are offset by the value each herdsman gains from the additional animal he grazes (£4-£6=-£2), but the total loss to the grazing area is greatest. Playing the game without collusion results in both Herdsmen choosing to add a head of cattle, even though it causes losses to both of them and their mutual restraint would have resulted in losses to neither. If we consider the problem from the Herdsman '1's point of view, if the Herdsman '2' adds a head of cattle (first column), herdsman '1' finds that he minimises losses by adding a head of cattle: In absolute value terms -£2 is less than -£3. Considering his possibilities if Herdsman '2' does not add a head of cattle (second column), Herdsman '1' still decides to add a head of cattle , since +£1>£0. That is he stands to gain rather than staying with no loss. Thus, Herdsman '1"s dominant strategy is to add a head of cattle no matter what Herdsman '2' does. Since the game is symmetric, Herdsman '2' will make the same choice. Both add a head of cattle and the tragedy of open access occurs. More over after each has added a head, if the private gains and losses from adding a head of cattle shift only slightly from those assumed here, the herdsmen will add more cattle in future plays of the game. This will continue until private gains and losses shift enough to reach an open access equilibrium.

Runge (1986), however argued that the representation of prisoner' dilemma does not clearly explain the important considerations. He suggested that community management involves the strategic interdependence between all the villagers to manage their natural resources. Instead of prisoner's dilemma it is the co-operative game such as the "assurance problem" that clearly presents the appropriate representation that individuals co-operate with each other and achieve a common interest and improve the resource management even though there exist incentives to cheat the agreement.

5.4.2 The Assurance Problem

The assurance analogy to the prisoner's dilemma is "the battle of sexes" in which a couple face the choice of entertainment and companionship (Magrath, 1989). One partner prefers the dog races to the ballet, the other the reverse. Both, however, prefer to accompany the other rather than go to their preferred event alone. A battle of sexes game is presented in Figure 5.2.

		Second Partner	
		Ballet	Dog Races
First Partner	Ballet	1, 2	-1, -1
	Dog Races	-1, -1	2, 1

Figure 5.2: Battle of Sexes

In contrast to the prisoner's dilemma this game has two stable equillibria. That means both go to either dog races or ballet together. Once an agreement is made there is no incentive to defect, unless a new agreement is made with the other partner. The problem is assuring other players actions. Runge argues that conceiving of

community resource management as an assurance game has several advantages. It displays that co-ordinated action can arise between the players without being imposed from outside. It emphasises interdependence of the players and the possibility of multiple stable outcomes. The structure of assurance problem is also such that once an agreement has been made, defection is no longer possible. Runge (1981) uses the assurance game to support the argument, made by others without reliance on game theory justification (Ciriacy-Wantrup and Bishop, 1975), that community management of natural resources is a viable institutional arrangement.

5.4.3 Multiperson and Repeated Games

Single play, two person games predict the outcome in the absence of other players. But in reality it is a multiperson repeated game that best explains the group interactions within themselves. Resource use almost always involves groups significantly larger than two, and users generally interact over extended periods of time. Theoretical, experimental and empirical studies of multiperson games and repeated games suggest that co-operation can emerge under a wide variety of circumstances (Magrath, 1989). These circumstances differ from place to place and region to region. Most important of all is the existence of an institution within the community, that can take care of the natural resources use and the legal set-ups that permit such an institution to come up. The rules governing various aspects of resource use also are to be designed. Rule making, monitoring the behaviour of individuals within the community and sanctioning the rule breakers are essential for establishing a common property regime.

5.5 The Logic of Collective Action

"The logic of collective action" developed by Mancur Olson (1965), explains the difficulty of getting individuals to pursue their joint welfare, as contrasted to individual welfare. Olson summarises the accepted view in his own words:

"The idea that groups tend to act in support of their group's interests is supposed to follow logically from this widely accepted premise of rational, self-interested behaviour. In other words, if the members of some group have a common interest or object, and if they would all be better off if that objective were achieved, it has been thought to follow logically that the individuals in that group would, if they were rational and self-interested, act to achieve that objective." (Olson 1965). Olson (1965) further emphasises that unless the number of individuals is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests.

5.6 Investment in Common Property under Open-access

There is always a tendency to over invest in the private inputs necessary to extract the resource leading to the dissipation of the economic rent attributable to the resource under the common property open-access situation. In addition, investment in commons improvement is generally lacking since no user in an open access situation can be assured of reaping the benefits of improvements to the resource before others do so. For example if a herdsmen fertilises an open-access grazing area, there is nothing to prevent other herdsmen's animals from consuming much of the increase in grass. As a consequence, there is insufficient motivation to invest in the improvement. The lack of incentive to invest in the resource results from a divergence between the party who incurs the costs and those who reap benefits. Under-investment in the commons improvement is mainly due to lack of assurance of reaping the benefits. An individual investing in resource improvements may receive some of the benefits from the investment but may not be able to capture all the benefits. The leakage of benefits destroys the incentive to invest. This means that even if any individual invests in the resource, that investment may result in a positive externality. This means that from the social perspective private individuals under invest in activities although such investment might generate positive externalities. No individual will be willing to

contribute to the investment unless some arrangement is devised by which all contributing share the improvement costs.

According to Scott (1955) the economic objective for the jointly exploited resources should not be to maximise the single period resource rent but rather to maximise the return from the resource over present and future periods. In order to do this, users must take into account the effect of current resource extraction on future extraction possibilities. Therefore, for both physical and financial reasons, users should consider the balance between extraction and conservation of the resource. In an open access situation, however, competition for the resource causes users to ignore the so called user cost; the present value of foregone future extraction benefits or increased future extraction costs caused by current resource exploitation. Under investment in the commons improvements in addition to over exploitation of the resource is a primary problem, which must be tackled by any joint resource management system.

5.7 Common Property Externalities

Externalities lead to non-optimal market allocation. The literature is filled with examples of 'market failure' arising from the divergence of private from social cost (Stevenson, 1991). The tragedy of the commons arising from grazing too many cattle on a given area of land has been widely noted as an important representative case of symmetric externality. The private benefit of grazing an additional head of cattle on a common grazing range exceeds the private cost, because part of the cost is incurred by the entire group engaged in grazing. As a result individuals have an incentive to '*free ride*' and resource over-exploitation results (Hardin, 1968).

In much of the developing world, common property provides a complex system of norms and conventions over individual grazing rights, closely resembling the traditional, common property institutions of pre feudal Europe.

In the past many economic consultants and planners have called for the imposition of private property rights to halt this tragedy of commons (Johnson, 1972, Picardi, 1976). Following the tradition of enclosures of common grazing lands, efforts have been made to impose private property schemes to "internalise" a common property externality. Many have failed seriously. Not only have they failed to stop over grazing, they also have contributed to further inequality in situations where there was already unequal distributions of wealth. Lands formerly held in common are being transferred to individuals such as high ranking bureaucrats, who can exercise influence in the allocation of use - rights. These individuals often fail to protect the quality of the common property (Hitchcock, 1980).

5.8 Need for Institutional management of CPR's

Common property rights are a special class of property rights which assure individual access to resources over which they have collective claims. Common property is created when members of an interdependent group agree to limit their individual claims on a resource in expectation that the other members of the group will do like wise. Rules of conduct in the use of a given resource are maintained to which all members of the inter dependent group subscribe. If individuals fail to contribute to the management of a collective good when they expect that others will, they are behaving as 'free riders'. Free riders respond to incentives to shirk responsibility to the group to which they belong (Runge, 1981).

Resources are managed as common property by rules for user group behaviour when their continuing use is conditional on the inter-dependent behaviour of the group members. Common property regimes provide assurance that the resources on which all persons collectively depend upon will be available sustainably. The same assurances would not be provided by the adoption of private or state property rights since the consequences for productivity, sustainability and equity would be different. For people in the developing world, who are directly dependent on the availability of renewable resources, common property regimes can provide equitable and sustainable

access to the resource at minimal cost. Rules or norms for the interdependent use of collective goods develop in the face of uncertain or limited resources availability. These rules originate within the group, are mutually accepted by the group, and contain their own means for resolving conflicts.

For resources such as forests, grazing lands and fisheries on which whole communities may depend and where the potential for free riding exists, questions of efficiency, equity and sustainability are inextricably bound together. In situations of uncertain resource availability, common property regime members prefer to trade off some of the individual benefit generated by a system of private use-rights for the collective assurance that the resource will be used equitably and as a consequence sustainably.

A well functioning common property regime may be distinguished by the following features (Bromley, 1985):

(a) Efficiency - a minimum of disputes and limited level of efforts necessary to maintain compliance;

(b) Stability - the regime has the capacity to cope with the progressive changes through adaptation, such as the arrival of new production technologies;

(c) Resilience - the regime has the capacity to accommodate surprises and sudden shocks; and

(d) Equity - there is a shared perception of fairness among the members with respect to inputs and outputs.

Using these four criteria, efficiency, stability, resilience and equity the institutional performance of such regimes can be appraised and their value as foundations for institutional innovation can be assessed.

In order to meet these criteria and to guide the use of collective resources, numerous variables must be defined by the group implementing the management of the common property resource. They are determining:

(a) What constitutes membership of the group having access rights to the resource with the duty to respect the rights of members;

(b) What constitutes agreement;

(c) On what basis will the right apply over time i.e., annually or seasonally;

(d) How rights are transmitted between generations;

(e) Where control resides;

(f) How compliance with agreed rules and conventions is to be maintained;

(g) How departures from the rules are to be corrected and sanctions imposed; and

(h) How disputes are to be settled.

Institutional arrangements, such as rules and conventions, are clearly important elements in resource conservation. They translate claims on the resource into property rights for some, and duties for others. In western society property rights have become centred on the state and the individual in the belief that common property is inherently unstable, subject to inevitable pressure from free riders, and bound to be degraded in the tragedy of commons. Many case studies from developing countries suggest that common property regimes not only can be viable but are essential. Common property regimes have the capacity to manage rural resources in ways that meet the multiple criteria (efficiency, equity and sustainability) are important to rural people.

5.9 Common property and Collective action

Many forests and natural resources have been managed for several centuries as common property regimes by communities all around the globe. Some may have disappeared naturally as communities opted for other arrangements, particularly in the face of technological and economic change, but in most instances common property institutions seem to have been legislated out of existence (McKean, 1995). The justification often provided for eliminating the communal ownership of common property resources is that individual or public ownership of common property resources would offer enhanced efficiency in resource use and greater long-term protection of the resource base.

Although common property has proved a stable form of resource management in some traditional societies, the combination of population growth, technological change, climate and political forces has de-stabilised many existing common property institutions (McKean, 1995). In Sahel and South Africa, serious misuse of resources has been alleged to be the direct result of traditional common property institutions (Hitchcock, 1980; Picardi & Seifert, 1976). In response to this, western economic consultants and planners have called for the imposition of private property rights (Johnson, 1972; Picardi, 1976).

The boundaries of the resource must be well defined legally and physically for the creation of common property institutions at the village level. The criteria for membership in the resource user group must be clear. Common property resources in Indonesian villages are under stress because the community opens membership in the user group not only to all the village residents but also to all their kin in the neighbouring villages (Vondal 1987). Stevenson (1991) notes that many Swiss villages limit eligibility to persons, who live in the village and purchase shares. New residents must find shares to buy and share owners who leave the village find that it is in their interest to sell their shares because they are unable to exercise their village

rights elsewhere. Japanese villages usually confer eligibility and shares of harvest in households rather than individuals and may also limit membership to long established main households rather than "branch" households (McKean, 1992).

In India, traditional village-based institutions have, in the past, regulated user access to the common property resources and enforced users' obligations relating to investment for the conservation and development of village common property resources. Villagers used to respect their village institutions and contribute to the upkeep of the common lands and other natural resources. Any violations of restrictions were met with stiff penalties. The advent of the modern legislative system has largely destroyed the authority that village organisations had in dealing with abusers of communally accepted distribution mechanisms. This is unfortunate as practice and theory alike suggest that real benefits may accrue from the allocation of common property rights in many situations.

It is the creation of a village level institution, which brings people together, and ensures protection and development of the common property resource base. Management of the natural resource base of a village is not possible without an effective village-level forum for finding common solutions and resolving disputes. Common property resources may support the economic growth of the village through supply of food, fuel, fodder, and artisanal materials for development. Village institutions need some financial help in order to arrest the resource degradation. This is where the role of government funding is crucial.

Similarly motivated private property schemes have been attended throughout the developing world. Many, perhaps most, have failed to stop over use, and in many of the cases may have contributed to even more rapid degradation of resources and to increased inequality in already unequal distributions of the wealth. Not unlike European lands that were enclosed, areas formerly held in common are often transferred to individuals (such as high ranking bureaucrats) who can exercise

influence in the allocation of use rights. These individuals then fail to manage these resources effectively.

The common property may be as viable as private property on the grounds of both efficiency and equity (Bromley, 1985). In many cases common property institutions may play a key role in the effective management of the scarce natural resources, complementing and combining with the private property rights. What follows is thus neither an attack on the private property nor wholesale endorsement of the common property. It is an argument in favour of institutions that are well adopted to the particular resource constraints facing the villages and community groups in the developing countries.

5.10 Summary

In this chapter some of the concepts relating to CPR management have been discussed. Different property rights sets have been examined critically in order to weigh the merits and demerits of different property rights. Common property rights provide a solution to the rural resource management problems under specific circumstances. These circumstances have been specified. In the next chapter the survey methodology in the case study area is presented in order to examine the institutional development of village common lands of Southern Haryana region.

Chapter VI

Survey Methodology

This chapter describes the approach and methods applied to generate the information required to test the hypotheses presented in Chapter I. The survey was undertaken in 1995-96 in southern Haryana state. This survey sought to verify or deny the information pertaining to the region and to facilitate the data analysis concerning the key issues in CPR management currently in practice in this region. Survey methodology and the methods used for analysing the village institutions and people's participation are presented.

6.1 Objectives of the Survey

The main objectives of the survey were:

(a) to identify key issues concerning CPR management;
(b) to explore the parameters helpful in institutional development;
(c) to elicit people's opinion with regards to government's attitudes, their preference and choice of species to be planted;
(d) to explore the traditional management and indigenous knowledge on management of common lands;
(e) to identify the factors of socio-economic and cultural importance which influence the CPR management;
(f) to inquire interdependence of people in meeting their basic needs;
(g) to understand the current participatory process and to identify the issues such as, conflict resolution, product sharing/distribution;
(h) to understand and appreciate different household level attributes concerning strengthening of village institutions;
(i) to explore the level of people's participation in CPR management;
(j) to evaluate the institutional performance in different case study villages.

6.2 Survey methods

Both primary and secondary data were collected as part of the survey. Primary data was collected from 196 households belonging to 15 case study villages. Initially pilot studies were conducted across the region and it was found that the formal method of preparing the questionnaires and interviewing was more useful rather than informal meetings, which elicited little data of quantitative information. The participatory rural appraisal (PRA) methods can sometimes miss out valuable information and are prone to bias and are time consuming. PRA techniques are known at first to omit people such as minority groups and out castes who live on the finges of the village (Chambers, 97). The formal approach is less vulnerable to interviewer's bias and inconsistency and allows for more sophisticated statistical treatment (Gardner, 1978). To elicit the expert opinion government officials' were interviewed with the help of a well structured questionnaire.

Secondary data was collected from village panchayath records, village forest committee meetings minutes, revenue records maintained by the village patwari, data from the districts' statistical offices, central statistical organisations' records, forest department's records, natural resource data management systems (NRDMS), agricultural and livestock departments' records and Haryana Agricultural University records, government of India's publications, etc. Both primary and secondary data formed a significant attempt to seek solutions which could help in identifying many aspects of CPR management and to suggest further improvements in institutional building to manage the village common lands in a sustainable manner.

6.3 Village Selection

A project for the rehabilitation of the common lands has been in operation in the southern Haryana region since 1990. This entire area is divided into 5 divisions such as, Ferozepur Zhirka, Sohna, Rewari, Narnaul and Dadri respectively. The divisions

were further divided into 14 sub divisions from the operational point of view by the Forest Department. A list of the villages in each of the five divisions was obtained from the local Divisional Forest Office. Three villages were selected in each of the divisions as part of a stratified sampling procedure. Thus 15 villages were selected out of the total 293 villages in the case study area (Figure 6.1).

Village selection was carried out on the basis of the survival rate of the forest plantations. This formed the preliminary basis for the village selection. Survival rates of the plantations were provided by the Forest Department. These data showed a large variation in the survival rates of the plantations, with all other technical parameters, such as climatic and edaphic factors being similar for the entire area.

Since the Forest Department did not have any legal control in regulating access to these plantations success of the plantations was probably dependent upon some other socio-economic factors. The amount of 'Social Fencing', provided by the village community in preventing the cattle grazing in the plantation areas is one such potential factor. While survival rate of the plantations was itself a measure of success, it could not fully explain the successful growth of these plantations. Hence a Success Index (SI) was developed (see section 6.4).

Three classes of villages were identified on the basis of the Success Index of their forest plantations. In the first class all villages had a Success Index greater than 60%, in the second the Success Index varied between 30 and 60%, while in the third the Success Index was less than 30%. The form of management pertaining to these village common lands in each of the three classes was measured from information pertaining to the formation and management of village forest committees.

Surveyed Villages: 1. Madhogarh 2. Sonkh 3. Baroji-Gundawas 4. Rajgarh 5. Nayan 6. Bhond 7. Mohammadbass 8. Khol 9. Budin 10. Zerpur 11. Kotla 12. Kultazpur 13. Pachnota 14. Thekri 15. Bawana Gujjar

Figure 6.1: Map Showing Case Study Area in Haryana State

6.4 Household Selection

Household selection was on the basis of the stratified random sampling with strata being the land holding capacity and caste. The advantage of stratified random sampling is that it offers the possibility of greater accuracy in comparison to either simple random or a systematic sample by ensuring that every group was represented in the sample. A list of households was prepared in each of the sample villages. A minimum of 5 percent of households were interviewed through the structured questionnaires (Table 6.1).

Table 6.1: Number of Sampled and Total households in the study villages

Village	Households (number)	Number of sampled Households	Percentage of Total Households	% of sampled households to total households
Baroji-Gundawa	73	4	5.47	2.04
Sonkh	157	8	5.09	4.08
Bawana Gujar	142	7	4.92	3.57
Rajgarh	439	22	5.01	11.22
Nayan	752	38	5.05	19.38
Madhogarh	360	18	5	9.18
Bhond	175	9	5.14	4.59
Mohammadbaas	100	5	5	2.55
Khol	468	24	5.12	12.24
Budin	350	18	5.14	9.18
Zerpur	200	10	5	5.10
Kotla	176	9	5.11	4.59
Kultazpur	260	13	5	6.63
Pachnota	180	9	5	4.59
Thekri	28	2	7.14	1.02
Total	3860	196	5.07	100

Usually the head of the household, who normally takes all the decisions concerning the farm as well as village common land management, was chosen for the interviews. No explicit consideration of gender of the respondent was considered since the interviews were conducted on the basis of the head of the household irrespective of whether it was male or female. Since most households owned agricultural land, land holding capacity became the criteria for selection. The strata was divided into four classes on the basis of land holding capacity. They are large farmers (owning more than 4 ha), small farmers (owning more than 2 ha but less than 4 ha), marginal farmers (owning less than 2 ha) and land less (Table 6.2).

Table 6.2: Number of households in each village based on landholding size.

Village	Large Farmers	Small Farmers	Marginal Farmers	Landless	Total
Baroji-Gundawas	16	32	20	5	73
Sonkh	5	45	90	17	157
Bawana Gujar	6	32	72	32	142
Rajgarh	28	0	324	87	439
Nayan	30	228	260	234	752
Madhogarh	6	26	178	150	360
Bhond	4	6	125	40	175
Mohammadbaas	2	66	20	12	100
Khol	0	327	45	96	468
Budin	5	48	215	82	350
Zerpur	6	2	166	26	200
Kotla	25	35	60	56	176
Kultazpur	0	80	102	78	260
Pachnota	15	13	112	40	180
Thekri	5	17	0	6	28
Total	153	957	1789	961	3860

Then the number of households selected from each strata was determined proportional to the total number of households in the village, but not exceeding 5% of the total households in order to maintain this ratio equally for all the villages.

In order to capture the social dynamics of the households the next strata was the caste of the households. A list of all households based on caste for each of the land holding classes was prepared. Then the number of households selected from each caste group was determined in proportion to their total number with every household in each of the landholding classes having equal probability of selection.

The questionnaire designed for officials was used to conduct interviews of government officials connected with the implementation of the project in order to capture the expert knowledge accumulated by their experiences. In all 196 households were interviewed with the help of the questionnaires. The ratio of sampled households to total households was maintained in order to ensure equal sampling levels.

6.5 Questionnaire Preparation

Two types of formal questionnaires were designed. One for interviewing the villagers (Appendix 6.1) and the other for the officials of the Forest Department and other Departments (Appendix 6.2). The collation of these data enabled the degree of CPR management to be ascertained for each village. The experience and knowledge of the researcher concerning the area was beneficial in designing the format of the questionnaires. There were no problems with the questionnaires designed for the officials since their literacy level was quite high, but the problem was significant in dealing with a large number of illiterate villagers, who participated in the process. To avoid difficult questions and to standardise the questionnaires pilot studies were conducted in five villages.

The questionnaires were tested on the site and suitable modifications were made before conducting the formal interviews of the villagers in case study villages. The formal questionnaires so prepared were used to interview villagers in the sampled villages at the household level. Since this is the basic unit in any village. A household was defined as all those who stayed, worked and ate in the same house. The questionnaires were designed addressing the two main issues prescribed by Converse and Stanley (1988). One is the presumption that the questions will generate the right kind of information and the other being the respondent will be able to answer the questions correctly. The questions were designed to be straight forward and unambiguous. The questions included open-ended, closed and dichotomous consisting of attitudinal, quantitative and qualitative information.

6.6 Development of Methods used for Institutional Analysis

This section is presented in three parts. The first concerns the determination of people's participation level, while the second and third are concerned with the development and use of the Success Index (SI) and the Resource Condition Index (RCI), respectively. The development of these three parameters was essential in analysing the strengths and weaknesses of the common property resource management in force in the surveyed villages.

6.6.1 Estimation of Success Index

In order to calculate the success of plantations raised on the village common lands the following procedure was adopted. Sampling of the plantation sites was carried out keeping in mind the area of the plantation in the sample villages. Since it was practically impossible to find out the condition of each and every plant in the entire plantation it was essential to restrict the sampling intensity to achievable limits within the available time and the scarce resources at the disposal of the researcher. However, this was found that the overall results of the procedure adopted gave satisfactory results. Based on the extent of the area the sampling intensity was adopted (Table 6.3).

Table 6.3: Plantation areawise Sampling Intensity

Area	Sampling Intensity
Less than 10 ha.	10%
10-20 ha.	5%
Above 20 ha.	2.5%

Though this estimate did not give precise results species-wise as planting was neither in pure blocks nor regular mixtures, but provided a sound overall estimate of the quality of the plants.

The procedure for selecting the transect was:

a. The plantation map of the site was examined to see the size, shape and distribution of blocks.

b. Each block was sampled and a base line was laid out using the ranging rods. If the configuration of the block and terrain permitted the base line was laid along the contour line so that the sample transects were at right angles and followed the slope of the terrain. Alternatively, such base lines were also taken along the foot hills, ridges or any where in the midway.

c. The available area of the plantation was divided into transects of 5 metre width since it was convenient and wider than the 3x3 metre spacing of the planted seedlings. The length of the base line divided by 5 gave the total number of transects. If the sampling intensity was 10% then each sampled transect was 50 metres apart. Where as, the transects were 100 metres and 200 metres apart in the case of 5% and 2.5% sampling intensities.

d. In order to avoid the personal bias in choosing the transect location, the position of the first transect number was chosen from the random numbers, selecting any number between 5 and 50 and subsequent ones being 50 metres apart for 10 percent sample size.

e. Using a compass, transect lines were set out in both directions at right angles to the base line. The 5 metre wide transects were marked temporarily by stretching a pair of ropes on either side of the offset line, checking at intervals to maintain a 5 metre width.

f. Plants on the transects were enumerated and recorded on a prepared worksheet listing the transect number and recording the type of different plants in three different categories, such as fully grown plants, partially browsed or damaged and dead or missing plants.

The survival percentage was calculated by:

$$\text{Survival percentage} = \frac{\text{Sum of the plants (fully grown + partly browsed)}}{\text{Total number of plants planted in the transect}} \times 100$$

The Success Index (SI) of plantations raised on the common lands is a measure of how successfully the plantations are being raised. In order to measure the Success Index of the plantations on the common lands, plants within sample plots were given different weights indicating their growth levels. All other technical parameters were assumed to be equal in all plantations since all of them fall under the same Aravalli ecosystem which has very little variation with respect to climatic and edaphic factors. The Success Index of the plantations is measured by the following equation.

$$\text{Success Index} = \frac{N_1x1+N_2x0.5+N_3x0}{N_1+N_2+N_3}$$

Where:

N_1 is the number of plants fully grown according to their age. This includes all the plants which are totally unbrowsed and undamaged by cattle trampling. These plants are given a weighting of '1'.

N_2 is the number of plants half browsed or half damaged by the cattle trampling but surviving. These plants are given a weighting of '0.5'.

N_3 is the number of plants dead or missing or totally struggling to survive. These plants are given a weighting of '0' since they will eventually fail to grow into a full grown tree. (Although one can eliminate $N_3 \times 0$ since it has no meaning in the equation its presence shows that it was also taken into consideration by eliminating the dead and missing plants).

The Success Index demonstrates the importance villagers place on protecting the plantations raised on the village common lands. If full protection is accorded by the villagers then this is reflected in the increased success index of the plantations.

6.6.2 Resource Condition Index (RCI)

While the Success Index of the plantations itself is a measure of success, it cannot fully explain the holistic resource situation in various villages because it relates only to plantations. Hence, a more comprehensive index, the Resource Condition Index (RCI) was developed to take into consideration the proportionate areas of village common

lands under plantations and natural village forests (including pastures). The Resource Condition Index was calculated for each village by;

$$RCI = \frac{\text{S.I. x Area Under Plantation}}{\text{Total Common Land}} + \frac{\text{Crown Density of Village Forests x Area Under Forests}}{\text{Total Common Land}} \times 100$$

Where:

RCI = Resource Condition Index.

S.I. = Success Index of the Plantations raised on common lands.

6.6.3. People's Participation Level

People's participation in this joint management effort at improving the resource condition of the villages is crucial if any such effort is to succeed. Without involving the users of these resources any top down approach by the government to control the resource degradation is likely to fail as has happened in the past (SPWD, 1992). People's Participation was evaluated by using the formation and management of the Village Forest Committees (VFC) as an indicator. Specifically, the frequency of meetings of the VFC and recording of the proceedings, the actual tasks undertaken / completed by the VFC's, attendance in the VFC meetings and the resolution of conflicts by the VFC's

(Table 6.4, explains the procedure adopted for calculating the people's participation level for Nayan village as an example). People's participation level is used as an indicator in determining the success of the institutional building at the village level.

Table 6.4: Evaluation of People's Participation Level for Nayan Village

Item	Score (Range 1-10) with 1 being the least and 10 being the best	Weightage given to each activity out of 100 Points	Total Points column(b) x column(c) / 10
(a)	(b)	(c)	(d)
Formation and constitution of VFC	8	20	16
No. of meetings undertaken by the VFC in a year and the attendance in such meetings	6	5	3
Maintenance of records	7	5	3.5
Formulation of rules concerning access to CL in VFC meetings	8	20	16
Evolving product distribution mechanisms by the VFC	8	10	8
Tasks undertaken by the VFC and their completion	4	20	8
No. of conflicts resolved by the VFC	6	15	9
Co-ordination between VFC and Forest Dept.	5	5	2.5
People's Participation Level			**66**

The criteria adopted in calculating the people's participation level is by assigning different points to different aspects. On a 1-10 scale the individual aspects listed in the Table 6.4 were given a score. Care was taken in assigning the scores. Records of the village forest committees were scrutinised with care and the perceptions of people towards the functioning of the VFC's formed a useful tool in ascertaining the correctness of the scores. Each aspect involved in calculating the people's participation level is discussed and the scoring pattern is explained below.

(A) Formation and constitution of the VFC: Presence of a democratic organisation or an agency, which has the legitimacy and capability to manage the village common lands for the benefit of local people is a fundamental aspect as far as CPR management is concerned. However formation alone does not provide the capacity to function effectively. The efficiency is dependent on a number of factors. But it is a step forward in creating institutional framework so as to enforce an order to an otherwise freely exploited resources. A weighting of 20 out of 100 points is considered as sufficient for this aspect. The range of the score given to it varies on different levels of the formation and constitution of VFC. A score of 10 out of 10 indicates that it is a well structured and well designed body, whose constitution is an ideal one. The constitution of the committee is truly representative and takes care of the interests of all the sections of the village community. On the other hand a score of 5 could be given if there was laxity or lacunae on the part of the formation and constitution of the committee. But even in this case there is an organisation, that can at least start functioning and that there is a scope for it's improvement. If a score of 1 or 2 indicates that either the VFC was not properly formed or it was not constituted properly. The scoring was according to the observation of field circumstances, the records of the village and the frequent interactions with the people.

(B) VFC meetings and the attendance in them: The frequency with which the VFC meets in a year and the members attending it and taking interest in its' proceedings is very important for the successful functioning of the VFC. A weighting of 5 out of 100 is given to this aspect. Though it cannot be said that the frequent meetings alone can reflect participation of people in the VFC functioning, it definitely shows the interest generated by the activity amongst them. If the VFC met at least once a month and that all its' members attended it then a score of 10 out of 10 can be given. A meeting at least once in a month was considered sufficient since weekly or very frequent meetings are not very useful. If frequent meetings are arranged the essence of having a meeting is lost. The lower scores indicate the lesser frequency of meetings and also the lack of interest of members in attending the meetings.

(C) Maintenance of Records: It is an essential feature of a successful organisation to maintain the records properly. In this case it is the land records, meeting minutes, constitution and formation of VFC records, the plantation records, records showing number of violations by villagers and the cases pending in the courts, etc. If all the records were properly maintained then a score of 10 out of 10 can be given. If some records are not properly maintained then a score of 5 or so can be given. If the record maintenance was extremely poor then a score of 1 or 2 can be given. A weighting of 5 out of 100 points was considered to be sufficient for this aspect.

(D) Formulation of Rules: Rules are essential for an organisation to function properly. In order to guide it's day to day functioning, successful design of the rules is an essential feature. Rules relating to the access, exclusion and their efficacy are considered for giving the scores. However, a subjective judgement had to be applied in assigning a particular score. A score of 10 out of 10 is given for the successful design of the rules of access and exclusion. If they were too lax or there was scope for avoidance then a score of 1 or 2 was given. If any VFC was falling in between these extremes then a score of five or more or less was given. Since this was an essential part of the successful functioning of the VFC a weighting of 20 out of 100 points was given.

(E) Evolution of Product Distribution: Most conflicts in CPR management arise due to the incentive to free ride and reap benefits out of self interest and against the community interest. If a just and equitable product distribution can take place of the common land products, then there shall be co-operation from all corners. A score of 10 out of ten was considered in an ideal situation. Where as, a score of 5 was given if these were lax and if there were no rules then a score of 1 or 2 was given depending on the circumstances. The rules relating to fodder and fuelwood extraction, and distribution of the produce amongst the individual households was considered under this aspect. A weighting of 10 out of 100 was given to this, which was considered sufficient.

(F) Tasks undertaken by the VFC: It is important that there exist certain tasks or targets to be achieved. In the absence of any specific tasks even if there are elaborate and well designed rules they become meaning less. The setting up of targets by the VFC and their achievement was considered as an important aspect for the successful management of common lands. The tasks of different VFC's set out for them were reviewed and the evidence of fulfilment of these tasks was evaluated and a score was given according to the number of the tasks and the achievement level. The range of the scores given were from 1-10 with one being the least and 10 being the best. Care was taken to take in to consideration the type of tasks and whether they were relevant or not. A weighting of 20 out of 100 was given.

(G) Conflict Resolution: It is imperative to expect that in such a fragmented, caste ridden, democratic society having conflicts to use a resource held in common was quite normal. Through conflicts, debates and resolution the VFC's can become mature organisations. The number of conflicts and their resolution level formed the basis for assigning the scores from 1 to 10, with 1 being the worst and 10 being the best. A weighting of 15 out of 100 was considered sufficient.

(H) Co-ordination between VFC and the Forest Department: In this participatory process co-ordination between the Forest Department and VFC is an essential feature in providing the frame work for the institution building. The Forest Department is also

providing financial support in the form of undertaking the plantations on village common lands for the benefit of villagers with the help of the VFC. Though this co-ordination in the beginning is very useful but once the VFC's become mature in taking care of their common lands even government's help can be dispensed with. That is why a weighting of 5 out of 100 was given for this aspect.

Though calculating the people's participation level in this way can be termed as subjective and prone to bias on the part of the researcher, but it is a step forward in quantifying the different parameters that are essential for the institutional building at the village level. It was not possible to include all the minute aspects but major aspects concerning people's participation were included.

6.7 Limitations of the survey data

A number of villagers could not provide accurate data on what was harvested, stored, consumed or bought or sold. Most of the figures were approximations. Their estimations were based on volumes rather than in kilo grams or quintals. Almost all of them did not maintain any records of day to day transactions. However care was taken to ascertain the factual position from knowledgeable persons in the village.

6.8 Data analysis

The data was transferred on to spread sheets and analysed using the SPSS (statistical programme for social sciences) and Microsoft Excel 5. The statistical analysis of the data provided the information concerning CPR management, such as people's participation level, enforcement mechanism, institutional building, product sharing mechanism and sanctioning the rule breakers. It has also provided the information pertaining to the household dynamics. The primary data combined with the secondary data provided the information required for constructing the linear programming models presented in Chapter VIII. These data enabled the calculation of coefficients used in this models to conduct scoping studies on CPR management.

6.9 Summary

In this chapter, the survey methodology, data collected and methods of data collection were presented. The data was required to test the hypotheses. The aim of the survey was to verify and or to deny the information concerning the region, in order to analyse the key issues in CPR management and household dynamics. In the next chapter survey results are presented with an in depth analysis of the strength of the institutional development at the village level. The development and use of Resource Condition Index to measure success of the institutions that manage the common property resources are presented.

Chapter VII

Survey Results and Discussion

In this chapter a brief description of the participatory afforestation process and the survey results are presented and discussed. The results of the case study, which show clear benefits deriving from common property regimes, will be used to examine institutional development at the village level. A composite resource condition index developed in Chapter VI when used in conjunction with people's participation level enables the determination of the strength of the village institutions in converting open-access regimes into common property regimes. Mechanisms and processes involved in assisting local people to establish common property regimes are also discussed. Important aspects of socio-economic and cultural factors, which influence the institutional building at village level are presented.

7.1 The Participatory Process: Institutional Development at the Village Level

Realising the enormity of the problem of destruction of the vegetative cover of the common lands in the Aravallis the Government of Haryana started a participatory afforestation project in 1990 for the rehabilitation of 33000 ha. under common lands. In order to re-establish community participation in the management of common lands by villagers, the Forest Department provided an institutional framework for the formation of village forest committees (VFC). In each village a 9-15 member VFC with the Sarpanch (Chairman of the Panchayath, an elected village council) as its head was constituted. The VFC includes the Sub-Divisional Forest Officer/Ranger and the concerned Forest Guard as its members from the Forest Department. The rest of the members come from the village community with at least 3 being women. Adequate participation of the members of the scheduled castes was also provided at the time of the constitution of the VFC. The VFC functions as an executive committee of the village Panchayath. All other villagers in the village are the general members of the VFC. VFC's meet as frequently as necessary

for the purpose of taking decisions on the use of village common lands and distribution of the produce from the village common lands.

Through a participatory rural appraisal process taking due consideration of the villagers' expectations and choice of species, an agreement is signed between the Panchayath and the Forest Department for handing over a part of the village common land for the purposes of tree planting and seeding of grasses and legumes. The villagers agree not to graze livestock in the afforested village common lands until the trees become mature. In the mean time, villagers are encouraged to cut and carry the grasses and legumes to stall feed their cattle from the areas under plantations. The Forest Department, after three years of maintenance, will handover the land to the VFC for further maintenance and management.

The labour required for plantation activities is drawn from unemployed labourers of the village. In the meantime, all efforts are made by the Forest Department to train the VFC and the villagers in all aspects that require a smooth functioning of the VFC and taking over the management of the village common lands. The VFC functions as an executive committee of the Village Panchayath: an elected body of the village. All other villagers in the village are the general members of the VFC. The VFC meets at least 4 to 12 times each year or as frequently as necessary for the purpose of taking the decisions on the use of the village common lands and the distribution of the produce from the village common lands. The VFC members are in constant contact with the villagers and the Forest Department. Figure 7.1 shows the importance of this joint management effort to replace open-access system by a community controlled common property resource management (also see photos presented in Appendix-7.1).

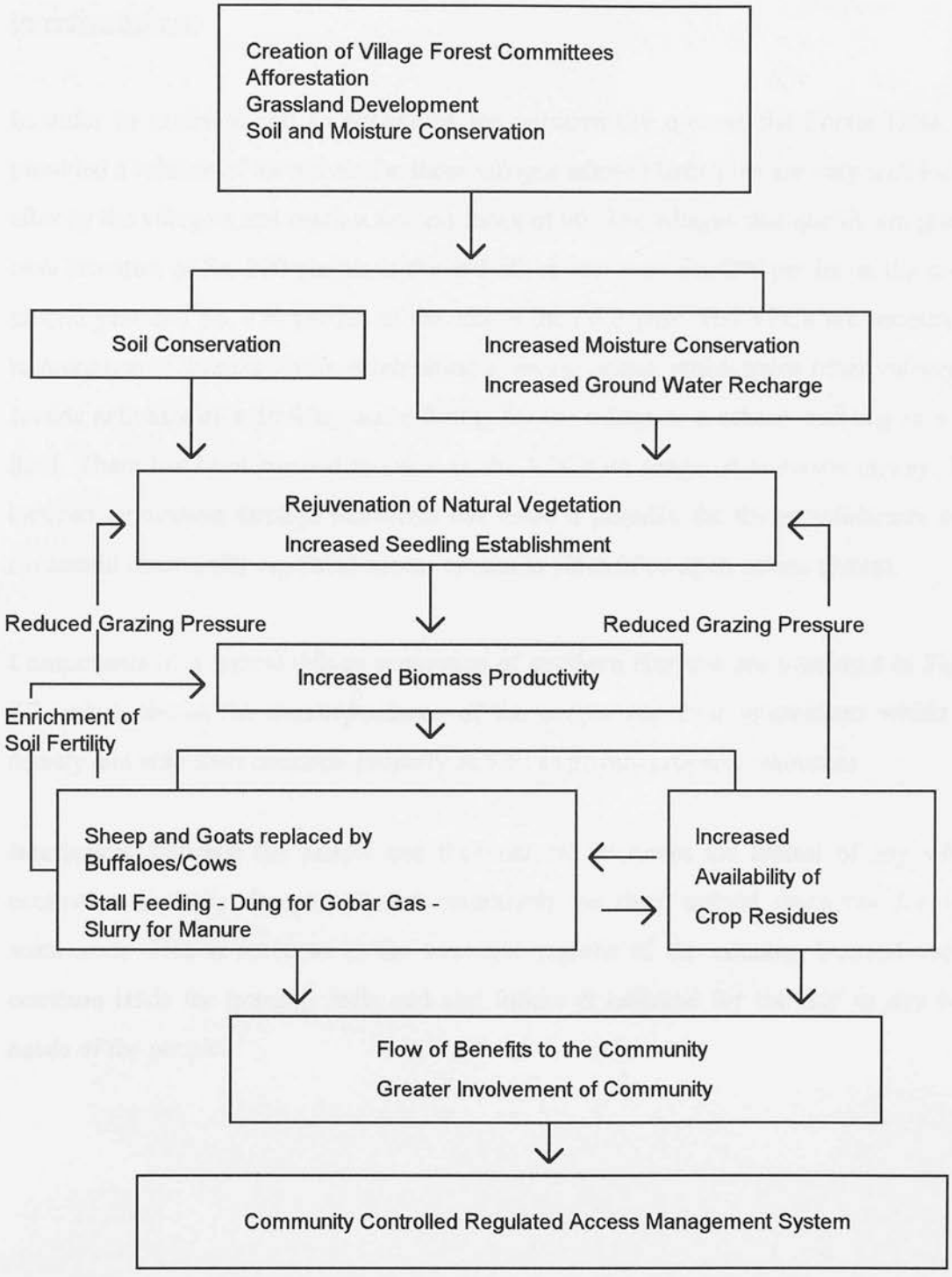

Figure 7.1: Participatory Process (Coming together of Forest Department and the Villagers resulting in a regulated access management system).

Incentive Scheme

In order to motivate and to strengthen the participatory process the Forest Dept. has provided a scheme of incentives for those villages whose plantations are very well looked after by the villagers and reach a success index of 60. The villages that qualify are given a cash incentive of Rs. 250 per ha. at the end of the first year, Rs. 200 per ha. at the end of second year and Rs. 150 per ha. at the end of the third year. The VFC's are encouraged to make use of these funds for establishing a sewing centre, which trains other villagers in sewing activities or a drinking water facility for the village or a school building or a fish farm. There has been much discussion in the VFC's on usage of incentive money. This induced motivation through incentives has made it possible for the establishment of a successful community regulated access system in place of an open-access system.

Components of a typical village ecosystem of southern Haryana are presented in Figure 7.2, which shows the interdependence of the people and their interactions within the society and with their common property as well as private property resources .

Interactions between the people and their natural resources are typical of any village ecosystem in India. People depend extensively on their natural resources for their sustenance. This is more so in the semi-arid regions of the country. Dependence on common lands for grazing, fuelwood and fodder is essential for the day to day basic needs of the people.

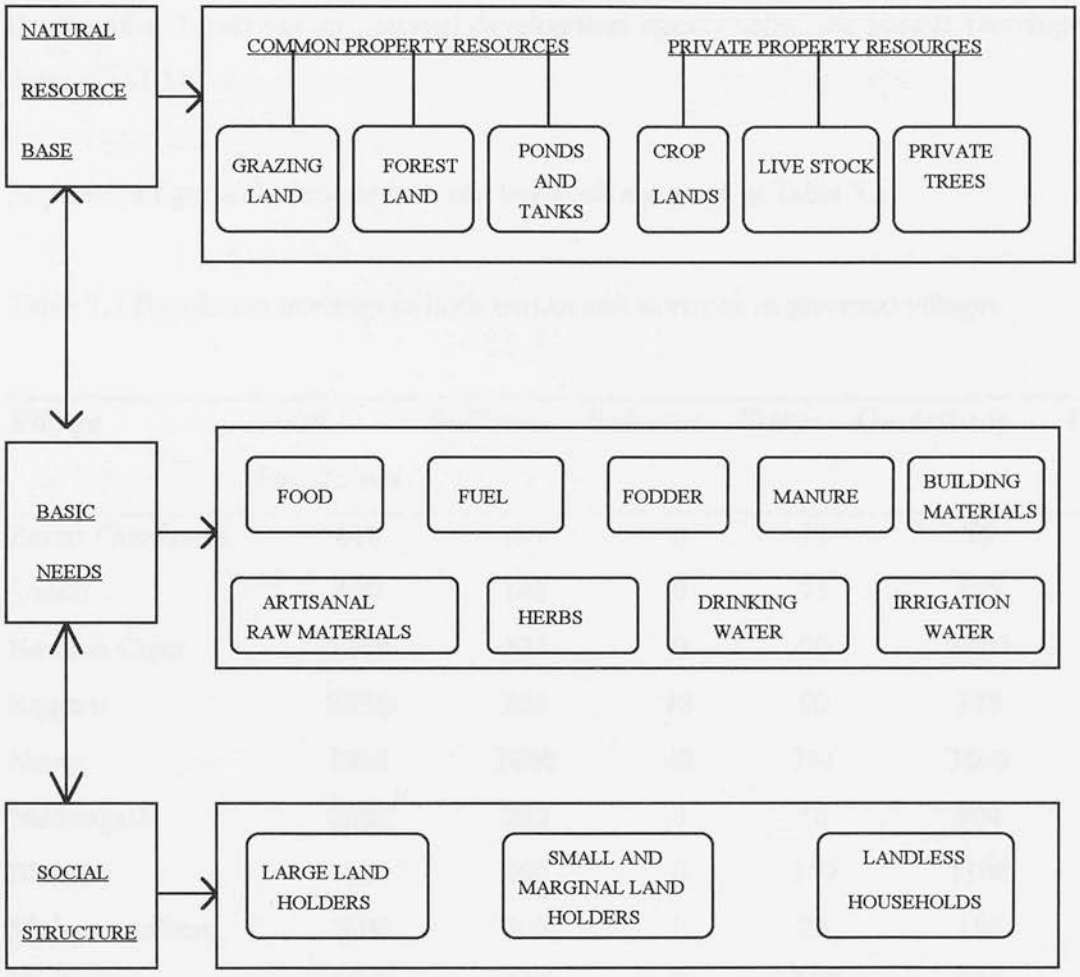

Figure 7.2: Typical Village Ecosystem of Southern Haryana

7.2 Survey Results and Discussion

7.2.1 Composition of Households

83.2 percent (163 households) of the sample were Hindus, whereas, 16.8 percent households (33) were Muslim households in the surveyed villages. The Meo community belongs to the Muslim religion. They inhabit the Mewat region of Gurgaon and Faridabad Districts. Meos were notified as criminal tribes by the then British Indian Government for their habit of plundering the cities and hiding in the Aravalli hills. After the independence the Indian Government de-notified them as criminal tribes and helped them to overcome

their poverty by setting up a special development agency called the Mewat Development Agency (MDA).

Population figures for both human and livestock are given in Table 7.1.

Table 7.1 Population numbers of both human and livestock in surveyed villages.

Village	Total Population	Buffaloes	Bullocks	Cows	Goat/Sheep	Camel
Baroji-Gundawas	610	151	0	71	75	0
Sonkh	620	148	0	75	575	0
Bawana Gujar	1209	300	0	50	2000	2
Rajgarh	2956	205	18	50	175	28
Nayan	3533	1000	40	361	3600	161
Madhogarh	2550	250	0	56	904	60
Bhond	1800	400	0	150	1100	0
Mohammadbaas	1000	200	0	25	150	0
Khol	5325	245	0	150	230	35
Budin	2750	250	0	100	1500	100
Zerpur	1500	250	0	40	500	60
Kotla	1100	100	25	200	2300	8
Kultazpur	2300	250	0	50	2300	15
Pachnota	1400	150	50	70	3500	30
Thekri	380	70	0	45	150	50

Source: Census of India (human population) 1991 and Livestock Census, 1987. Government of India.

In the rest of the case study area almost all the villages are inhabited by the Hindus only. The Hindu religion comprises various castes (Table 7.2). Caste is also a major issue as far as management of common lands are concerned. It was found that a majority of Gujjar

dominated villages do not prefer to have any sort of regulation of access to common lands. Basically this community was a nomadic cattle rearing community, but now a settled one. Still pastoralism is a common practice amongst them. Even though they see reason in community regulated access management they would still prefer to have no regulation at all. As such they do not oppose planting a part of the village common lands, but are not interested in the protection of these plantations.

Table 7.2: Caste wise composition of Households amongst the Hindus

Caste	Number of households	Percentage amongst Hindus
Ahir	20	12.27
Bania	3	1.84
Brahman	15	9.2
Dhobi	1	0.61
Gujjar	45	27.61
Harijan	31	19.02
Jat	4	2.45
Nai	2	1.23
Rajput	32	19.63
Saini	10	6.14
Total	**163**	**100**

Amongst the surveyed households 136 (69.4 percent) were headed by males and 60 (30.6 percent) were headed by female households.

7.2.2 Education Level

A majority of individuals surveyed were illiterate (85 households). This shows the backwardness of these villages in terms of the human resource. Even amongst those reaching up to primary level there were huge drop outs by the time they reached high

school level (Figure 7.3). Hardly any body could reach the graduate level. Education level was not an impediment in establishing the common property institutions. This can be clearly seen from the level of RCI in the surveyed villages. RCI was less in some of the better educated villages compared to the villages having large number of illiterates. People see reason in coming together in order to take care of the common lands management.

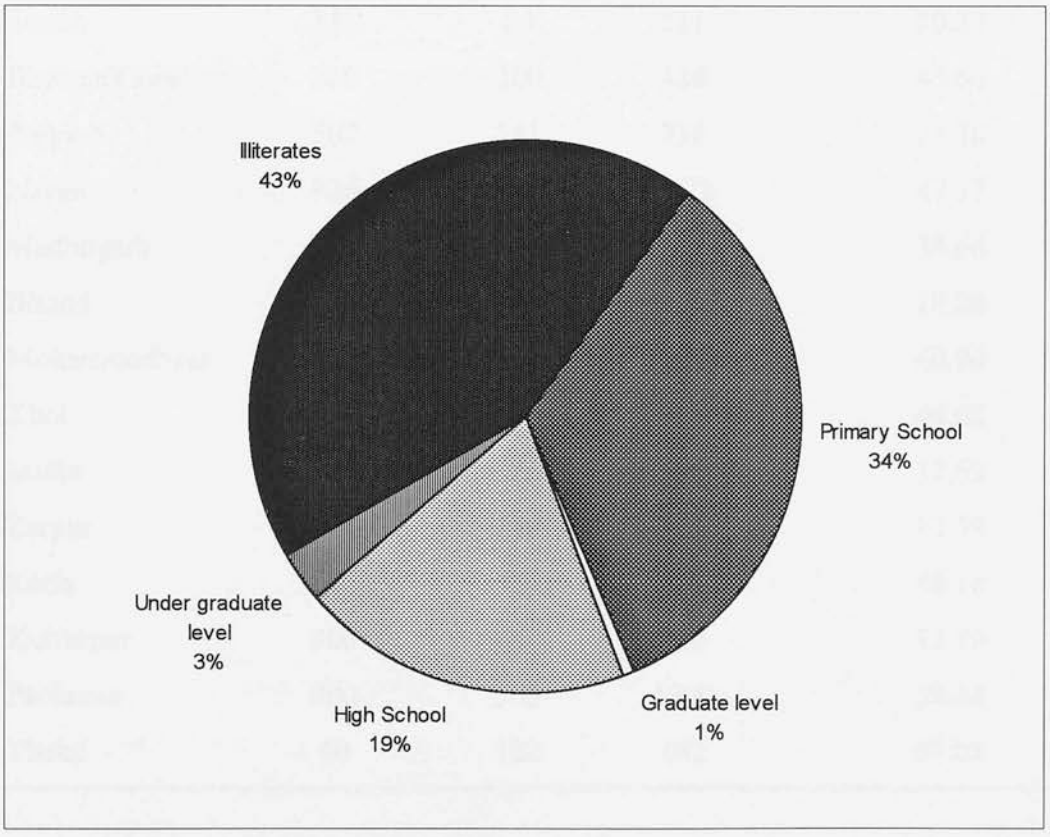

Figure 7.3: Education level amongst the surveyed households.

7.2.3 Village level attributes

The ownership of land is classified as two types. They are private lands comprising farms and panchayath lands comprising village common lands (Table 7.3). The extent of common lands and its ratio to total land varies from village to village. The common lands meet the fuel and fodder requirements of most of the villages.

Table 7.3: Extent of Common land, Farm Land and the ratio of Common lands in the case study villages.

Village	Cultivated (PR)in ha.	Common Land in ha.	Total Land	Ratio of Common Land to Total Land in Percentages
Baroji-Gundawa	81	455	536	84.88
Sonkh	147	64	211	30.33
Bawana Gujar	238	200	438	45.66
Rajgarh	507	231	738	31.30
Nayan	936	836	1772	47.17
Madhogarh	760	479	1239	38.66
Bhond	593	147	740	19.86
Mohammadbaas	150	100	250	40.00
Khol	745	586	1331	44.02
Budin	541	325	866	37.52
Zerpur	874	159	1033	15.39
Kotla	656	563	1219	46.18
Kultazpur	500	80	580	13.79
Pachnota	800	500	1300	38.46
Thekri	60	122	182	67.03

It was observed from the survey that large farmers (owning more than 4 ha.) were less dependent on common lands for their fodder requirements than small farmers (2 ha. to ≤4 ha.), marginal farmers (≤2 ha.) and landless. As the land holding level increased dependency on common lands decreased.

With regards to fodder utilisation from various sources by different households it was found that the requirements of the fodder by the livestock according to the standard feeding schedules were not being fulfilled. A huge gap in the supply exists especially for the small, marginal and landless households (Figure 7.4). Average requirements of fodder

per household was 35.75 tonnes, 33.105 tonnes, 31.575 tonnes and 22.51 tonnes by the large farmer, small farmer, marginal farmer and landless households respectively.

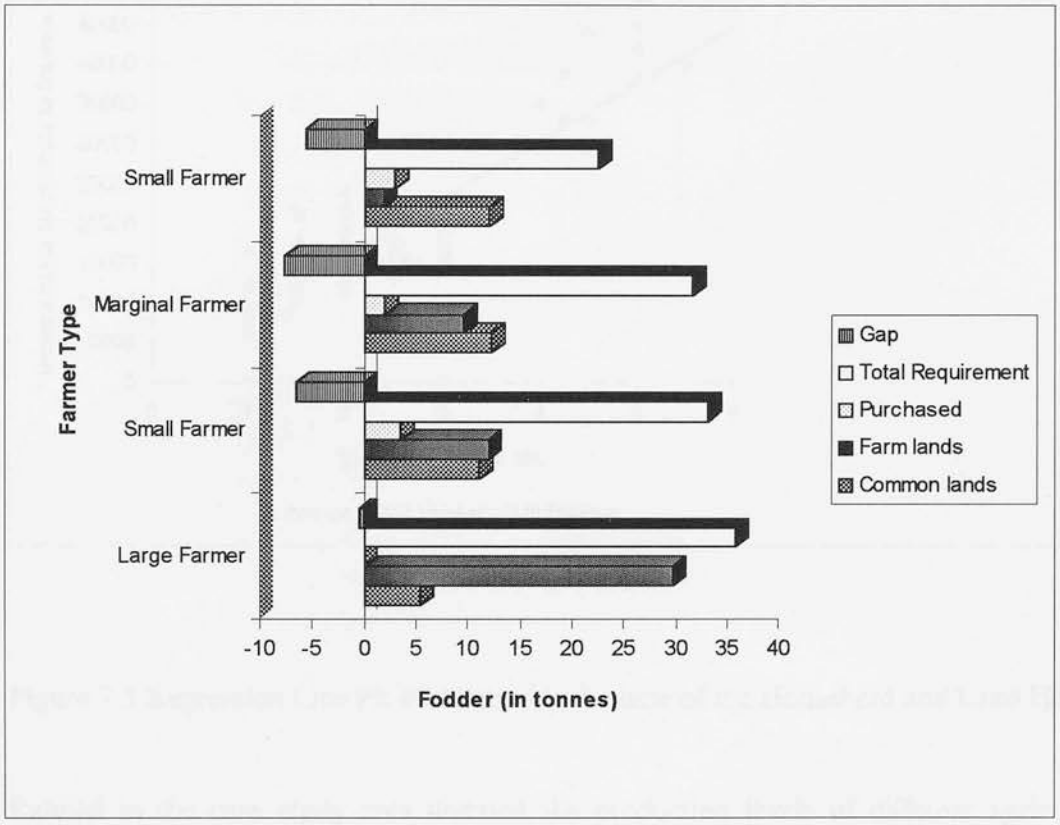

Figure 7.4: Utilisation of fodder from different sources by different households and fodder demand and supply.

A simple linear regression analysis (Figure 7.5) was conducted using land holding level and the level of income of the households. It suggested a significant relationship between the two. As the land holding level increased income of the households increased substantially ($R^2 = 0.80$, $P < 0.0001$, $n = 147$). Landless households were excluded from the analysis.

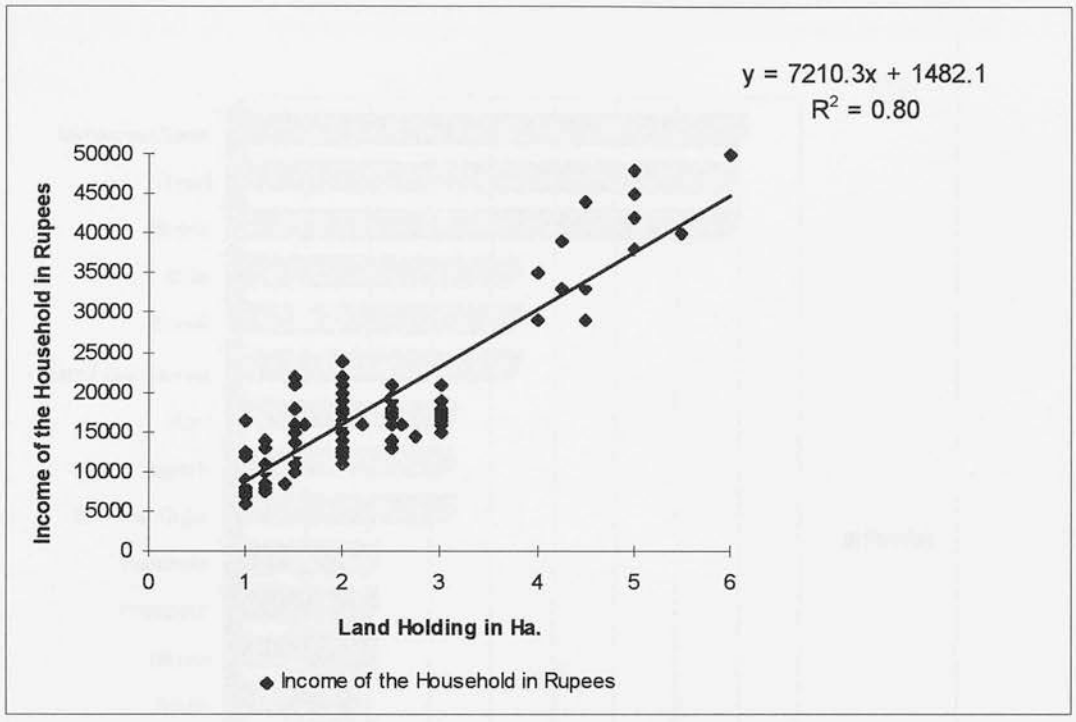

Figure 7.5 Regression Line Fit Plot between, Income of the Household and Land Holding

Rainfall in the case study area dictated the production levels of different agricultural crops. Rain fall levels are greater towards the East compared to the West (figure 7.6). Low levels of precipitation combined with extensive usage of underground water is resulting in lowering of groundwater levels. Extensive usage of ground water for irrigating the agricultural crops also turned many fresh water reserves into brackish waters. Pumping of these brackish waters to irrigate agricultural crops is reducing the productivity levels of the cultivated land and impairing the soils permanently.

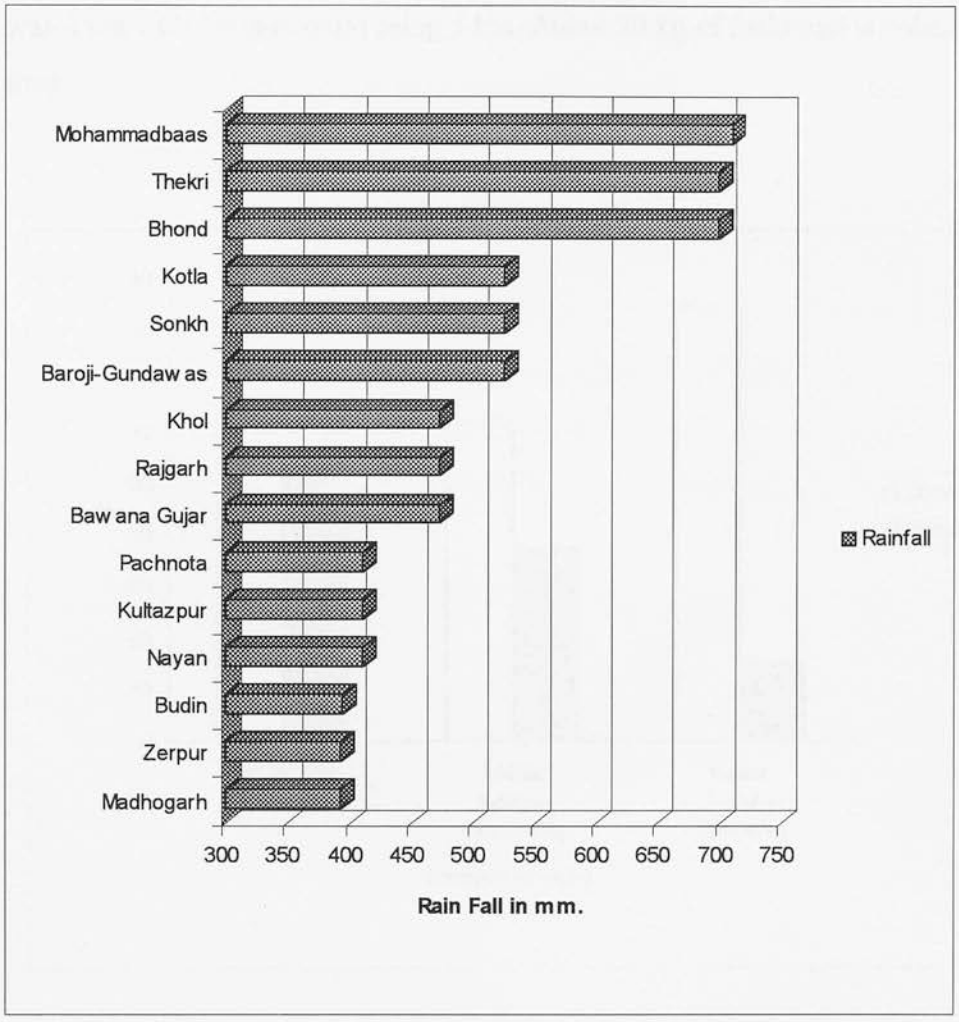

Figure 7.6: Average annual rainfall (in mm) in surveyed villages

Women were primarily engaged in fuelwood collection. Households were categorised into 3 groups according to income [High Income Strata (HIS) annual income of more than 27,500 Rupees, Middle Income Strata (MIS) annual income of 11000 to 27500 Rupees) and Below Poverty Line (BPL) annual income of less than Rs. 11000]. All economic groups showed a substantial dependency on common lands for fuelwood collection. Compared with the High Income Strata and the Middle Income Strata, those who live under the poverty line were more dependent (84.7%) on common lands for their fuel requirements (Figure 7.7). The minimum distance required for fuelwood collection

was 2 km with the maximum being 5 km. About 30 kg of fuelwood is collected in 5 hours time.

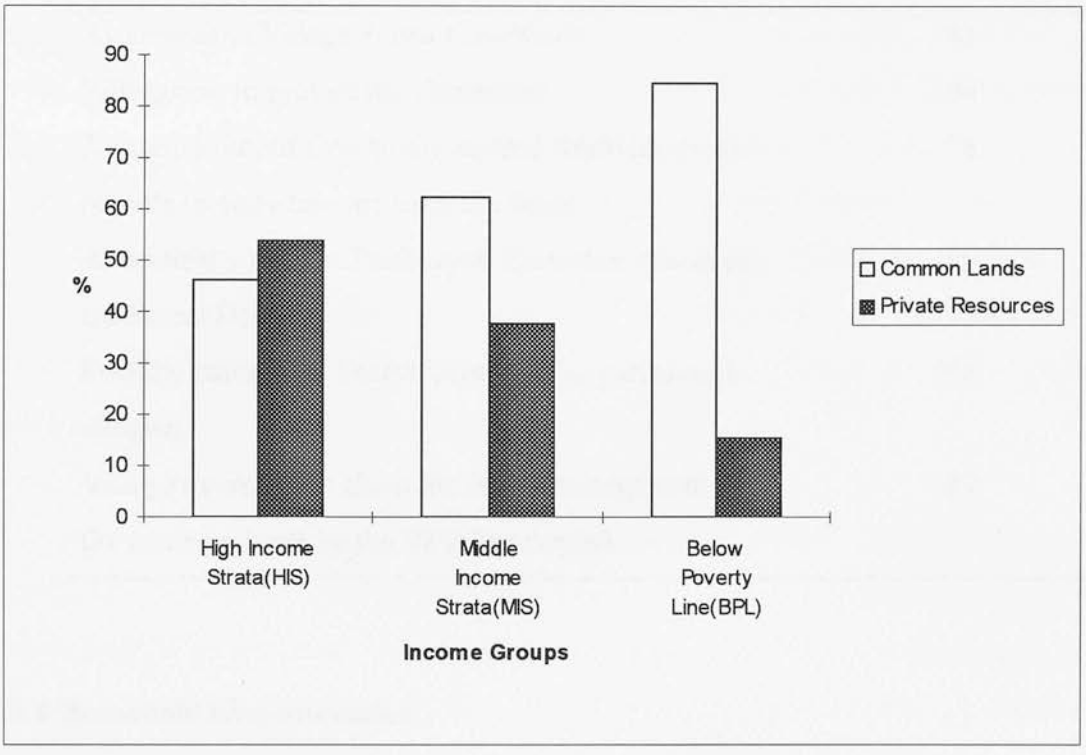

Figure 7.7: The percentage of households in each of three income groups (high income, middle income and below poverty line) who made some use of common lands and private lands as a source of fuelwood.

A large proportion of positive responses to CPR's were recorded. These are essential if a common property regime is to replace an open-access regime. There was a high level of awareness of the commonly agreed restrictions and their enforcement by the VFC/Panchayath. 97 percent of villagers were willing to accept the take over of the management of their common lands by the VFC/Panchayath once the Forest Department had handed-over the plantations at the end of the three years of maintenance.

Table 7.4. Percentage of responses which were positive in respect of selected indicators of attitudes to common property resource management regimes

Indicators	Percentage of Responses
Awareness of Village Forest Committee	83
Willingness to protect the plantations	94
Awareness about Commonly Agreed Restrictions wit regards to entry into the common lands	76
Awareness about the Publicity & Extension efforts of the Forest Dept.	95
Friendly attitude of Forest Dept. staff as perceived b villagers	98
Villagers perception about the future management of the common lands by the VFC/Panchayath	97

7.2.4 Household level attributes

53.6 percent households (105) reported that the agricultural production from their farm lands met their consumption requirements and part of the produce which was surplus to their requirements was sold in the market at the support prices announced by the government or even at a higher price. 20.9 percent households (41) felt that agricultural production from their farms was just sufficient to meet the household needs, where as 3.1 percent households (6) felt that the agricultural production from their farms was insufficient to meet their demand. 22.4 percent households (44) did not own any farm land (landless households) and hence they had to depend upon market purchases for their food consumption.

52 percent of the households (102) were owners of the farm lands, while 3.6 percent households (7) were tenants and 21.9 percent households (43) were owners as well as tenants.

63 percent households did not own any goats. 24.5 percent households owned 3 or less goats. Those, who owned and reared goats in large numbers were mainly landless people. Goat rearing was considered to be very beneficial by them because of the benefits such a such system provided. The goat owners take them to the common lands for free grazing. Since they have to incur no feed costs they can reap greater benefits from the sale of goats for meat in the market. According to a study conducted by the Tata Energy Research Institute, Delhi (1994) it was found that the return on investment in free grazing scenario was 348 percent on investment in 10 years.

75.5 percent households (148) felt that the government should rehabilitate the degraded village common lands by carrying out tree plantations on village common lands since they did not have adequate resources to arrest the degradation of village common lands. 20.9 percent households (41) felt that the VFC's were in a better position to undertake planting and protection of trees provided the Forest Department trains them in technical aspects and finances the plantation costs. 3.6 percent households (7) were indifferent.

Even though a large number of households were aware of the VFC's they failed to distinguish between the two in terms of management of village common lands. Since it was a joint management effort some even felt that it was the VFC and the Forest Department who were responsible for managing the village common lands (Table 7.5).

Table 7.5: Agency wise responses for managing the common lands amongst the surveyed households.

Agency	Number of Households Responded	Percentage of total households
Village Forest Committee	104	53.1
Gram Panchayath	17	8.7
Forest Department	21	10.7
VFC and FD	16	8.2
VFC and Panchayath	36	18.4
Don't know	2	1

A majority of the households (76 percent) felt that they did not think of having a sharing mechanism for distribution of the produce from the village common lands. While 37 percent felt that they were yet to decide on the strategy for distribution of produce but were hopeful that given the co-operative mood of the villagers and the interest shown in VFC meetings would lead them to a proper and just distribution of produce amongst the households.

34.2 percent of the households had an annual income of less than Rs. 11000. Incidentally this category of people were below the poverty line prescribed by the Government of India, Planning Commission. 58.7 percent households had an annual income of Rs. 11000 to 27500. 7.1 percent of the households reported an income of more than Rs. 27500. Most of the households in this category owned more than 4 hectares of land.

There appeared to have been an excellent co-operation between the villagers and the officials of the Forest Department. Almost 95 percent of the households were in touch with the officials of the Forest Department (Forest Guard, Deputy Ranger/Forest Ranger and Sub-Divisional Officer). Only 5 percent of the households reported that they never communicated with the officials of the Forest Department.

39.5 percent of the land holding households(60) felt that their farm was fully productive where as, 60.5 percent (46.9) felt that it was less productive. Those, who felt that their lands were fully productive had irrigation facility while the rest of the households cited lack of irrigation as the main reason for low productivity of their farm lands.

88 percent of the households (173) felt that the marketing facilities for forest produce were inadequate where as the rest felt that they were adequate.

7.2.5. Re-investment of the proceeds from the final harvest of plantations

91.8 percent households (180) were ready to re-invest part of the proceeds from the current plantation final harvests for undertaking plantations on a recurrent basis so that they continue to get benefits from the plantations. Only 16 households, representing 8.2 percent were categorical in saying 'no' to this proposition. A majority of such cases came from the villages, which had lower level of peoples' participation. This sort of attitude is quite remarkable since this shows that continuity of plantations on the common lands and plantation maintenance under common property can be assured so that resources continue to be available in future. This opinion comes from almost all the villages.

Those, who were willing to reinvest part of the proceeds from the final harvest stated that the preferable agency for undertaking tree plantations on common lands was the Forest Department (Table 7.6). This expression of preference in favour of Forest Department for executing tree plantations is some what disturbing and shows that either the villagers do not have adequate knowledge of undertaking plantations or they are interested to leave it to the agency, which specialises in such activity.

Table 7.6: Agency wise Households' preference for undertaking afforestation

Agency	Number of Households	Percentage
Panchayath	31	17.2
Forest Department	120	66.7
VFC & Forest Department both	21	11.7
VFC & Panchayath	3	1.7
Panchayath & Forest Department	5	2.8
Total	**180**	**100**

Most of the people do not procure any small timber from the village common lands any more, where as in the past they used to get this timber from them. The reason given for changing their behaviour was that the common lands were so degraded that only small trees were left on these lands, and these only fit to be fuel wood for cooking purposes rather than of any timber value.

194 households felt that tree planting was good and that it created assets for the village community, where as only two individuals opposed it. Those opposed did not give any specific reasons. Since their number was quite small (1%) it did not matter on the over all situation. Nevertheless, the entire community across the case study area felt that it was good to plant trees. This realisation was a very positive one if proper CPR management were to be established.

185 households (94.4 percent) felt that the tree planting was linked to religious sentiments. The interesting fact is that even amongst the Muslim community many felt that it was linked to religion. The negative responses came from only 5.6 percent households, who are resident in those villages which have very low level of people's participation.

Planting trees on farm lands was considered as an income generating activity by 3.1 percent (6 households) of the households. Whereas 68.4 percent households (134) expressed that it would meet the household needs of fuelwood, small timber and timber, while the rest of the households did not express anything. 140 households (71.4 percent) had at least some trees planted, or naturally regenerating on their farm lands. Tree density was found to be 6 to 13 trees per hectare of farm land. This ratio was greater in the western districts of Bhiwani, Rewari and Mohindergarh. In these districts, Jand (*Prosopis cineraria*) trees grow naturally, a characteristic feature of desert areas. Jand is a multipurpose tree, whose every part is used by humans or their livestock. The other most important tree was Keekar (*Acacia nilotica*). Which, was a valuable fuelwood tree besides being a good source of fodder for goats. Many people use it as a small timber for agricultural implements and some use it as a source of timber. However, most people were not interested in planting this species since it depletes nutrients very fast and does not allow growing of agricultural crops under it's shadow.

A majority of 151 households representing 77 percent of the surveyed households responded that the afforestation of village common lands should be done by the Forest Department. This also indicates the continued dependence on the Forest Department. Many felt that the lack of training to raise seedlings and establishing the plantations were the reasons for preferring FD to plant trees. While some others felt that political differences amongst the villagers made them prefer FD.

Choice of the species for planting stemmed from the need for meeting their basic needs. Mostly endemic species were preferred. In order of preference these were, *Zyziphus mauritiana, Acacia leaucophloea, Cassia siamea, Cordia myxa, Holoptelia integrifolia, Ailanthus excelsa, Bamboo, Butea monosperma, Acacia senegal, Anogeissus pendula* and *Dalbergia sissoo* were preferred respectively. Where as, *Prosopis juliflora*, was the least preferred.

176 households (89.79 percent) responded that the conflict resolution was taken care of by the VFC and the panchayath together. Where as, the rest said it was the Forest

Department that was responsible for conflict resolution. Issues of conflict could not be identified in clear cut terms. Responses varied from household to household. Many even responded that there were no conflicts at all. Some felt that the conflicts were of political in nature. Many (177 households) were willing to co-operate with the VFC for enforcing the commonly agreed restrictions and help it in the management of common lands (Table. 7.7).

Table 7.7: Reasons for co-operation with the VFC amongst the responded households

Reasons for co-operation	**Number of households responded**	**percentage**
I like co-ordinated management	116	59.2
I was motivated by the panchayath	7	3.6
Degradation under open-access	49	25
VFC and FD's publicity efforts	2	1
I will get employment	3	1.5
I cannot say	19	9.7

7.2.6 Perceptions of officials about the participatory development of common lands

The current participatory development of common lands involves the Forest Department officials and the villagers. In order to capture the expert knowledge accumulated through their experiences interviews of the Forest Department personnel were conducted. Some officials of the Animal Husbandry Department, the Revenue Department and the Agriculture Department were also interviewed. In all 42 officials at various hierarchical level were interviewed. Out of this 10 officials belonged to the Animal Husbandry, Revenue and Agriculture Departments, the rest were from the Forest Department.

A large number of officials (88%) were enthusiastic about the success of the current participatory process. While, the rest apprehended that the political differences existing at various levels in the village were sufficient to destabilise any institutional development. Caste factor was suggested as another impediment to proper institutional building at the village level. Caste, political differences, weak panchayaths, poverty and illiteracy were suggested as the major reason for the degradation of village common lands. Almost all of them were concerned about the degradation of common lands. 78% believed that the participatory process would empower the village communities and encourage the VFC's to acquire sufficient skills in managing the village common lands.

92% officials felt that the training programmes meant for the village communities would result in a dynamic local institutions that would take care of their natural resources. 47% officials felt that the distribution of produce would be a bigger problem when the current plantations would come to maturity at the end of their rotation period, while the rest felt that by that time the VFC's would be mature enough in handling even the distribution problems as well. 95% officials suggested that rewarding the lower staff for their good work was essential for improving their performance and involvement in enlisting peoples' participation. They felt that the Forest Guards and Foresters who do good work in a particular village should be suitably rewarded in order to encourage others. Table 7.8 shows the contributory factors for the success of the participatory process.

Table 7.8: Officials responses for various contributory factors for the success of the current participatory process.

Item	Low	Medium	High
Villagers are enterprising/rational	2	16	24
Villagers are co-operative	10	4	28
Sincere, receptive and well trained staff	5	15	22
Villagers get employment	0	20	22
Villagers get additional income	0	5	37
Presence of active panchayath	3	11	28
Availability of land for plantations	9	20	13
Involvement of women	7	12	23

7.3 CPR Management and Institutional Analysis

The analysis focuses on the effect of institutional mechanisms with respect to enforcement. Successful management of the common lands depends on agreed rules that can solve the appropriation and provision problems related to the use of the common lands. The most important rules are, who can use the village common lands?, how much and what type of products can be extracted and the conditions of such resource extraction? and the rules relating to enforcement. The creation and enforcement of these rules is the most important aspect of common property resource management. If these rules are too lax or overly restrictive, the capability of the resource to continue generating resource units is threatened. If too restrictive, users may be forced to violate prescribed rules due to their extreme need for products from the common lands. Behaviour in violation of prescribed institutional rules creates higher order CPR dilemmas that require a solution to problems associated with monitoring and sanctioning. The costs of monitoring and enforcing rules that are not perceived as equitable are higher than enforcing rules that participants consider to be equitable. In addition, failure to sanction rule violators, or mistakenly sanctioning those who did not violate the rules, encourages

further rule violations or promotes resentment among users against existing institutions. The analysis of fifteen villages common lands shows that the success and failure of the institutions that manage the village common lands is crucial for the improvements in resource conditions.

7.3.1 Functioning of VFC's

VFC's day to day functioning is conducted by rules and regulations, which the VFC has designed with the help of the Forest Department. In most instances the Village Forest Committee (VFC) elected by the villagers designed the rules. In others, they were aided by the Forest Department officials. Since all the study villages are situated in the same state of Haryana and in the same Aravalli ecosystem, their resource management institutions have been subject to the same administrative and bureaucratic regulations. Government regulations are not responsible for variations among the study villages. The variation in the resource conditions of the three sets of the villages can be explained best by examining the rules for using the resource, monitoring the use and sanctioning of rule violators.

There are mainly two types of products which most of the village common lands provide for the day to day sustenance of the villagers. They are, fuelwood and fodder. The fodder regulations permit the removal of fodder from the village common lands. They also indicate the extent of removal, the manner in which fodder can be extracted, and the obligations users must fulfil to remain beneficiaries. Cattle and livestock cannot graze in the common lands where the young plantations are growing. Villagers can harvest only for a duration of three months following first monsoonal rains. While extracting leaf fodder from the trees villagers must leave 75% of the leaves to remain on the tree. In different villages different procedures are adopted for the removal of fodder and fuelwood.

In almost all the villages, villagers have equal rights without regard to their contribution in maintaining the upkeep of common lands. In most cases, institutional rules not only

specify who has the right and how the right can be used but they also state as to how much of the resource can be extracted. Fodder and fuelwood from the village common lands constitute a renewable resource. In order to ensure regular supplies of both fodder and fuelwood and the continued health of the village common land, it is therefore essential to match the extraction levels to regeneration. Villagers are assigned as to how many bundles of grass can be cut from the common lands. The plantation watchers (guards appointed by the VFC) maintain a strict vigil over violators of the commonly agreed restrictions and report violations to the VFC or panchayath. There are villages where the panchayaths or the VFC's have not designed any rules relating to fodder or fuelwood extraction from the common lands. Fodder and the fuelwood removal from the village common lands by villagers is measured by the no. of headloads. Each headload usually varies from 25-30 Kg. in weight. The regulations for the fuelwood collection indicate that villagers can extract only the dead, dry, deceased and fallen trees but not the green trees or trees with smaller girth. Certain types of trees cannot be extracted at any cost owing to religious purposes or other reasons (for example the Pipal tree, which is worshipped by most of the Hindus and Buddhists as sacred tree and the trees present in sacred groves*).

From the above it can be inferred that there are cases of successful design of rules and regulations amongst the VFC's to use resources and to use them sustainably and equitably. Some of the VFC's have succeeded in the design of rules that limit extraction of fodder and fuelwood and the distribution of the produce on an equitable basis among the villagers. In three of the villages surveyed the panchayaths or the VFC's failed to create rules that would promote sustainability and equity. The next most important issue in CPR management is monitoring in order to ensure the compliance of the rules designed by the VFC.

* Sacred Groves are the tree groves present around the Hindu temples.

7.3.2. Monitoring

In most of the surveyed villages, rule violations occurred frequently (Table 7.9). In the three villages that maintained detailed records, minor violations occurred almost everyday.

Table 7.9: Village wise number of violations and cases compounded and cases pending in the courts

Village	No. of Violations	Compounded by the VFC/Panchayath	No. of cases in the court
Madhogarh	7	7	0
Sonkh	12	9	3
Thekri	12	12	0
Kultazpur	14	14	0
Mohammadbaas	15	11	4
Baroji-Gundawa	22	22	0
Rajgarh	23	23	0
Zerpur	38	4	1
Pachnota	79	12	5
Khol	85	37	14
Budin	95	13	0
Bhond	117	10	2
Kotla	148	33	16
Nayan	169	34	11
Bawana Gujjar	263	41	0

To detect all the violations monitoring mechanisms have to be in place. But it is a prohibitively expensive proposition to undertake policing the common lands. It is important to understand that a resource system need not deteriorate, however, if the

violations are minor and a significant proportion of violators are discovered and penalised. The exact frequency of rule violations and the probability of detection depended upon the benefits from breaking the rules, the effectiveness of monitoring, the costs of getting caught and the cost of monitoring. Therefore, it is only when rules are not enforced or monitored and violations not sanctioned that formal rules become meaningless.

In some of the villages panchayaths and the VFC's took great pains to monitor both the violators as well as those guards who are appointed to monitor the violations and spent efforts to minimise the resource abuse by the violators. This has kept the number of violations to a minimum. But such villages spent substantive amounts of money in monitoring and sanctioning. They attempted to improve the efficiency of monitoring, increased the hours spent on monitoring, and tried to improve the sanctioning mechanism so as to deter people from violating the commonly agreed restrictions.

7.3.3. Sanctioning and Arbitration

In all the successfully operating villages, VFC's have designed the sanctioning mechanism for sanctioning violators of the commonly agreed restrictions. The VFC's employ a variety of mechanisms to increase the effectiveness of the sanctions they have imposed. They ask the offenders to render written apologies, confiscate cutting implements, ban further usage rights in the village common lands, impose fines, report the violations to the Forest Department officials, and sometimes seek redress in the courts. The sanctions they impose depend upon a number of factors, such as the severity and nature of the offence, whether the person is a known trouble maker and the attitude of the violator towards the authority of the VFC. In some extreme cases, the panchayaths and the VFC's have decided to expel and excommunicate or socially boycott the most serious violators although this extreme step has not yet been resorted to. In many cases even the panchayaths excuse repeat violators from paying fines imposed on them, if the offender is willing to tender a written apology. Such an apology reinforces the authority of the panchayath/VFC to manage the village common lands and to punish other violators.

Most of the panchayaths also act as arbiters over disagreements that arise about the imposition of sanctions on violators. In this capacity they often reduce or excuse fines, resolve disputes between village users and the guards monitoring them. Even though the panchayaths and the VFC's have no formal powers to punish violators most people respect their sanctions rather than pursuing the cases in the courts of law since it is an expensive proposition. Unless the user, who violated rules is influential and wealthy, he or she will find it worthwhile to pay the small fine rather than go to the court. From the analysis of the amount of expenditure spent on monitoring and sanctioning it was observed that the panchayaths that spent more efforts and funds in monitoring and enforcing the commonly agreed restrictions have succeeded in strengthening the resource management situation in their villages.

Discussions with VFC's and villagers revealed wider differences between VFC's, not only in homogeneity of caste but also in their general attitudes towards the poorer sections of the community. Their perceptions also differ from village to village on other issues such as women participation. In some cases, for e.g., Khol, the VFC is dominated by richer members of the community who showed no interest in improving the lot of the landless and of the women who used the common lands. The landless and poor comprise a third of the village population on an average. They are more dependent on the common lands for meeting their fodder and fuel requirements. In contrast, richer sections of the society meet most of their needs from their own farm lands. It was observed during the survey, that no access to village common lands was normally permitted in the plantation areas. This has also put hardships to the landless and other poorer sections of the society.

There has been no difficulty in sharing grass fodder which all VFC's allow to be cut and carried freely. This was much appreciated by the women grass collectors. Difficulties may arise with the yields of fuelwood, poles and timber as the plantations grow towards maturity. It was observed during the survey that most of the VFC's were unanimous in dealing with the produce from the final harvest. It was an established custom to auction the produce and use the proceeds for general community works. This process benefits the

village rich and the poor alike, and puts the landless and poor at a disadvantage and may eventually alienate them from the management of the common lands.

The resource base of the fragile Aravalli ecosystem is vulnerable to rapid degradation and has a low regenerative capacity. The land is much less productive than the lands in the irrigated plains (Srivastava et al, 1994). Mainly these lands can generate fodder, fuelwood, medicinal plants and some raw materials for handicrafts etc. With proper protection and improvements in resource situation the availability of munj grass (Saccharum munja) and the leaves of Dhak (Butea monosperma) will increase. Munj grass is used for making cane furniture and Dhak leaves are used for making leaf plates. Development of such small scale industries could provide more employment and additional income to the poorer sections of the society.

In the next sections the use of Success Index and Resource Condition Index is attempted in order to evaluate the institutional success in managing the common lands and replacement of open-access regime by the common property regime.

7.4. Success Index and People's Participation

There was a strong correlation (+0.89, n=15) between the people's participation level and the Success Index of plantations raised on the common lands (Figure 7.8), and this is discussed further for each of these success categories.

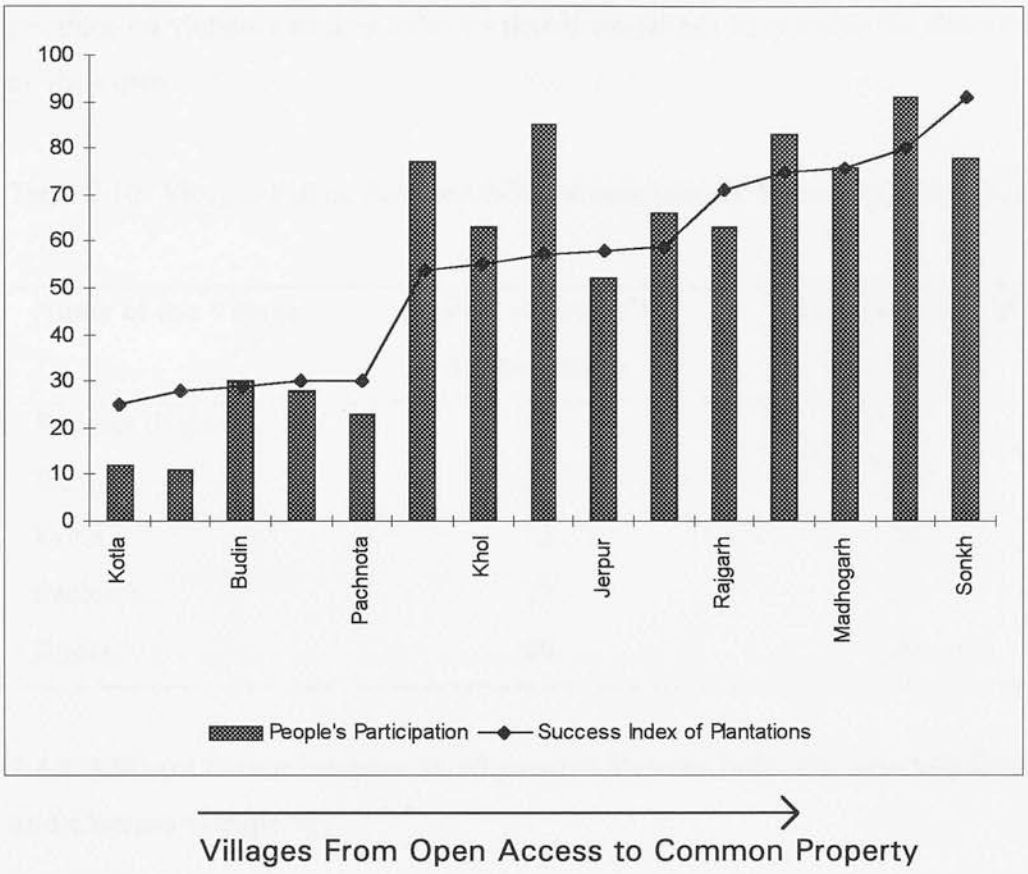

Figure 7.8: Relationship Between Success Index and People's Participation for each village.

7.4.1. Villages falling between 0-30 percent Success Index(Open-access)

The lowest level of people's participation was seen in Bawana Gujjar village, which had a majority of the population (80%) belonging to the Gujjar community (now settled but previously a nomadic cattle rearing community) (Table 7.10). This was primarily on account of their unwillingness to impose any restriction on their entry into the village common lands. In some other villages it was observed that the lowest level of people's participation was due to the fact that there were severe political differences amongst the residents of the village with regards to regulated access to the village common lands. 69% of the respondents in this category believed that the situation would be better if the government took over the management of the common lands forever and imposed stiff

penalties on violators as they believed that it would not be possible for them to manage on their own.

Table 7.10: Villages Falling Between 0-30 Percent Success Index (Open-Access)

Name of the Village	Level of People's Participation	Success Index of Plantations
Bawana Gujjar	11	28
Bhond	28	30
Kotla	12	25
Pachnota	23	30
Budin	30	29

7.4.2. Villages falling between 31-60 percent Success Index (In between Open-access and Common Property)

In this category a transition stage from open-access to common property could be observed with the success index of the plantations increasing in proportion to the level of people's participation (Table 7.11). In some villages this proposition was slightly at variance with the rest. Even though there was a high level of people's participation, the success index of plantations is not rising proportionately on account of illegal grazing by the villagers of the bordering Rajasthan state.

Table 7.11: Villages Falling Between 31-60 Percent Success Index
(In between Open-Access and Common Property)

Name of the Village	Level of People's Participation	Success Index of Plantations
Khol	63	55
Thekhri	85	57
Baroji Gundawas-Gaber	77	54
Nayan	66	59
Jerpur	52	58

7.4.3 Villages falling above 60 percent Success Index (Common Property)

In this category establishment of proper common property institutions could be observed in villages which had a high level of people's participation (7.12). This was reflected in high levels of the Success Index of the plantations. In some villages people had come together to establish truly participatory common property institutions since most of the villagers were convinced that resource abuse in the past was the result of lowering agricultural production, resulting from the depletion of the underground water table. They had even decided to expel and excommunicate violators of the commonly agreed restrictions on the access to village common lands. In response to a suggestion made by the Forest Department to the VFC's, villagers in a Muslim dominated village (Mohammadbass) had sold their native goats and replaced them with less problematic Berberi goats. Berberi goats are stall fed and do not climb hills and browse trees.

Table 7.12: Villages Falling Above 60 Percent Success Index
(Successful Common Property)

Name of the Village	Level of People's Participation	Success Index of Plantations
Rajgarh	63	71
Mohammadbass	91	80
Sonkh	78	91
Kultazpur	83	75
Madhogarh	76	76

7.5 Resource Condition Index and Enforcement

It was found that the Resource Condition Index was directly proportional to the number of violations committed by the villagers (Figure 7.9). As the number of violations per thousand population increased the RCI was decreasing substantially. There was a negative correlation (-0.489, n=15) between number of violations recorded and the resource condition index, which indicates that the villages that have maintained a strict vigilance over rule breakers have succeeded in improving the resource condition of the villages. This explains the extent of the efficacy of the management of village common lands in these villages. In order to arrest the degradation and improve the RCI in these villages stricter enforcement of entry and access to the common lands has to be ensured.

In Bawana Gujjar highest number of violations per thousand population (217) were recorded. Due to lack of proper sanctioning mechanism these violations continue to be committed. More over, it has something to do with the cultural factors as well. This village is predominantly inhabited by the Gujjar community, who are opposed to any retractions and interested in free access to common lands. On the other hand villages that had less number of violations committed reported an excellent resource condition index.

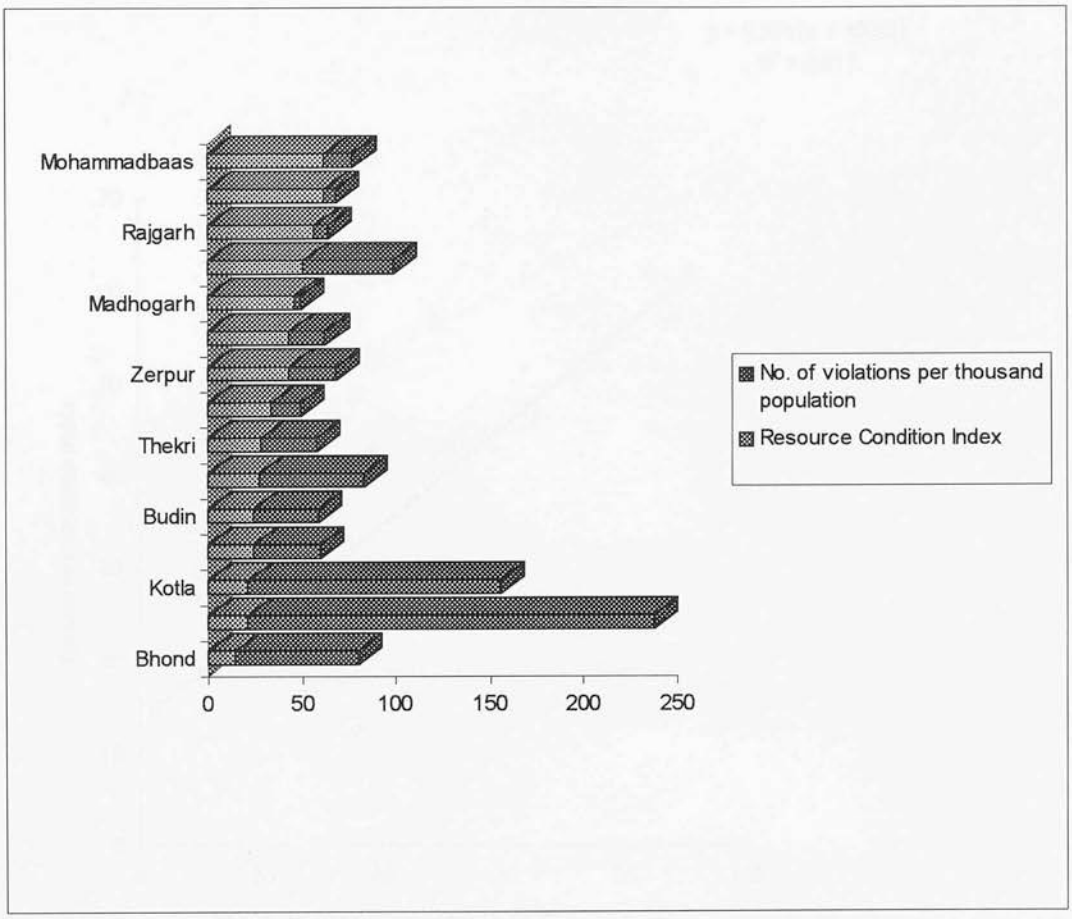

Figure 7.9: RCI and number of violations committed per thousand population.

The proportion of panchayath expenditure spent on enforcement (monitoring, sanctioning and arbitration) appeared to have a significant relationship with RCI (linear regression, $R^2 = 0.917$, $P < 0.0001$, $n = 13$) (Figure 7.10). Two villages, which did not maintain records of expenditure were excluded from the regression analysis. This statistical evidence suggests that there is a strong positive relationship between the proportion of resources committed to and the success in maintaining common property resources.

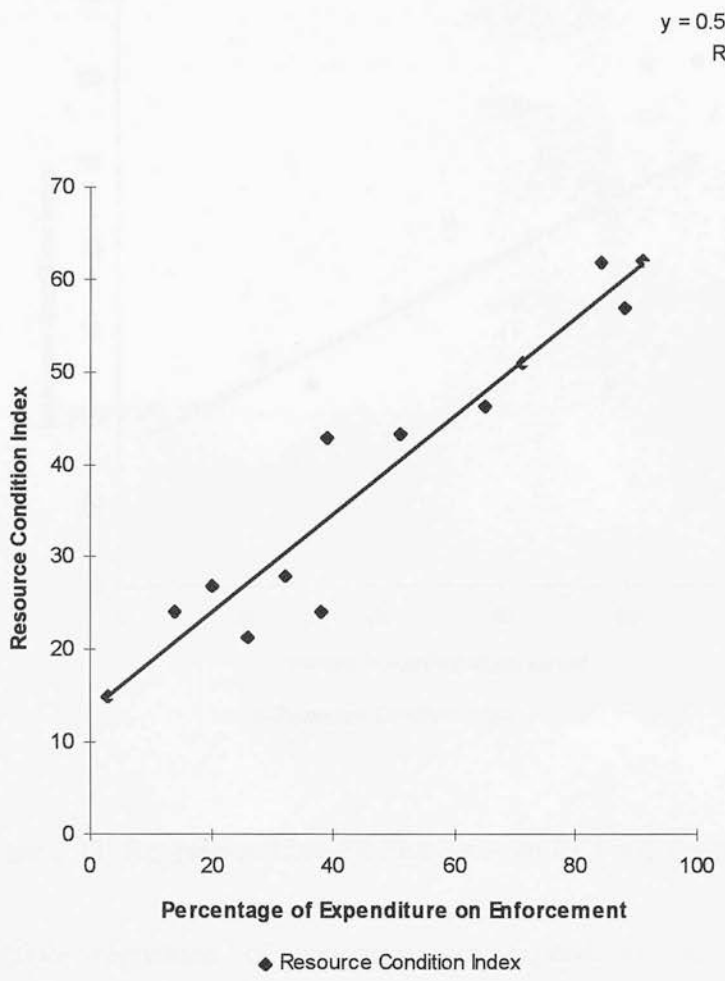

Figure 7.10: Regression - Line Fit Plot Between Percentage of Expenditure on Enforcement and RCI.

The level of people's participation was also significantly related to RCI (R^2 = 0.474, P=0.0045, n = 15) but the fit was less good than for panchayath expenditure on enforcement. In some of the villages even though there was a high level of people's participation, the RCI did not rise substantially owing to illegal grazing by the villagers of neighbouring Rajasthan state (Figure 7.11). This implies that without effective 'Policing' of common land by committing resources, participation itself is unlikely to guarantee successful maintenance of common property resources.

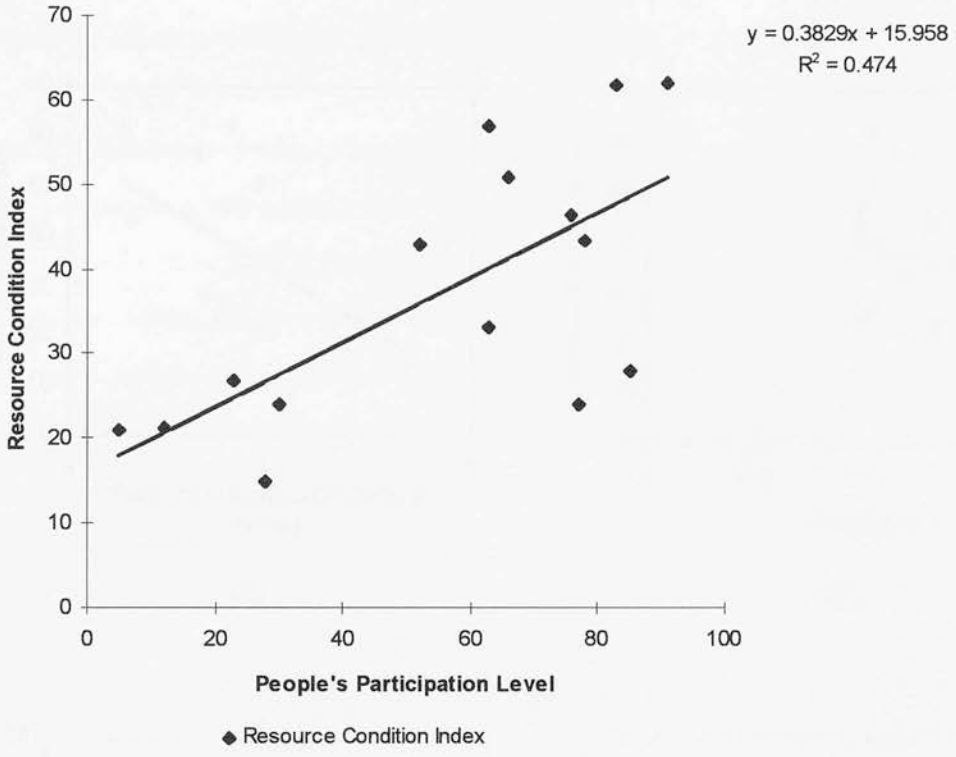

Figure 7.11: Regression Line-Fit Plot between RCI and People's Participation Level

Multiple regression of percentage of expenditure on enforcement and people's participation on RCI was carried out but the coefficient for people's participation was not significant. The best relationship remains the simple linear regression of percentage of expenditure on enforcement on RCI as described above.

Although RCI appeared to be dependent on percentage of expenditure on enforcement and people's participation level, the possibility exists that RCI may also be related to other variables. In order to explore other potential relationships simple linear regression analysis was repeated between RCI and population density of the village, livestock numbers, ratio of common land to total land of the village and rainfall as the independent variables. As can be seen from Figure. 7.12, none of these variables explained a significant amount of variation in RCI.

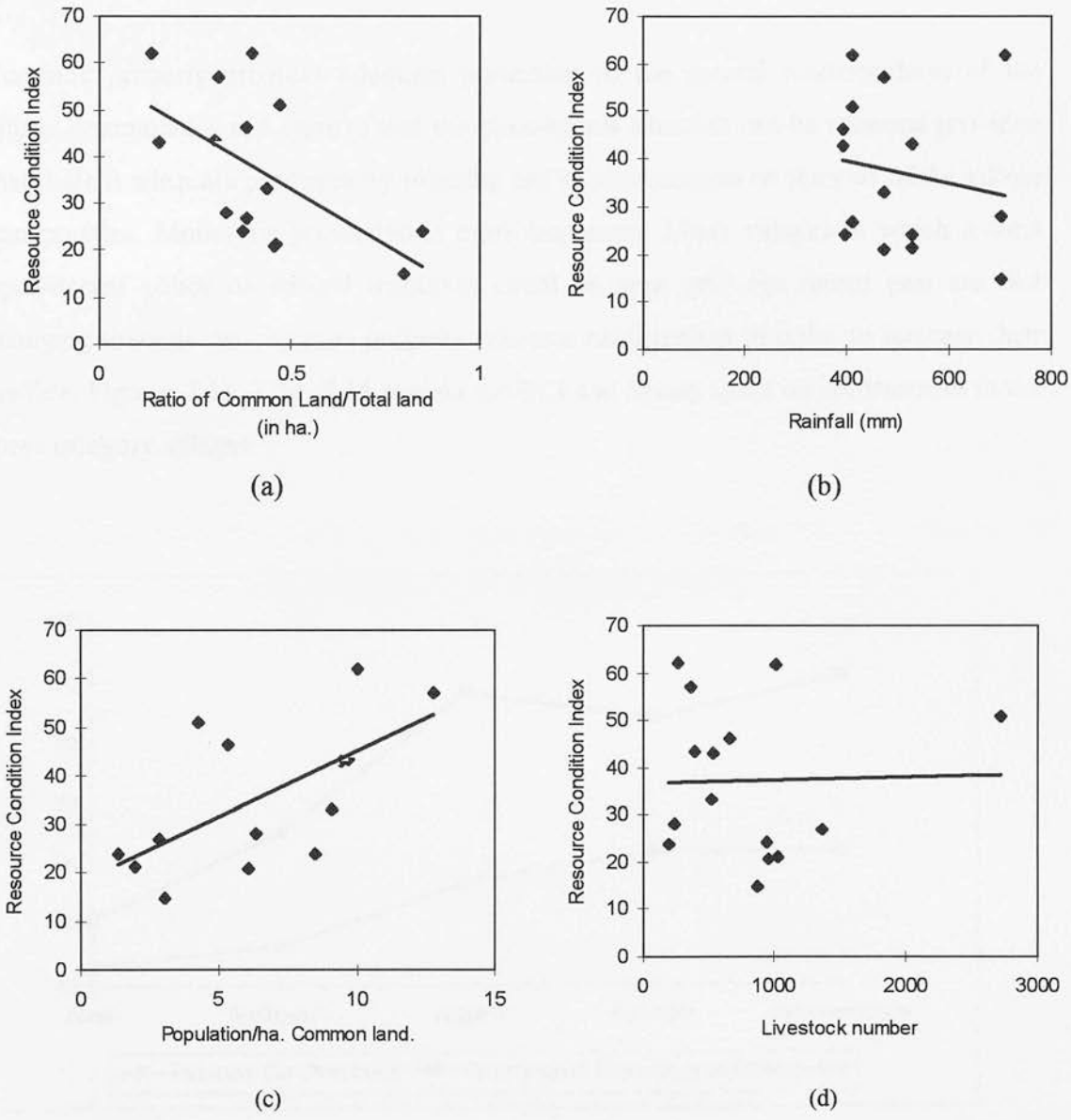

Figure 7.12: Regression Line-Fit Plots between RCI and

a) Ratio of common land/total land ($y = - 0.48.012x + 57.247$, $R^2 = 0.34$)
b) Rainfall ($y = - 0.0236x + 49.03$, $R^2 = 0.03$)
c) Population / hectare ($y = 7.492x + 18.22$, $R^2 = 0.28$)
d) Livestock numbers ($y = 0.0006x + 36.71$, $R^2 = <0.001$)

This clearly indicates that those villages that have committed substantial resources to enforcement are more likely to achieve high quality common property.

Common property provides adequate protection to the natural resource base of the village communities and ensures that the open-access situation can be reversed provided that there is adequate participatory planning and implementation on the part of the village communities. Money on protection is more important. Many villages in which a total open-access policy on natural resources could be seen until the recent past are fast changing towards the common property resource management in order to increase their welfare. Figures 7.13, 7.14, 7.15 explain the RCI and money spent on enforcement in the three category villages.

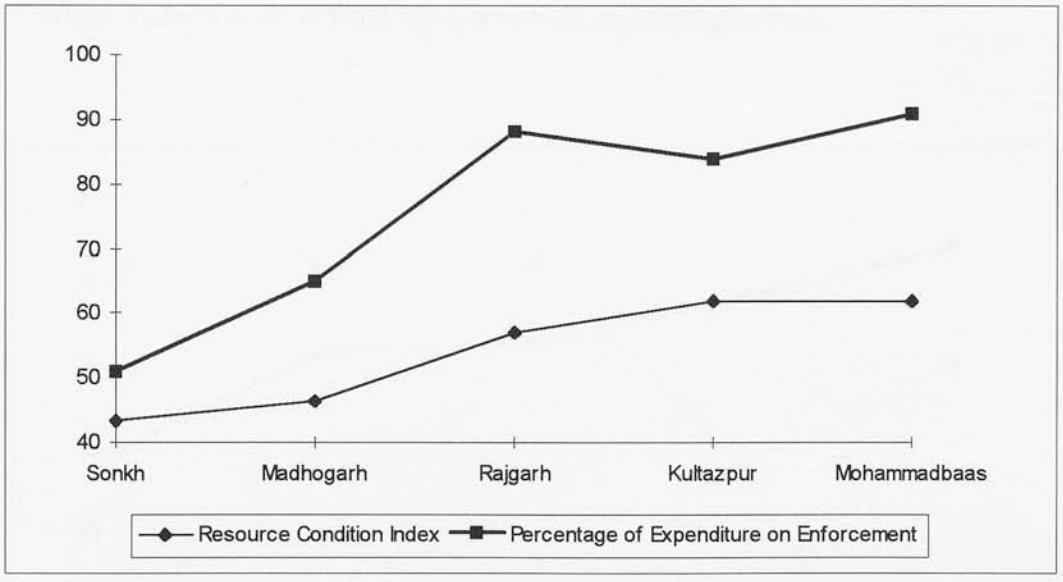

Figure 7.13: Resource Condition Index and percentage of money spent on enforcement (villages under common property)

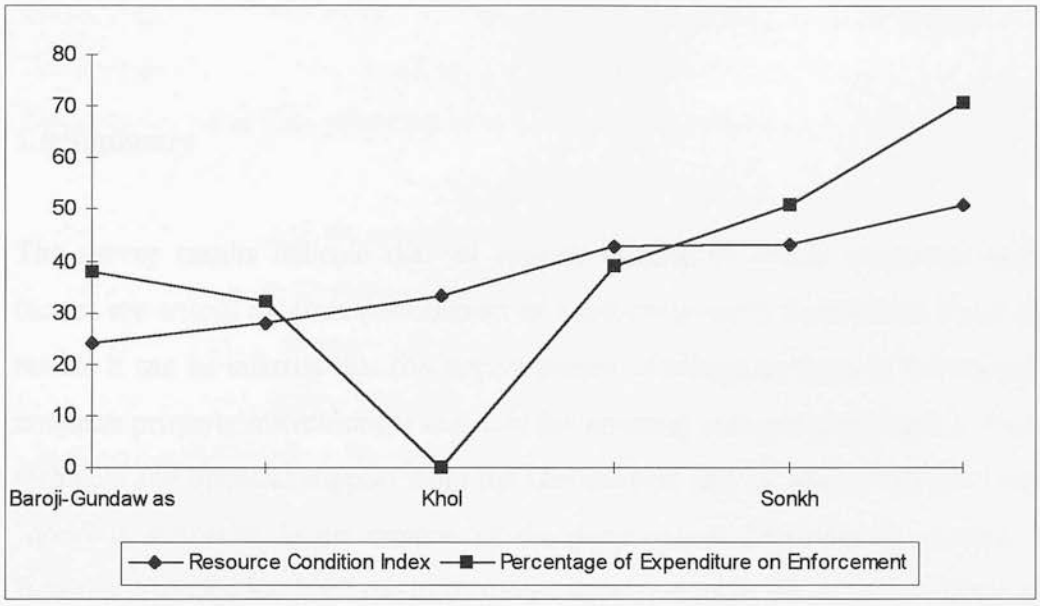

Figure 7.14: Resource Condition Index and percentage of money spent on enforcement (villages under transition from open-access to common property)

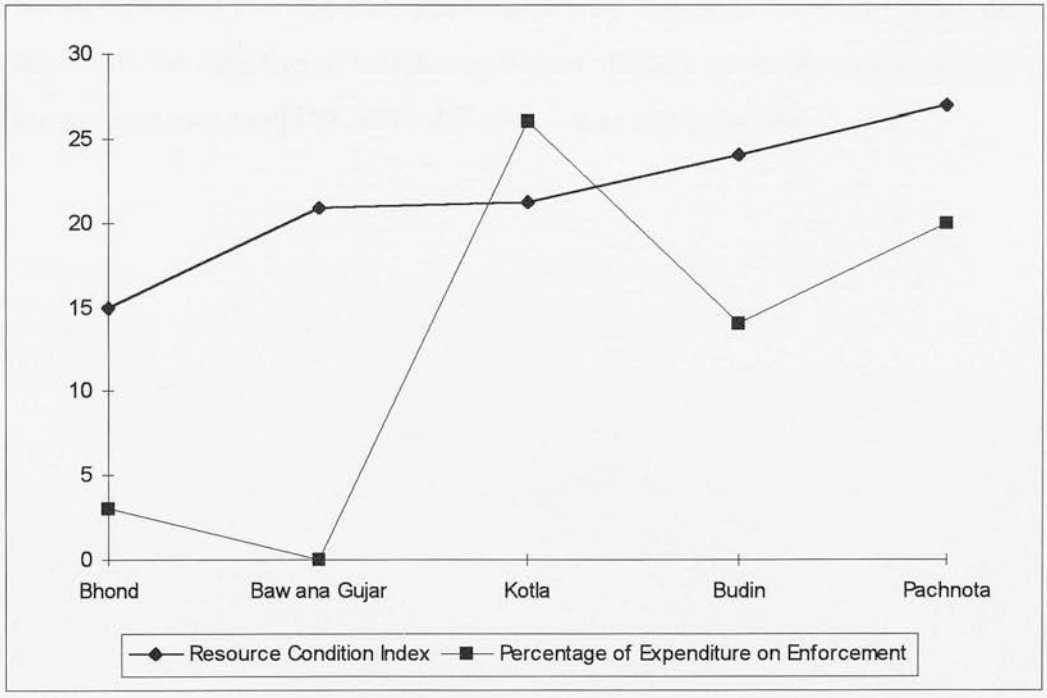

Figure 7.15: Resource Condition Index and percentage of money spent on enforcement (villages under open-access)

7.6 Summary

The survey results indicate that all aspects relating to social, economic and cultural factors are crucial for the establishment of common property institutions. From the above results it can be inferred that the empowerment of village institutions for managing their common property institutions is essential for arresting resource degradation. Provision of technical and financial support from the Government and its role as "enabler" rather than "doer" is important in the context of the participatory development process. The key factor in Aravallis has been the institutional development at the village level for managing the common property resources and the involvement of all the sections of the society in evolving commonly agreed restrictions and their enforcement at the village level. Participation is important but probably not enough on its own. In the next chapter a mathematical programming model was applied to a village incorporating all the households dynamics and their interactions with their farm lands as well as the common lands with the objective of maximising the net village income and to analyse how effective the management would be under different management options.

Chapter VIII

Development and Construction of a Mathematical Model for CPR Management

In this chapter the need for a mathematical programming technique for modelling the use of common property resources is explored. A single objective linear programming model application is presented in the present context in order to analyse the effect of CPR management under different management options. Model development and construction is presented in order to conduct scoping studies, which would help in identifying the changes in the resource condition under different scenarios.

8.1 Linear Programming technique for CPR management

There are number of mathematical programming techniques available for incorporating complex information pertaining to resource management. Single objective linear programming (LP) is recognised as a powerful and versatile computer based aid to decision making at farm planning, since it provides valuable insights into the nature of resource allocation (Dent et al., 1986). LP has been applied to a wide range of allocation problems in resource management including forestry (Beneke and Winterboer, 1973; Barnard and Nix, 1979; Hazel and Norton, 1986; Bell, 1977; Mendoza, 1987; Dykstra, 1984; Rae, 1984; Nhantumbo, 1997). In an LP framework, the decision maker wishes to maximise or minimise an objective function, subject to a number of linear constraints. Usually the objective function represents profit maximisation or cost minimisation. LP formulation assumes that all the underlying relationships are linear, and parameters have single value expectations (Romero and Rehman, 1989).

However, single objective LP can accommodate multiple objectives in the form of constraints. The constraint method optimises one objective while all other objectives must be satisfied by linear inequalities and the procedure determines minimum or maximum values for those objectives. This reduces a multi-objective problem into a

single objective formulation, which can then be solved by LP algorithms. The shadow prices of those objectives which are not optimised, will indicate the rate and limit of trade-off between the optimised and other objectives. This process can be repeated for all objective functions treating remaining objectives as constraints.

The mathematical basis of a single objective LP problem is stated in the form of the following equation:

$$\text{Maximise} \quad Z = \sum_{j=1}^{n} c_j x_j$$

$$\text{Subject to:} \quad \sum_{j=1}^{n} a_{ij} x_j \leq b_i \qquad i = 1,2,3.....m$$

$$\text{and} \quad x_j \geq 0 \qquad j = 1,2,3.....n$$

Where;

'Z' denotes the objective function value

'c_j' is the forecasted net revenue of a unit of j th activity

'x_j' is the level of j th activity

'n' denotes the number of activities

'm' denotes the number of constraints

'a_{ij}' is the quantity of the i th resource required to produce one unit of the j th activity

'b_i' is the amount of the i th resource available

The main advantages of the LP formulation include the generation of many management alternatives that may aid conflict resolution in the VFC's with regard to efficient management of common property resources of the village, evaluation of management strategies and forecasting likely scenarios under open-access and common property regimes. The main disadvantages of LP include: (i) it may be difficult to decide which of the several objectives are fulfilled in different strategies

when so many management alternatives are presented to the decision maker, (ii) the technique is not truly multi-objective but rather single objective with associated constraints, (iii) there are situations when some of the activities may take a zero or a very high level. This problem can be overcome by assigning lower and upper bounds to the objectives to be maximised or minimised. The main limitations of an LP model are divisibility of variables, linearity of constraints, additivity, and non-negativity of activities (Pannell, 1997). However, Dent, et al (1986) observed that, "the limitations imposed by the assumptions of linear programming are more perceived than real; given sufficient time and ingenuity it is possible to achieve a high degree of realism in representing a complex situation."

Despite these limitations and weaknesses, LP is a useful tool in representing a complex system in a single matrix. Unlike humans, an LP model is free to consider all strategies without preconceptions or prejudices. The LP model allows the modeller to put technical and biological information into an economic context and to quantify the economic, technical, and biological trade-offs in the system (Pannell, 1997). Often the amount of information available about a system may be so complex that managers may not be able to make coherent management decisions. The LP model fills this need well for large problems and is a valuable tool for developing an understanding of the subtleties and interactions of a complex management system (Pannell, 1997).

8.2 Objectives

In order to deal with the hypotheses suggested in Chapter I, section 1.2 the LP model was developed to achieve the following objectives:

(i) to optimise the use of private property resources as well as the common property resources of the village;

(ii) to integrate the private property resources and common property resources and the different households interactions with these resources into a simple and useful model;

(iii) to analyse the likely impact of different open-access and common property regime scenarios;

(iv) to study the impact of open-access and common property regimes on different households, such as, the large farmer, small farmer and landless households;

(v) to achieve overall economic efficiency in resource allocation of a village in a particular scenario;

and

(vi) to forecast the likely patterns of agriculture and common land use under different scenarios.

8.3 Model construction procedure

The LP model was constructed at the village level and was applied to one of the surveyed villages. Rajgarh village of the Rewari district was chosen for this application.

A single objective LP model (incorporating multiple objectives as associated constraints) was developed and solved by using the software package LINDO (Linear Interactive Discrete Optimiser - version 5.3). This model was constructed with the objective of maximising the net income of the village. The entire society was considered in terms of three land holding classes: large farmers (those owning more than 3 hectares of land), small farmers (those owning less than 3 hectares of land) and landless households, for model construction.

The assumptions for model construction were:

a. Production technology in agriculture is constant at the level of the year of survey (1995-96) (although some of the coefficients can be changed to reflect a change in the production process). The technology is assumed to be linear meaning that the production relationships in the model are constant irrespective of the scale of production;

b. Input-output prices are assumed to be constant at 1995-96 prices (time of the survey);

c. Different households were considered as homogeneous, even though the characteristics of different caste groups differ from each other. The composition in each household (males, females and children) was considered as fixed at certain level;

d. All land was assumed to be of homogenous capability since the entire region has only one class of land, sandy loam;

e. There is free flow of goods within the village and outside the village. Buying and selling of goods from within and outside the village is allowed. Each household can sell their surplus produce and buy according to their requirements;

f. The basic needs of the people, such as, fuelwood, fodder and food items are satisfied in the model. Expensive items such as consumption of liquor, buying of fruits and spending on festivals and social functions were considered luxury items and not considered. The basic aim of the model is to satisfy the basic needs of individual households and then to maximise the net cash generated from the resources at their disposal in order to meet certain essential items of living, such as buying of clothes, tea, coffee, power, medicines, leisure and entertainment. The general structure of the model is given in Table: 8.1.

8.4 Activities Considered in the Model

8.4.1 Production Relationships involving agricultural land

From the land holding point of view three types of households were identified. Those households owning more than 3 ha of agricultural land have been categorised as large farmers, those households owning less than 3 ha of land have been categorised as small farmers and the rest of the households having no land have been categorised as landless households.

Cropping activities of the different farmers were decided on the basis of the field survey. Since little distinction was recorded across soil types, the entire area was treated as having same type of soil conditions with little or negligible variations. The soil type is uniformly sandy loam with minor variations in the organic matter content and phosphate content. Based on the field survey, land was treated as homogenous since the farmers did not express any appreciable differences in soil conditions. Almost any crop could be grown suitable for the sandy loam conditions on any farm without appreciably affecting the production levels. However, land of small and large farmers was treated differently since both of them have different access to resources such as inputs, farm machinery etc.

Table: 8.1 General structure of the LP village model

ACTIVITIES	Production activities on agricultural land and common lands (68)*	Storage activities (8)	Selling activities (18)	Buying activities (20)	Consumption activity (60)	Labour activity (14)	Labour Selling activities (16)	Household food, energy demand activities (18)	Livestock fodder demand activity (10)		
Objective: (Maximise net income)											
CONSTRAINTS											
Total land under use (24)	+x									≤	TL
Production, selling and consumption of food crops rec. (80)	-x	+x	+x	+x	+x					≤	0
Storage transfer of crops (2)		-x	+x		+x					≤	0
Labour[1] rec (39)	+x					-x	+x			≤	0
Fodder rec.[2] (14)	-x								+x	≤	0
Household food[3] and fuel[4] rec. (58)	-x				+x					≤	0

TL = total land, rec. = reconciliation, * figures in parentheses refer to numbers of columns (activities) and number of rows (constraints) in matrix.

1 = number of man days

2 = dry matter in kilo grams

3 = energy in kilo calories

4 = fuel in mega joules

Intensive crop production often allows more than one crop per year to be produced from the same piece of land. The land held by individual farmers is under intensive cropping. The year is divided into two seasons, the Rabi season (dry season) and the Kharif season (wet season). The Kharif season is from July to October, where as, the Rabi season is from November to March. No production activities are possible from April to June, owing to hot, dry and desiccate winds from the Thar desert. During Kharif, Jowar (Sorghum), Bajra (pearl millet), Onions and Gram are grown, where as, in Rabi season more varied crops such as Wheat, Mustard, Peas, Tomatoes and Barley are grown. Due to the need to have balanced production of crops some crops are bound by land constraints.

Since subsistence farming dominates in this area, usage of fertiliser in crop production is not very common. Very rarely can one see fertiliser being applied by a farmer to his growing crops. Most people apply very little amount of fertiliser to small vegetable plots. Since there exists no pattern of fertiliser applications to agricultural crops, production of crops involving fertiliser is not considered in the model. However, dung usage in place of fertiliser is quite common. It provides a much needed nutrient replenishment for the soil and also provides dung cakes for fuel purposes. Hence, an option to produce crops using dung and without dung is provided in the model where, dung application to agricultural crops increases marginal crop production.

Agricultural crops provide grain, straw and crop residues. Grain is used for meeting the household food energy requirements, whereas, straw is used as dry matter feed for livestock. Crop residues, such as mustard sticks are used as fuel for cooking food for household consumption. The produce from the farm can be sold, bought, or stored for later use, according to convenience and profitability. The input-output coefficients used in the model were derived from the field survey and various other sources including field observations (GOH, 1995, NRDMS, 1994 and DSO, 1994). The annual rainfall in this village is fairly stable (425 mm) (HFD, 1989). It was therefore anticipated that crop yields would not vary significantly from year to year since the climatic factors remain stable from year to year. The average crop yields provided for

various crops in the model adequately represent the actual situation. The grains, straw and crop residues can be bought, sold, stored and, or consumed by the large and small farmers, where as, landless households have to buy and consume in order to meet their requirements. Food grains are converted into kilocalories and fodder is converted into kilograms of dry matter to meet the fodder requirement of livestock.

8.4.2 Crop Storage

Storing crops is a necessity for the households in order to meet the food requirements for the next season. Storage of crops naturally leads to certain storage costs as well as certain storage losses. Therefore, grain losses from one season to another are incorporated in the model, as are storage costs (Table 8.2).

Table 8.2: Crop storage losses and storage costs

Crop	Storage losses	Storage costs per kilogram (in Rupees)
Wheat	15%	0.30
Jowar	10%	0.20
Bajra	20%	0.30
Peas	10%	0.20

Source: Survey.

8.4.3 Sale of agricultural produce

The average sale prices of agricultural produce are given in Table 8.3. The cash generated from the sale of crops grown meets the input requirements for the next cropping season besides meeting several necessities of the household. The sale prices provided in the model are the prices prevailing at the time of data collection (1995-96). Price fluctuations were analysed and are presented in Chapter - IX.

Table 8.3: Average sale price of different crops

Crop	Sale Price per kilo gram (in Rupees)
Wheat	4.75
Mustard	9.00
Jowar	4.75
Bajra	4.50
Onion	3.00
Barley	4.45
Peas	10.00
Potatoes	1.25
Tomatoes	2.25

8.4.4 Purchase of food grains

Purchase activities for buying the food grains is provided for in the model, so as to facilitate supply of food grains needed by the households. The average purchase prices of food grains were much higher compared to the sale price in 1995-96. Table 8.4 provides the purchase prices prevailing at the time of field survey.

Table 8.4: Purchase price of major crops (1995-96)

Crop	Purchase Price per kilo gram (in Rupees)
Wheat	7.00
Jowar	5.50
Bajra	6.00
Onion	3.50
Barley	6.50
Peas	15.50
Potatoes	2.00
Tomatoes	4.00

8.4.5 Household consumption of food energy

The model satisfies the requirements of food energy demands of various households, thus fulfilling one of the basic needs of the household. The annual kilocalorie requirements by adult male, adult female and children of southern region of Haryana were specified by the National Institution of Nutrition (1991). No distinction in terms of kilocalories for different types of households was considered, however. The average food energy requirements are constrained to atleast be met in the model by every household. Seasonal food energy requirements are given in table 8.5. In the model, energy is defined in terms of kilocalories and proteins in terms of kilograms.

Table 8.5: Energy and Protein Requirements (Season wise)

Type	Kharif Energy (Kcal)	Kharif Protein (kg.)	Rabi Energy (Kcal)	Rabi Protein (Kg)
Male	294000	7.08	600250	14.45
Female	252000	6.24	514500	12.74
Children	210000	5.28	428750	10.78

Food energy requirements are normally met from cereals, pulses, milk, vegetables and fruits etc. Calorific supply from different types of foods is explained in detail in Table 8.6. Meat, being a costly source of energy (and also because it is consumed very rarely by a small section of the population) was excluded and not considered in the model.

Table 8.6: Energy and Protein supply from different types of food

Type of food	Calorific value (Kcal) per Kg of food	Protein content (Kg) per Kg of food
Wheat	3370	0.094
Jowar	2918	0.076
Bajra	3010	0.109
Peas	720	0.06
Gram	2700	0.22
Barley	3100	0.082
Potatoes	740	0.02
Tomatoes	140	0.009
Milk	650	0.032

Source: National Institute of Nutrition, Hyderabad, 1991

8.4.6 Common land

The common land products are mainly fuelwood and fodder. The outputs that are extracted by different land holding classes was taken into consideration in the model. Raising of plantations was not considered in the base model but was a potential common land activity that could be brought in to increase the output of fuelwood and fodder. This step allows for the analysis of the effect of a joint management effort.

Estimated production yields from raising the plantations are provided in the model. No costs of raising the plantations was provided since these are currently being provided by the Forest Department at no cost to the village. Outputs that accrue at regular intervals from these plantations was provided (Table 8.7).

Table 8.7: Estimated production of fuelwood and fodder from the plantations.

Fuelwood	6 th year (first thinning)	4.5 tonnes/ha.
	11 th year (second thinning)	7 tonnes/ha.
	21 st year	42 tonnes/ha.
Fodder	2 nd year - 6 th year	1.7 tonnes/ha/year
	7th year - 12 th year	3.6 tonnes/ha/year
	13 th year - 21 year	4.6 tonnes/ha/year

8.4.7 Livestock

Different types of livestock such as cows, buffaloes, goats, sheep and camels were treated as Tropical Bovine Units (TBU) for making the model structure simple and to keep it in manageable limits. The conversion factors used to calculate the number of TBU in each household type were adopted from the SETA report on rehabilitation of common lands in Aravalli Hills (1989). Table 8.8, provides the TBU conversion factors.

Table 8.8: Conversion of Livestock into Tropical Bovine Units (TBU)

Type of Livestock	Conversion Factor
Cow	0.75
Buffalo	0.9
Camel	1
Goat	0.25
Sheep	0.25

A fodder demand study was conducted extensively by the Haryana Forest Dept. through a series of surveys by an agrostologist (Dauley, 1994). Livestock feed demand was also ascertained during the field survey from different households and animal husbandry department officials. All these studies indicate the similar figures of fodder demand by different types of livestock. Fodder requirement in terms of kilograms of dry matter per livestock type was separately calculated and was provided as required by a TBU (20 kg Dry matter/TBU/day) in the model. However, the fodder requirement of different livestock types calculated by Dauley (1995) does not correspond with the conversion factors of TBU presented in Table 8.8 (Table 8.9).

Table 8.9: Per Day Fodder Requirement and Dung Production by different livestock

Type of animal	Fodder Requirement (Kg. of Dry matter/Day)	Wet Dung Production (Kg/day)
Buffalo	20	15
Cow	15	9
Camel	20	9
Goat	2	1
Sheep	2	1.5

Fodder from farms and village common lands was converted into dry matter equivalent. Livestock provide milk and dung and both these products are utilised in meeting the agricultural crop requirement as manure, and for meeting the household energy needs and have been separately provided in the model.

8.4.8 Labour

Available labour resources were calculated in each of the households and were incorporated in the model. The resource units have been distinguished as adult males and adult females. Though children working as farm labourers can been seen quite often on the farms, their labour was not separately considered in the model as child labour is legally prohibited by the government.

There are two types of labour. One is domestic labour i.e., supply from one's own family/household and the second one is hired labour. In addition to its own supply, a household can hire labour as and when the demand for such labour becomes necessary in meeting the crop requirements. Different labour activities include farm requirement, domestic requirement and livestock requirement. Though there is no sex discrimination of labour in terms of wages paid to the hired labourer as every hired labourer has to be paid a minimum wage determined by the government from time to time on the basis of the prevailing inflation under the Minimum Wage Act. However, certain activities are performed by female labourers only. Hence, there is differential requirement of hired labour for different crops. Similarly, quarrying can be done by males only.

Labour availability is considered in terms of man days only. There exists no system of working in terms of labour hours. Normally a manday is considered to extend from morning 8 am to 5 pm with a two hour lunch break. In most of the households, domestic work such as cooking food, taking care of livestock, collection of fodder and fuelwood and other household tasks are done by women. Hence the number of mandays provided by women to the farming labour pool is less. All the available

labour in various households has been pooled together for model purposes. Labour is drawn from the pool by the different households as and when it is required for their farm activities. In the model, provision has also been made to utilise the available labour from within the household and then hire the labour from outside the household since labour supply from within the household involves no cost but hiring of labour is certainly a costly proposition. Labour requirement per crop and other activities such as livestock rearing, working for forest and other public works department was provided in the model. Hiring of labour from outside the village is not provided since there is generally plenty of available labour from within the villages. Being an economically backward area, no such labour shortages could be anticipated. The average cost of hiring of labour is forty rupees per man day, at 1995 prices.

8.5 Constraints provided in the Model

8.5.1 Land

Land is a major constraint and is a fixed resource which can be utilised or remain slack. Land was considered to be of homogenous quality and to be distributed between the different types of household equally. Large farmers and Small farmers were provided at 4.2 hectares and 1.2 hectares respectively.

8.5.2 Production

Crop yields provided in the model are average yields mentioned in the survey by various households. Since no publication mentions crop yields with the application of dung and without the application of dung, the yields provided in the model are also based upon the survey of households (Table 8.10). However, the figures provided with dung application were almost the same as the figures published in official documents, such as the Statistical Abstract of Haryana, 1995 with minor variations. The purpose of dividing the activities into with dung and without dung application was to see how the energy requirements of the family are met by different households.

Dung has an important role in enhancing the crop productivity as well as meeting the household energy requirements for cooking food in the form of dung cakes. Under this constraint, the demand (for crops as manure and as dung cakes for cooking purposes) and supply (from the animal excretions) was specified as less than or equal to Zero, i.e., dung could not be imported into the household system.

Table 8.10: Average crop yields from the village survey

Crop Name	Yield in Kg./ha. (with dung)	Yield in Kg./ha. (without dung)
Wheat	2800	1900
Mustard	1200	800
Barley	2600	1850
Jowar	1800	1160
Bajra	1620	1050
Onion	4600	3800
Tomatoes	3010	2100
Potatoes	8600	5225
Gram	1350	865
Chick Peas	1440	920

8.5.3 Labour

Labour is in great demand especially during harvesting, weeding and land preparation periods. In addition to labour supply from within the family, hiring of labour is allowed in order to meet the short fall in labour requirements. Labour requirements of each crop was calculated and provided for in the model.

8.5.4 Household Food supply

The households have a choice of either producing food on their own farm or purchasing from the market, depending on the requirements. This constraint is concerned with the seasonal food consumption demand.

8.5.5 Household composition

The household composition is different for each land holding class. Based on the survey household composition of different land holding classes was incorporated in the model.

8.5.6 Fuelwood

Fuelwood can be purchased from the market or collected from the common land or from the farm land by individual households owning farms. Landless households have to either purchase from the market or collect fuelwood from the common lands. The other alternative to meeting the fuel supply is from the burning of dung cakes or mustard sticks. These three sources of fuel energy provide most of the cooking needs of the households. The annual requirements of the households are forced to be met in the model. Household fuel requirements provided in the model are based on the survey of the different households. There are no published surveys of the energy requirements of the households. The amounts of fuelwood, mustard sticks and dung cakes utilised by different households were converted into Mega joules and are provided in the model. Conversion ratios were, 12.368 mega joules/kg fuelwood, 11.255 mega joules/kg. crop residues and 8.753 mega joules/kg dung cakes respectively. The annual demand of the households was the same for small farmer and landless households at 36588 mega joules of energy, where as for large farmer households it was slightly higher at 48784 mega joules. No supply of alternative sources of fuel was considered in the base model, but in the scoping studies (Chapter IX) these alternatives were considered.

8.6 Model Validation / Verfication

Validation is a process of checking whether the matrix is consistent with the real world (Pannell, 1997). In other words, it is a process by which a model is determined to be a valid portrayal of the system modelled. Model validation refers to activities to establish how closely the model mirrors the perceived reality of the model user/developer team (Gass, 1983). However, a model cannot represent all of the perceived reality, so attention should be narrowed down to that part of the reality which the model is intended to represent (McCarl, 1984). The validation procedure involves comparing the performance of the model either against recorded data for the system or against a subjective judgement of what the output should be, given a broad understanding of the system or type of system which the model represents (Dent and Blackie, 1979). Many of the difficulties in validating a model arise from the data it is being validated against (Hazell and Norton, 1986). A model can also be validated by assumption, with or without comparing the results with the recorded data (McCarl, 1984). In order to judge if a model is valid, the optimal values of the decision variables, the dual prices and the objective function should be systematically validated. This validation of the model can be by construct or by results (McCarl and Apland, 1986). Validation by construct relies on the procedure believed to be appropriate by the model builder. These are based upon experiences, precedence, and or theory, using scientific estimation or real world data. Validation by construct means the validity of the model is assumed. Validation by results usually follows validation by construct and consists of a comparison of model solutions with corresponding real world outcomes. Virtually all models go through a validation by assumption stage, which involves a judgement of validation through expert opinion, antecedent, theory, data or logical structure.

In this study, model validation relies on the logical framework with which the model was built. Most of the data was either collected during field survey or taken from published sources. Efforts were made to make the model realistic and logical. The

experience of the researcher of having worked and lived in the area for over ten years also strengthens the presumption that the model is valid / verified.

8.7 Summary

In this chapter the development and construction of a single objective linear programming model has been presented along with model validation/verification. The activities and constraints specified in the model are discussed. This enabled the undertaking of scoping studies in order to forecast the likely patterns of changes under open-access and common property scenarios. In the next chapter the results of the scoping studies, sensitivity analysis and the model validation are presented.

Chapter - IX

Analysis of the Scoping studies Results and Discussion

In this chapter the single objective linear programming model developed in chapter-VIII is used for conducting the scoping[1] studies in order to determine the solutions under open-access and common property situations. The solution runs that were undertaken under different scenarios are presented and the results are discussed. The model validation is also presented.

9.1 Scoping studies

The main purpose of this research is to understand the likely scenarios if the current open-access situation continues and to forecast the likely benefits that would accrue to the different households under a common property situation. This study should help the village communities and their advisers to decide as to which one of these is beneficial for them to pursue.

The studies are conducted with the sole objective of maximising the net income of the village under both open-access and common property, while fulfilling the basic household needs. The different scenarios under which the scoping studies are conducted include:

(i) The likely scenario if open-access is pursued from the current level of extraction of fodder and fuelwood from the common lands;
(ii) The likely scenario if common property is pursued rigorously with stricter controls in access, distribution of produce from the common lands accompanied by proper enforcement;

[1] Means a range of view or the extent to which it is possible to range (Oxford Dictionary of Current English, 1992).

(iii) The likely scenario under both common property and open-access if the present level of increase in both human as well as livestock populations takes place over a period of time (dynamic situation);
(iv) The likely scenario if alternative energy sources are provided by restricting different households access to the common lands for both fuelwood as well as fodder;
(v) The likely scenario if access to common lands is restricted to only small farmers and landless households;
(vi) The likely scenario if agricultural production levels increase or decrease from the current level of production. These scoping studies results are presented and discussed in the following sections.

9.1.1 The likely scenario if open-access is pursued from the current level

For conducting the scoping studies under this scenario the observed resource degradation patterns in various case study villages formed the basis for determining the output that would be extracted successively by different households. The fuelwood and fodder resources were assumed to be degraded and are likely to result in a short fall of 20 percent successively from year to year since it is a free for all situation resulting in the absence of any proper management structure. In this scenario, no improvements in the situation are possible and a stage would eventually result whereby it would not be possible to extract anything, implying that the ultimate resource availability would be zero. The current level of extraction was the level which was prevailing at the time of the survey (1995-96). The solution runs were undertaken with the current annual extraction level of fodder and fuelwood from the common lands at 219,450 kilo grams and 184,000 kilo grams respectively. These figures were calculated by extrapolating and aggregating the extraction levels for whole of the village from the sample surveyed. The results from different runs with the successively declining extraction levels show that the village income declines under open-access for all the households. The net income of the entire village declines from Rs.5,973,569 to Rs.5,487,790 in a span of 60 years at the current prices (1995-96). While the decline is initially faster compared to the later years. As the following

sub sections show, almost every household gets affected under open-access, irrespective of land holding status.

9.1.1a Large farmer households under open-access

A marginal decline in the net income of the large farmer household takes place after the first three years. Thereafter it remains constant, since large farmers are not very dependent on fuel and fodder resources from the common lands (Figure 9.1).

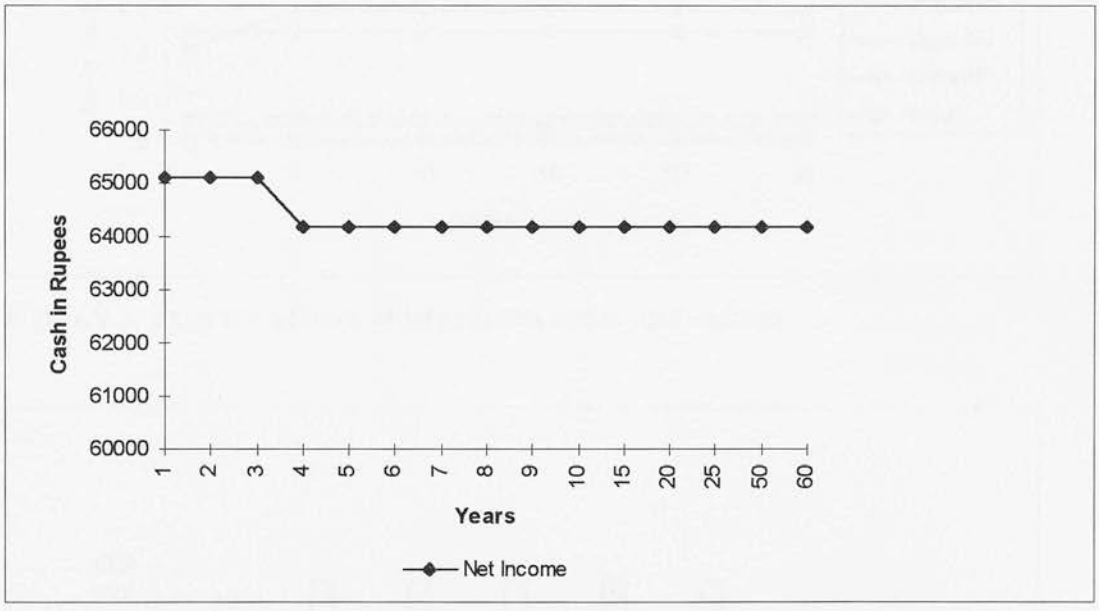

Figure 9.1: Large farmer household net income (in Rupees) under open-access

Apart from the slight decline in the net income of the large farmers a slight change in landuse pattern takes place in order to compensate for the loss of fodder and fuelwood supply from the common lands. The area under mustard crop grows slightly from 1.6 ha. to 1.7 ha. The model uses the alternative source of fuel (mustard sticks) in order to compensate for the loss of fuelwood supply from the common land. A similar pattern emerges from the fodder point of view. While the production of wheat declines an increase in Jowar (Sorghum) production takes place in order to compensate for the loss of supply of fodder from the common lands (Figure 9.2).

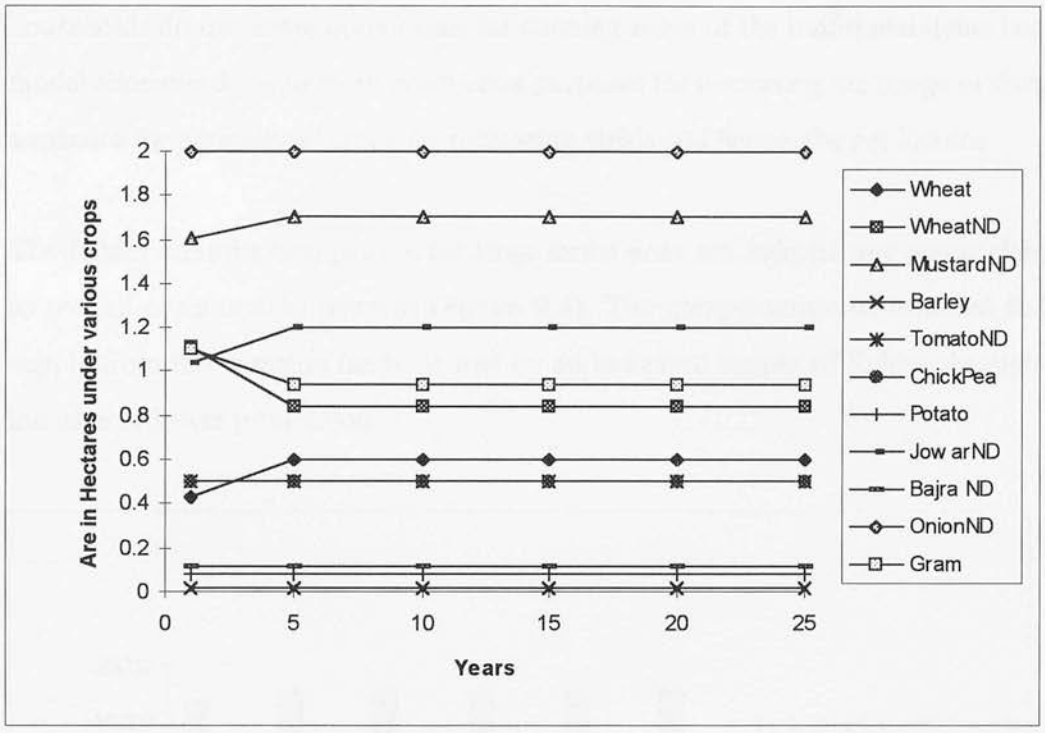

Figure 9.2: Land use pattern of large farms under open-access

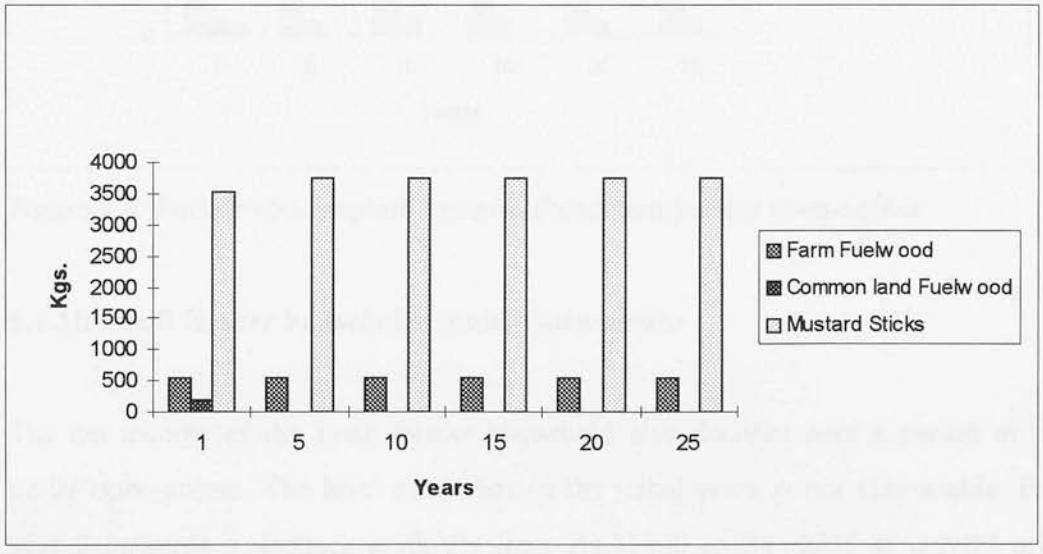

Figure 9.3: Fuel consumption scenario under open-access (large farmer household)

As far as fuel sources are concerned the model predicts the non-usage of dung cakes as a source of fuel. Instead, it increases the usage of mustard sticks produced through

increased area under mustard crop (Figure 9.3). In reality, most large farmer households do use some dung cakes for cooking some of the traditional items but the model allocates dung to more productive purposes for increasing the usage of dung as a manure for agricultural crops for increasing yields and hence, the net income.

The fodder consumption pattern for large farms does not indicate any major changes to overall consumption patterns (Figure 9.4). The compensation of lessened fodder supply from the common lands is met by an increased supply of fodder through the increase in Jowar production.

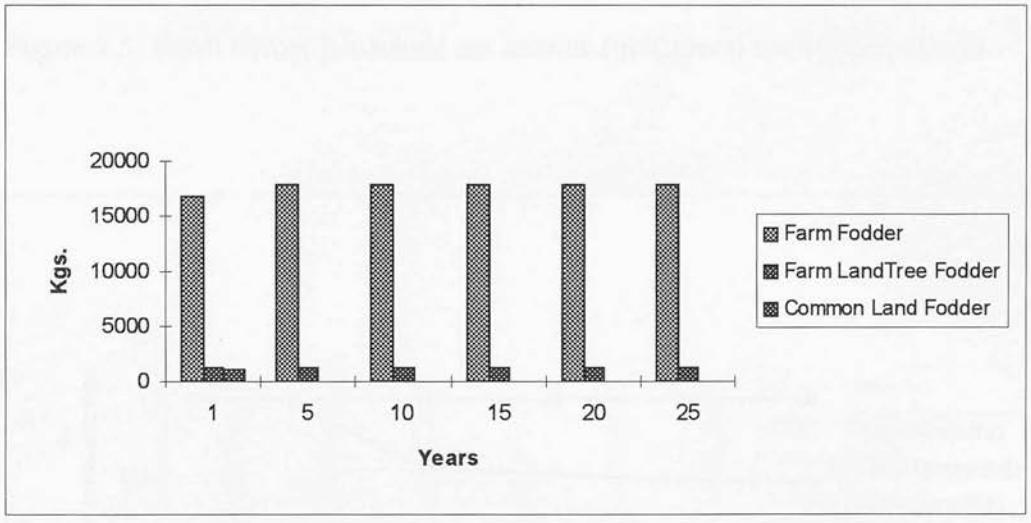

Figure 9.4: Fodder consumption scenario (large farm) under open-access

9.1.1b Small farmer households under open-access

The net income of the small farmer household also declines over a period of time under open-access. The level of decline in the initial years is not appreciable. From year 3 onwards it declines gradually from Rs.11420 to Rs.10230 at current prices (1995-96) with the falling extraction levels of fuelwood and fodder from the common lands (Figure 9.5).

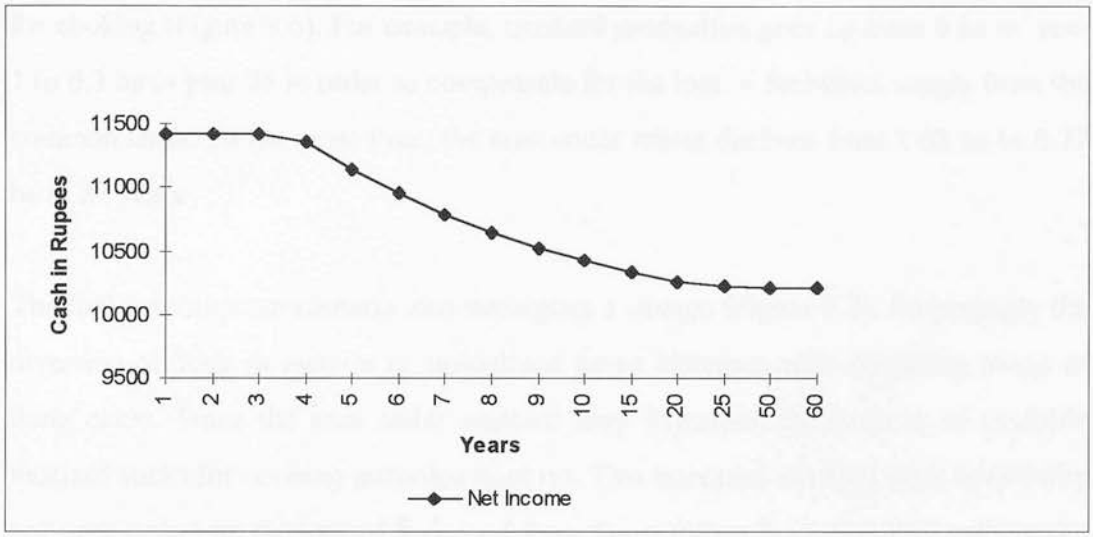

Figure 9.5: Small farmer household net income (in Rupees) under open-access

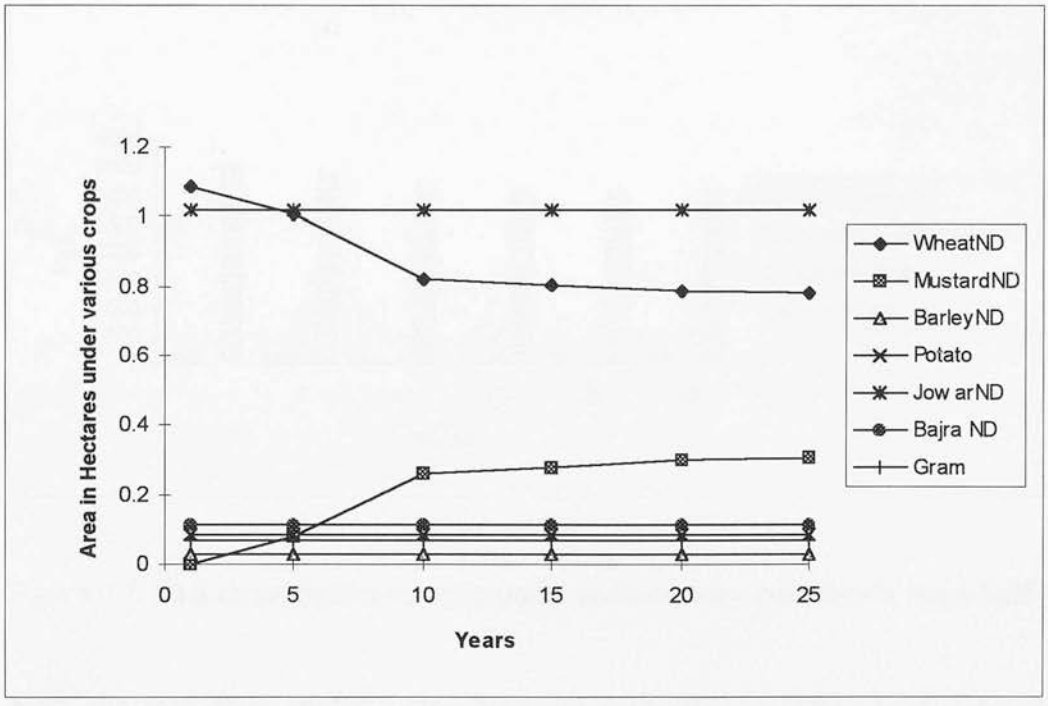

Figure 9.6: Land use pattern of small farm under open-access

As the open-access situation continues changes in landuse pattern become substantive indicating the increase in area under production of agricultural crops that provide fuel

for cooking (Figure 9.6). For example, mustard production goes up from 0 ha in year 1 to 0.3 ha in year 25 in order to compensate for the loss of fuelwood supply from the common lands. At the same time, the area under wheat declines from 1.08 ha to 0.77 ha in 25 years.

The fuel consumption scenario also undergoes a change (Figure 9.7). Surprisingly the diversion of dung as manure to agricultural crops increases with the falling usage of dung cakes. Since the area under mustard crop increases, the amount of available mustard sticks for cooking purposes goes up. This increased mustard stick availability not only makes up the loss of fuelwood from the common lands but also reduces the conversion of dung to dung cakes thereby making more dung available to agricultural production.

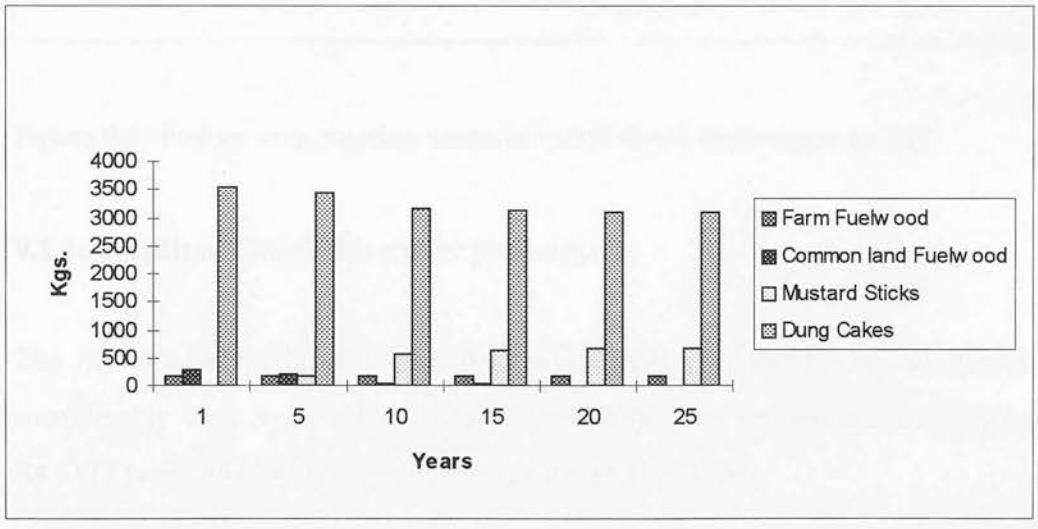

Figure 9.7: Fuel consumption scenario under open-access (small farmer household)

Since the area under mustard crop increases a shortfall in fodder production from farm lands occurs (Figure 9.8). Since fodder from the common lands also declines under the open-access situation the amount of TBU's that can be fed decreases from 1.81 to 1.59. The model uses only 1.81 TBU's as against the 2.6 TBU's available in the model. This indicates that the present livestock is underfed and will continue to be

underfed. This decreases the livestock productivity and reduces the income level of the small farmer households.

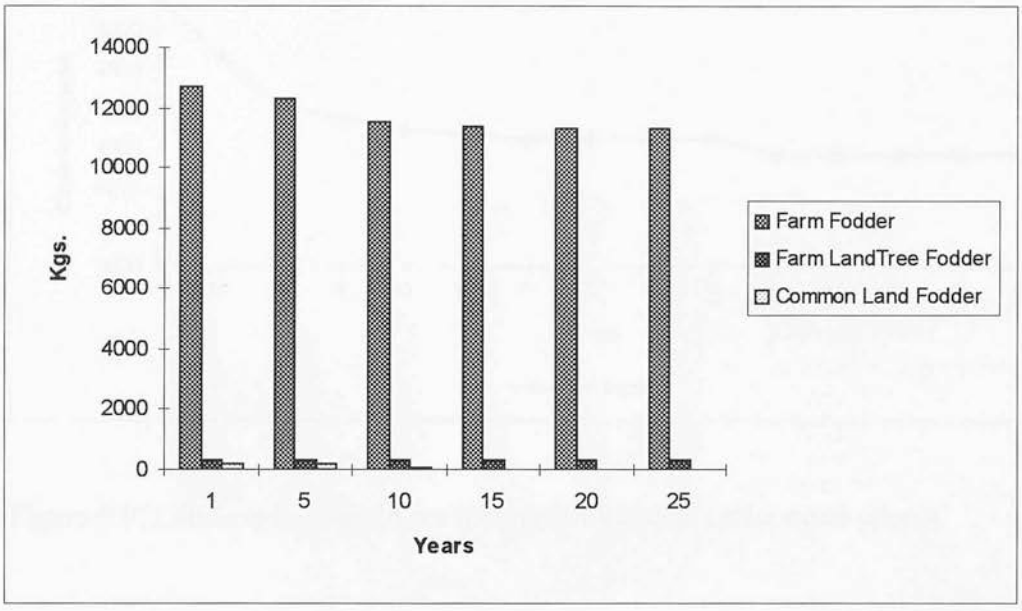

Figure 9.8: Fodder consumption scenario (small farm) under open-access

9.1.1c Landless households under open-access

The net income levels of the landless households also decline under open-access considerably over a period of time (Figure 9.9). The net income decreases from Rs.5173 to Rs.4372 in 15 years at current prices (1995-96).

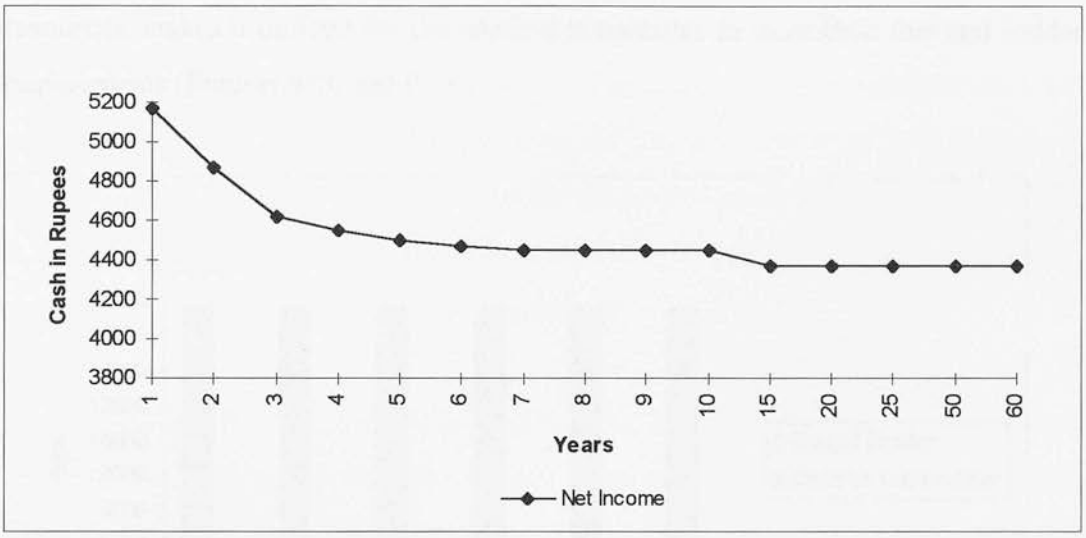

Figure 9.9: Landless household net income (in Rupees) under open-access

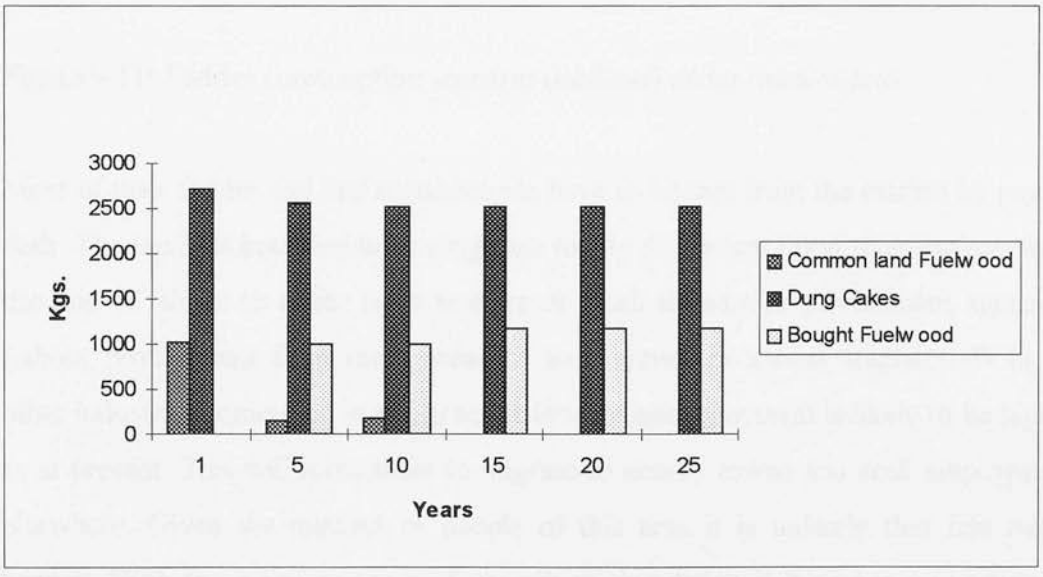

Figure 9.10: Fuel consumption scenario under open-access (landless household)

Increasing open-access, resulting in a reduced availability of fuel and fodder resources, makes it difficult for the landless households to meet their fuel and fodder requirements (Figures 9.10 and 9.11).

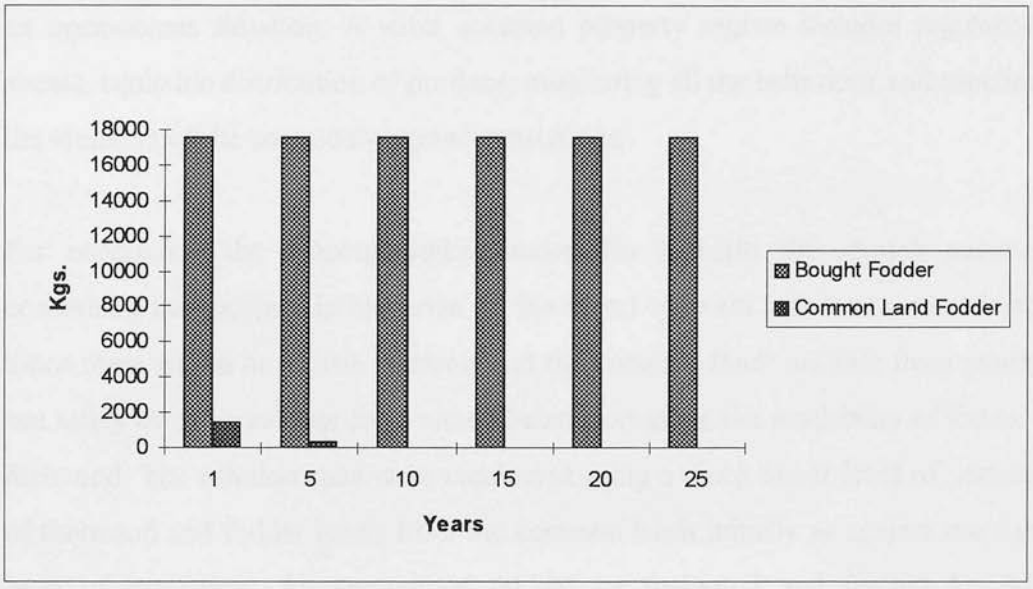

Figure 9.11: Fodder consumption scenario (landless) under open-access

Most of their fodder and fuel requirements have to be met from the market by paying cash. The landless households earnings are totally dependent upon their income from the sale of labour to either large farmers or small farmers or government agencies. Labour requirement from these areas of employment is almost stagnant. With no other industries coming up in this area the level of unemployment is likely to be higher as at present. This will force them to migrate to nearby towns and seek employment elsewhere. Given the mindset of people of this area it is unlikely that this might happen. With the increasing rate of growth of population it becomes a question of survival for the landless households. This proposition is examined later under a dynamic situation.

9.1.2 The likely scenario if common property is pursued by the village

In this section the model results are presented assuming that there exists a common property situation. This means that the regulated access system is in force in place of an open-access situation. A strict common property regime includes regulation of access, equitable distribution of produce, monitoring all the behaviour and sanctioning the violators of the commonly agreed restrictions.

For conducting the scoping studies under this scenario the growth parameters concerning the increase in bio-mass of this forest type are taken into consideration. Since there would be stricter controls and the common lands are free from grazing it can safely be expected that there would be an increase in the availability of fodder and fuelwood. The solution runs were conducted using a much lower level of extraction of fuelwood and fodder levels from the common lands initially as against the current level of extraction. An amount of 46,200 kg fuelwood and 69,300 kg fodder extraction in the first year is considered for safe removal as against the current level of extraction of 184,000 kg and 219,450 kg of fuelwood and fodder respectively. With reduced removal of fuelwood and fodder from the common lands, with proper monitoring and enforcement in place, was assumed to make that the resource supply levels will continue to increase at the rate of 7.5 percent per annum over the next 25 years until production levels peaked at 262,086 kg fuelwood and 393,130 kg fodder. These increases are in line with the projections predicted in the unpublished reports of the Aravalli project (GOH, 1989) assuming the scenario without the tree plantations on vacant spaces in common lands. Removal of 1134 kg fuelwood per ha of common land and 1701 kg fodder per ha in the 25 th year is a reasonable estimate if the access controls are strictly enforced by the village community. This exercise may be termed suspect but it provides reasonable answers to the likely scenarios under common property regime. In the absence of any published volume tables for this type of mixed forest, dominated by the presence of *Anogeissus pendula* the output levels prescribed are considered reasonable for forecasting the likely scenario.

The changes in net income and the resulting changes in landuse patterns, fuel consumption scenarios and fodder consumption scenarios for each of the different type of households are presented in detail in the following subsections under a common property regime.

9.1.2a Large farmer households under common property

The net income level of the large farmer households increases over a period of twenty five years from Rs.64,483 to Rs.65,885 at current price levels (1995-96) representing an increase of 2.17% (Figure 9.12).

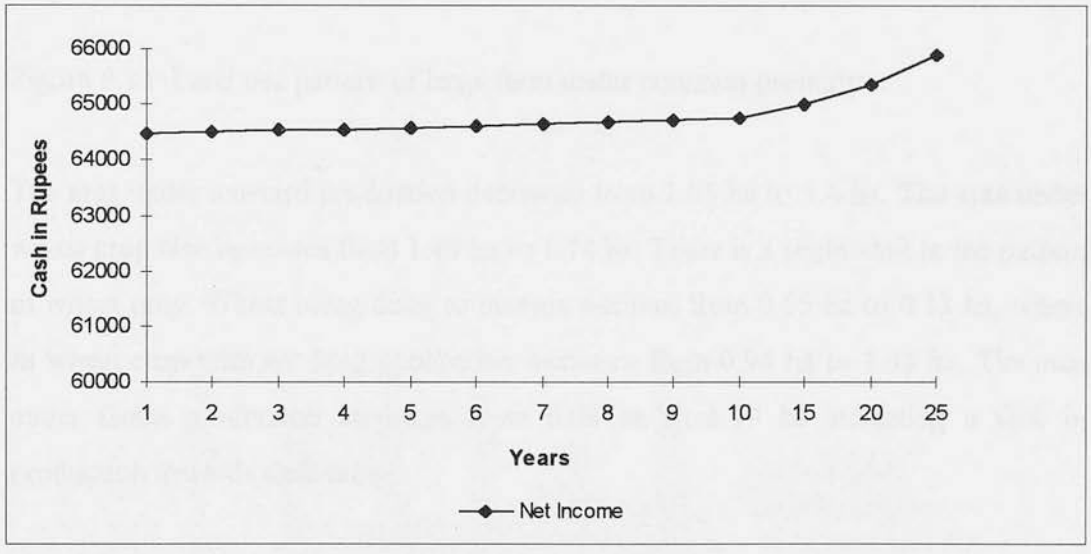

Figure 9.12: Large farmer household net income in Rupees (under common property)

Since fuelwood and fodder from the common lands is allowed to be distributed equitably amongst all households from the common lands the availability of these resources increases year after year. Due to the increased availability of fodder and fuelwood from the common lands under the common property the land use pattern changes (Figure 9.13).

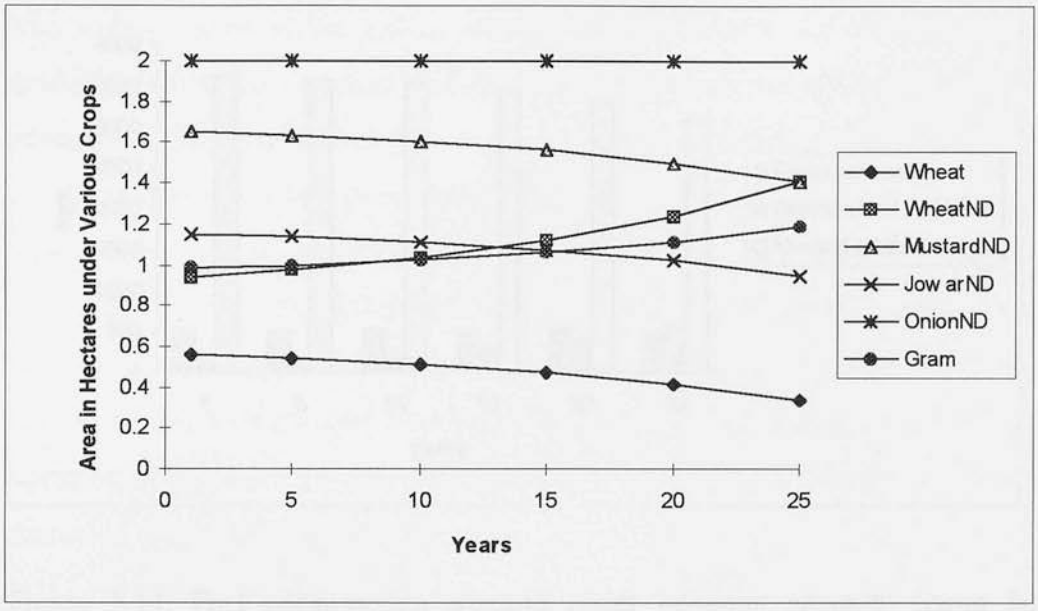

Figure 9.13: Land use pattern of large farm under common property

The area under mustard production decreases from 1.65 ha to 1.4 ha. The area under wheat crop also increases from 1.49 ha to 1.74 ha. There is a slight shift in the pattern of wheat crop. Wheat using dung as manure declines from 0.55 ha to 0.33 ha, where as wheat crop with no dung application increases from 0.94 ha to 1.41 ha. The area under Gram production increases from 0.98 ha to 1.19 ha indicating a shift in production towards cash crops.

The fuel consumption scenario for large farmer household changes with the increased availability of fuelwood from the common lands (Figure 9.14). The usage of mustard sticks comes down from 3639 kg to 3099 kg over a period of twenty five years. Though the model does not show any usage of dung cakes for cooking, this is unlikely to happen since some of the traditional dishes are made using dung cakes.

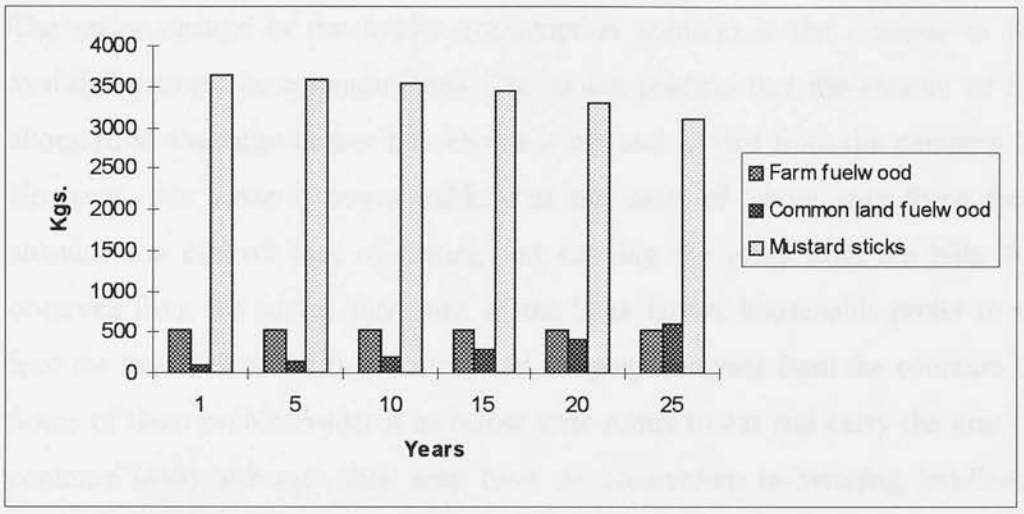

Figure 9.14: Fuel consumption scenario under common property (large farmer household)

The fodder consumption scenario also changes with the availability of increased fodder from the common lands (Figure 9.15).

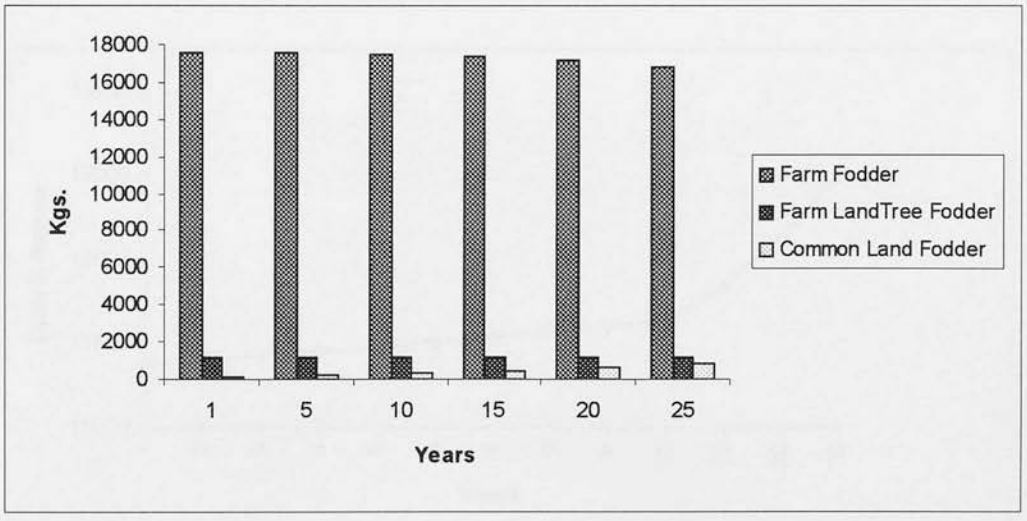

Figure 9.15: Fodder consumption scenario under common property (large farmer household).

The major change in the fodder consumption scenario is the increase in fodder availability from the common lands. The model predicts that the amount of fodder allocated to the large farmer households is cut and carried from the common lands. However, this scenario seems unlikely as the costs of labour may force them to abandon the difficult task of cutting and carrying the grass from the hills. It was observed from the survey that most of the large farmer households prefer to under feed the livestock rather than cutting and carrying the grass from the common lands. Some of them even consider it as below their status to cut and carry the grass from common lands although they may have no reservation in bringing headloads of fuelwood from the common lands.

9.1.2b Small farmer households under common property

The net income of the small farmer households increases substantially under common property from Rs.10775 to Rs.13034 over a period of twenty five years at current prices (1995-96) (Figure 9.16).

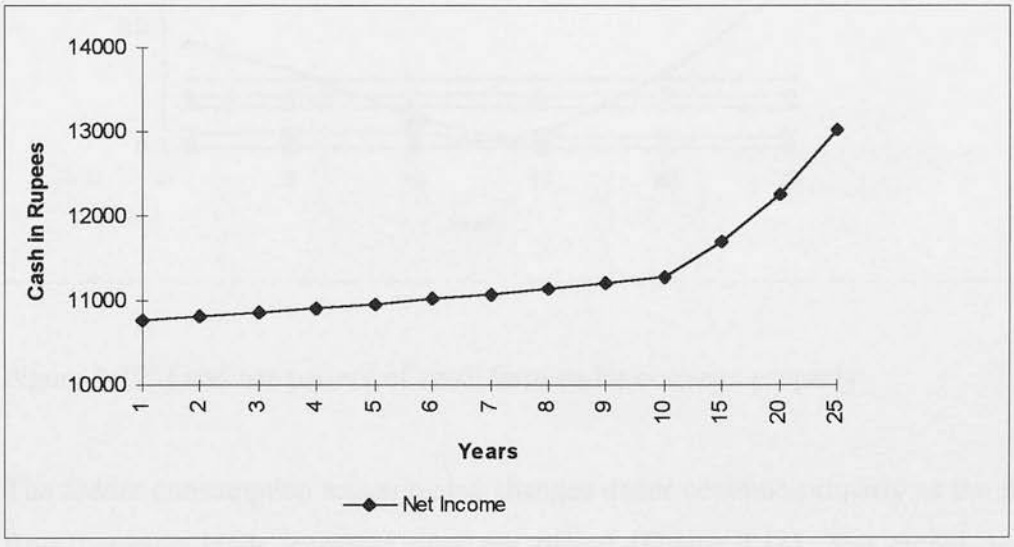

Figure 9.16: Small farmer household net income under common property

The land use pattern of the small farms also undergoes some change. As the fuelwood from the common lands keeps increasing, the area under mustard production declines from 0.18 ha to 0 ha in 15 years. The area under barley also declines marginally over the same period whilst the area under wheat increases from 0.91 ha to 1.1 ha (Figure 9.17).

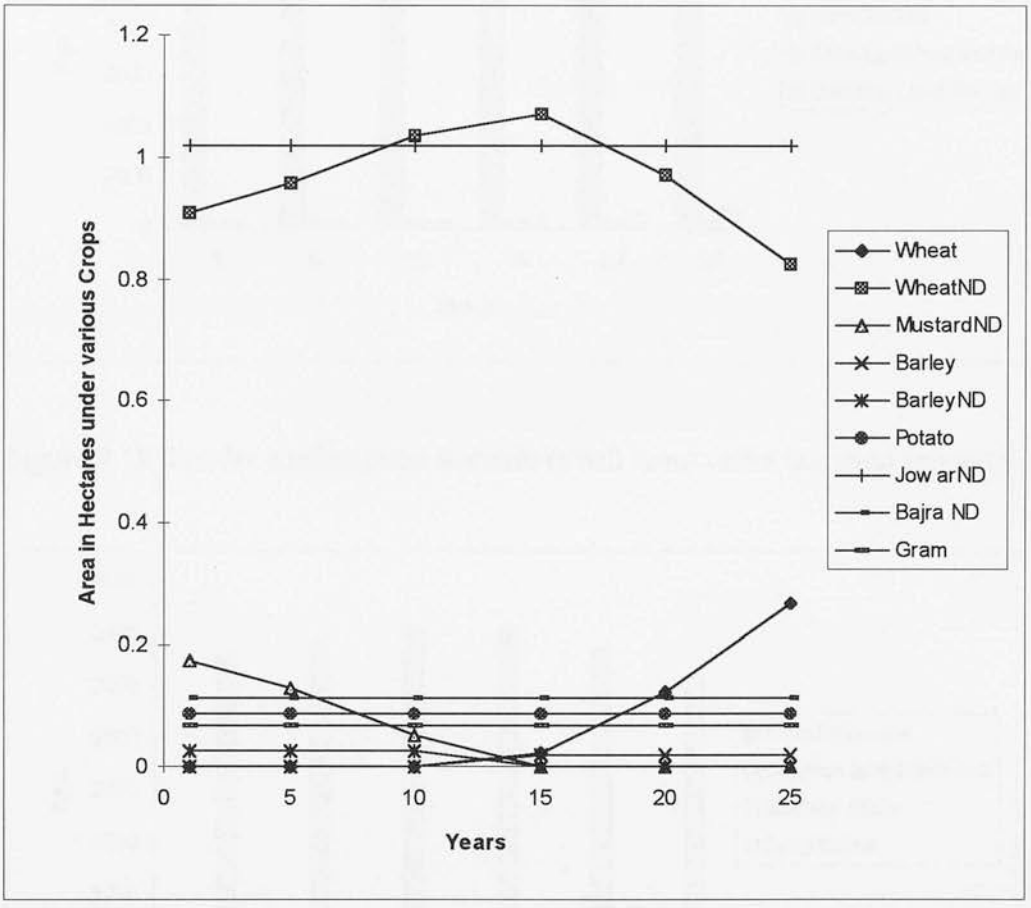

Figure 9.17: Land use pattern of small farm under common property

The fodder consumption scenario also changes under common property as the fodder from common lands increases over the period (Figure 9.18). The model predicts increased activity levels in the utilisation of Tropical Bovine Units (TBU) from 1.69 to 1.95 over the same period. This means that the present level of livestock numbers

kept by the small farmers is underfed and the optimal levels that can be sustained are far below the existing level of 2.4 TBU.

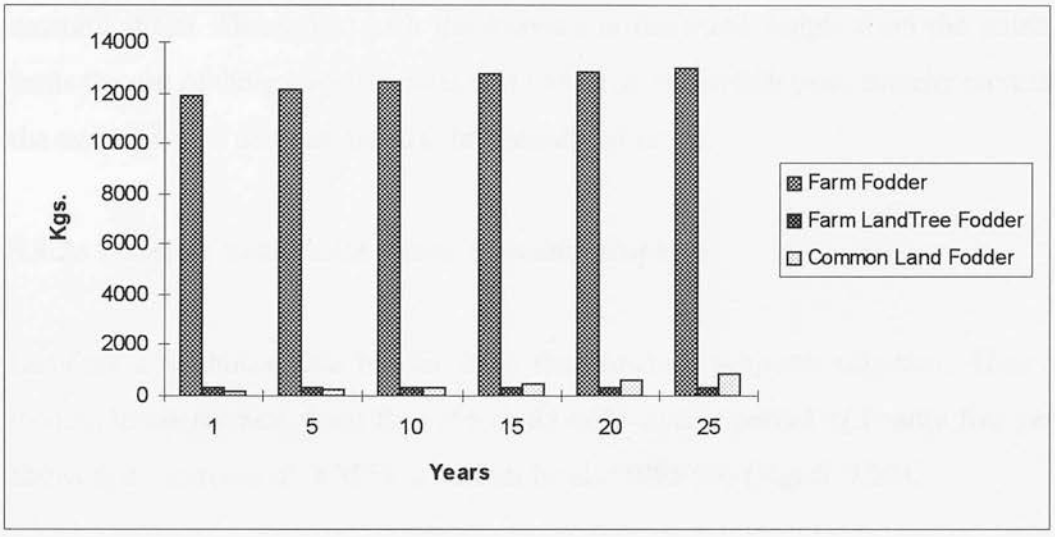

Figure 9.18: Fodder consumption scenario (small farm) under common property

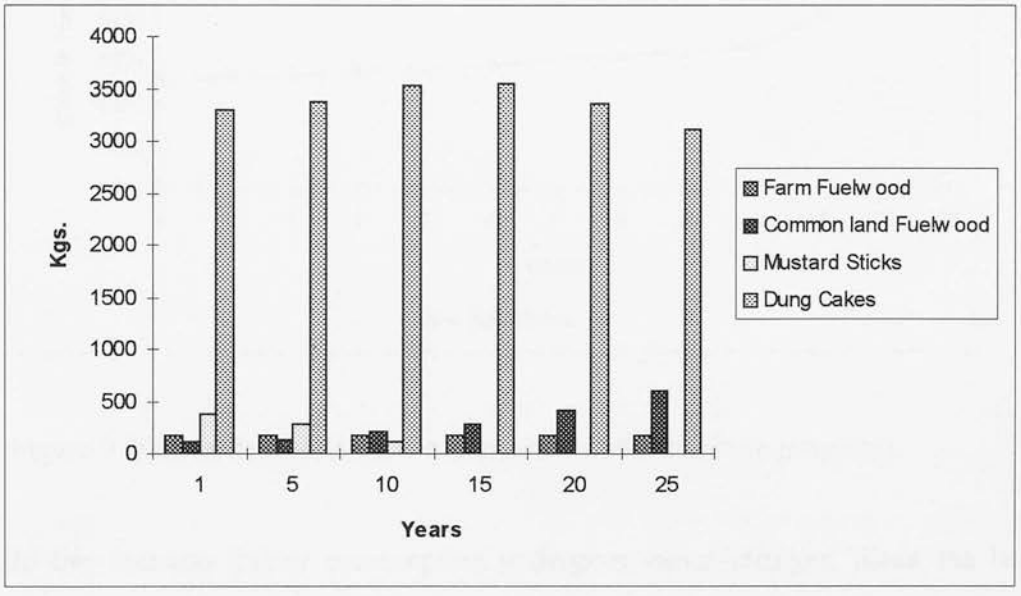

Figure 9.19: Fuel Consumption Scenario under Common Property (Small Farmer Household)

The fuel consumption scenario also changes with the increased availability of fuelwood from the common lands (Figure 9.19). From year 1 to 15 the use of dung cakes as fuel increases from 3304 kg to 3539 kg with the decline in the availability of mustard sticks. Thereafter, with the increase in fuelwood supply from the common lands the use of dung cakes declines to 3104 kg in twentyfifth year, thereby increasing the availability of dung as manure for agricultural crops.

9.1.2c Landless households under common property

Landless households also benefit from the common property situation. Their net income levels increase from Rs.4456 to Rs.4848 over a period of twenty five years, showing an increase of 8.79% at current levels (1995-96) (Figure 9.20).

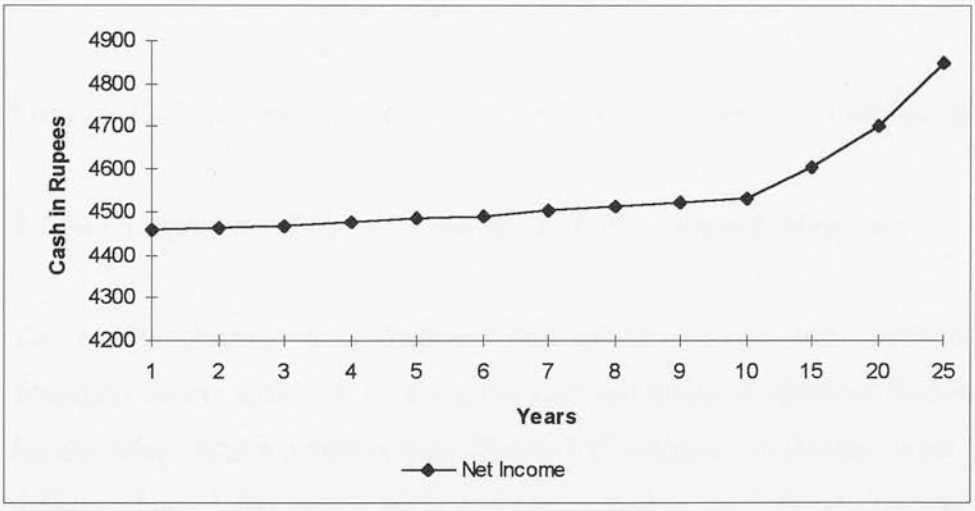

Figure 9.20: Landless household net income (under common property)

In this scenario fodder consumption undergoes minor changes. Since the landless households have to meet their fodder requirements only from two sources, namely, common lands and bought fodder. The increased availability of fodder over the period of time reduces the amount of fodder needed to be bought by the landless households.

The fuel consumption scenario also undergoes similar changes as the common property situation continues (Figure 9.21). The use of dung cakes remains the same for the entire period since they have no need to apply it for any agricultural crops.

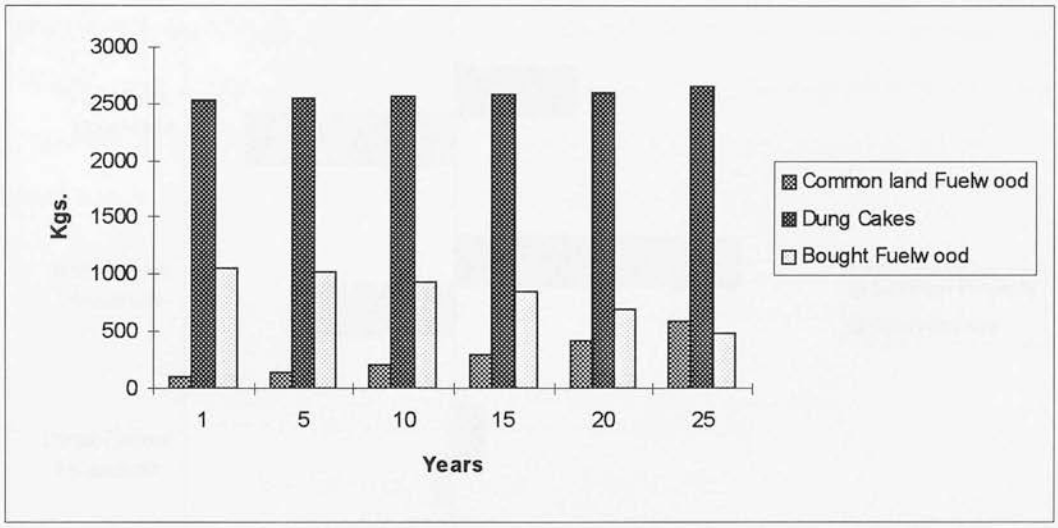

Figure 9.21: Fuel consumption scenario under common property (landless household)

9.1.2d Comparison of open-access and common property scenarios

The results obtained from different runs of open-access and common property situations clearly show that pursuing the common property option is the best solution for the village over a period of time. Figure 9.22 explains the changes in net income of different households under both common property as well as open-access. The changes in net income levels are less profound in large farmer households under both the scenarios in comparison to small farmer and landless households. The landless households suffer the most under open-access. They are predicted to experience a loss of 15.48% in their net income level over a period of 25 years from the current level (1995-96). The small farmer households gain considerably under common property due to the increased availability of fuelwood and fodder from the common lands, which results in an increase of 20.95% in their net incomes. Since 73.8 percent (324 out of 439) of the households belong to the small farmer type, this increase in

the net income level will bring substantial benefits to a majority of the households in the village, and thus, to the welfare of the village as a whole.

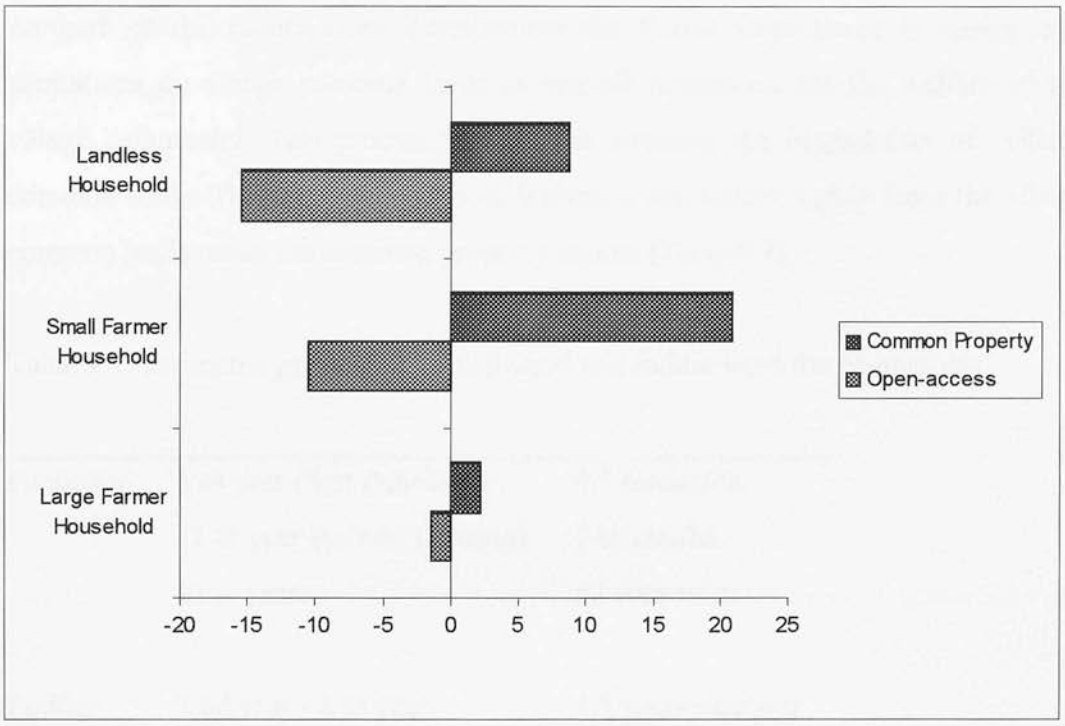

Figure 9.22: Changes in net income over twenty five years from the current level (1995-96) under different regimes (in percentage)

This comparison clearly indicates the importance of pursuing the common property regime by different types of land holding classes. If they co-operate, they stand to gain or else they stand to lose substantially if the open-access situation allowed to continue. It is in their mutual interest that they all pursue a regulated access management system towards their common property resources.

9.1.3 The likely scenario under common property if tree plantations are undertaken on village common lands

As part of the participatory development the Forest Department is raising tree plantations on village common lands as one-off investment for the welfare of the village community. This process is aimed at arresting the degradation of village common lands. This increases yields of fuelwood and fodder supply from the village common lands under the common property regime (Table 9.1).

Table 9.1: Estimated production of fuelwood and fodder from the plantations.

Fuelwood	6 th year (first thinning)	4.5 tonnes/ha.
	11 th year (second thinning)	7 tonnes/ha.
	21 st year	42 tonnes/ha.
Fodder	2 nd year - 6 th year	1.7 tonnes/ha/year
	7th year - 12 th year	3.6 tonnes/ha/year
	13 th year - 21 year	4.6 tonnes/ha/year

Source: Haryana Forest Department, 1989.

The model is run assuming that the common property situation would continue from the current year (1995-96), and that 5 ha of village common land is planted every year for 21 years on a 21 year rotation. That means, a total of 105 ha are afforested by planting trees out of a total of 232 ha of village common lands. These plantations continue to provide increased supplies from the common lands. These increases, resulting from thinnings and final harvest, are included in the model and the produceis assumed to be equally distributed amongst the households. The results from these model runs indicate a substantial increase in the net income of the village (Figure 9.23).

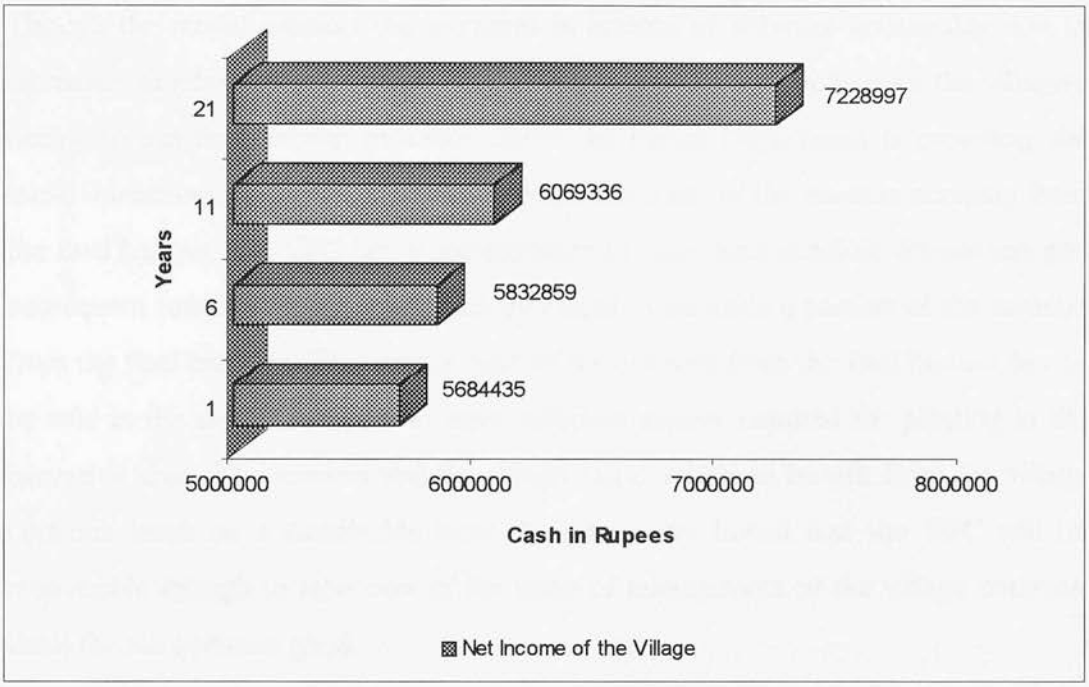

Figure 9.23: Net income of the village under common property if plantations are undertaken

Net income of the different households also goes up considerably over the period of time if plantations are raised and well protected (Figure 9.24).

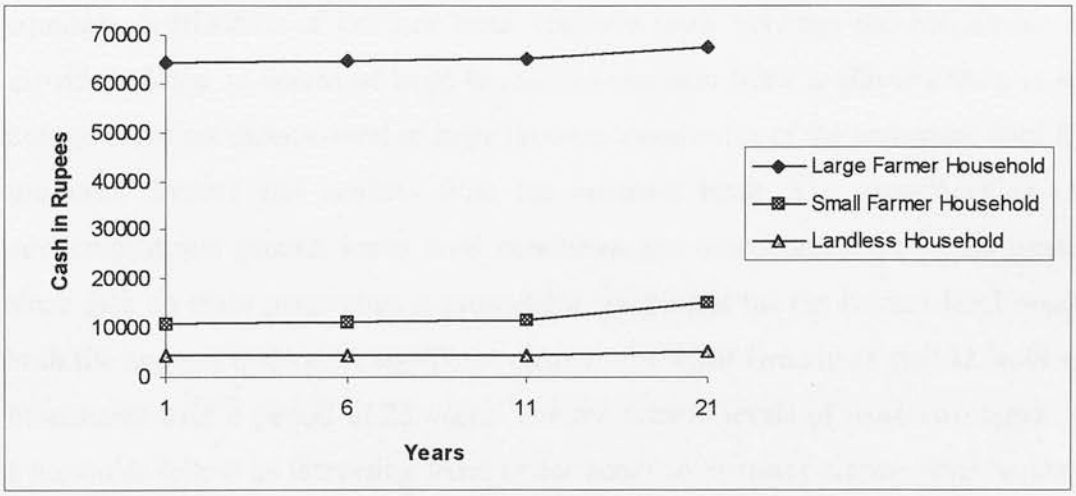

Figure 9.24: Net income of different Households under Common Property if Plantations are undertaken on Common lands

Though the model predicts the increases in income of different households due to increased supplies from the plantations, it remains to be seen as to how the villagers decide to use final harvest proceeds. Since the Forest Department is providing the initial investment, in plantations which do not share any of the revenue accruing from the final harvest, the VFC has a responsibility to raise plantations in the second and subsequent rotations. For this purpose they need to set aside a portion of the revenue from the final harvests. That means, part of the produce from the final harvest has to be sold in the market in order to have sufficient money required for planting in the harvested area. This ensures that the village can continue to benefit from the village common lands on a sustainable basis. It is therefore hoped that the VFC will be responsible enough to take care of the tasks of management of the village common lands for the common good.

9.1.4 The likely scenario under different regimes if access to common land products is restricted to only small farmers and landless households.

In order to forecast the likely scenario under different regimes (open-access and common property) access of large farmers to common lands is denied and only access of small farmers and landless is provided in the model. Under common property equitable distribution of produce from common lands between the households is provided. Since no access of large farmers to common lands is allowed there is no change in the net income level of large farmers, irrespective of the extraction level by the small farmers and landless from the common lands. The general effect on environment and ground water level conditions are unaccounted for in the model since data on these parameters is unavailable. In general the net income level under both the regimes undergoes significant changes for small farmers as well as landless households over a period of 25 years. The net income levels of these two types of households follow an increasing trend under common property regime whereas they follow a declining trend under an open-access situation (Figure 9.25 and 9.26).

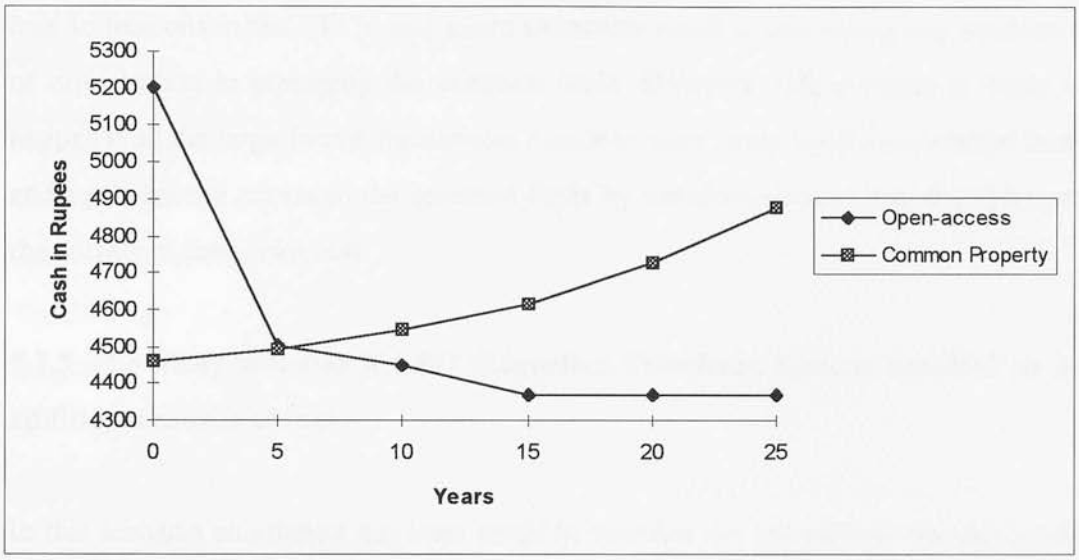

Figure 9.25: Landless household net income under different regimes (no access to large farmer households to common lands)

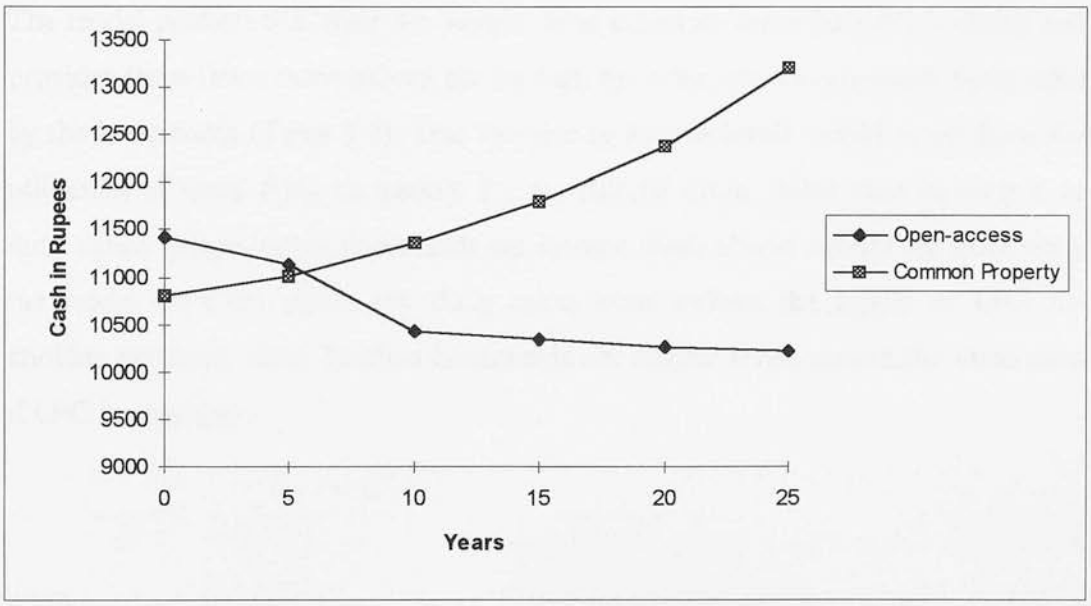

Figure 9.26: Small farmer household net income under different regimes (no access to large farmer households to common lands)

This scenario is unlikely to happen since no larger farmer household would like to be denied the benefit of access to the common lands. This sort of differential access will

lead to tensions in the VFC's and might ultimately result in destroying any semblance of organisation in managing the common lands. However, this scenario is likely to happen if all the large farmer households decide to keep away from the common lands and agree for the access to the common lands by the more disadvantaged sections of the society at their own cost.

9.1.5 The likely scenario if LPG (Liquefied Petroleum Gas) is supplied as an additional source of fuel

In this scenario an attempt has been made to visualise the net income changes at the current level if all the households in the village are allowed to buy an alternative source of fuel in the form of LPG. At present, LPG is supplied by the government at subsidised prices only in cities and big towns. If this supply is also made available to the villages then there would be substantial savings for the small farmer households. The model predicts that their net income level increases since the LPG is cheap and provides three times more energy per kg than the other sources currently being used by the households (Table 9.2). This increase in income levels would result from the utilisation of more dung as manure for agricultural crops rather than burning it as dung cakes. Large farmer households net income levels almost remain the same since the model does not utilise any dung cakes even without the supply of LPG for cooking purposes. Also, landless households net income levels remain the same even if LPG is provided.

Table 9.2: Net income changes of different households if LPG is supplied

Household Type	Current level (in Rupees)	Net income if unlimited LPG supply is allowed (in Rupees)
Large Farmer	65115	65550
Small Farmer	11420	13454
Landless	5173	5173

9.1.5a The likely scenario if no fuelwood is extracted from common lands and LPG is supplied as alternative source of fuel

Under this scenario the net income level of the village goes up from Rs.5973569 to Rs.6297321. The net income level of different households undergoes significant changes if no fuelwood extraction is allowed from the village common lands. When LPG is provided as an alternative source of fuel, the results indicate that the landless households, who are critically dependent on fuelwood from the common lands have to spend more money for buying LPG/fuelwood, and as a result, suffer a reduction in their net income levels. On the other hand, the small farmers gain since they need not divert dung for dung cakes and can meet their energy requirements from LPG. The increase in dung availability as manure also again increases their agricultural production, which in turn increases their income levels (Table 9.3).

Table 9.3: Net income changes if no fuelwood extraction is permitted

Household Type	Current level (in Rupees)	Net income if LPG supply is allowed and no fuelwood extraction is permitted from the common lands (in Rupees)
Large Farmer	65115	65174
Small Farmer	11420	12935
Landless	5173	3232

9.1.5b The likely scenario if no fuelwood is extracted from common lands, LPG is supplied as alternative source of fuel and fodder extraction by only landless households is permitted.

The model was run under this scenario to see how the net income levels change for different households. LPG availability was ensured for all the households as an alternative source of fuel. No extraction of fuelwood from the common lands was allowed but fodder was allowed to be collected only by the landless households. The model predicted that if there was no fodder available to buy from the market then the income levels significantly changed for the landless households (Table 9.4). The optimum levels of the TBU's that can be kept by the landless comes down to 0.34 TBU. In this scenario, both large and small farmers tend to produce more crops that would provide sufficient fodder for their livestock, such as sorghum and bajra. At the same time since the labour requirements are less for these crops the overall employment available for landless households comes down. This resulting unemployment and the lessened income from the sale of livestock products on account of use of only 0.34 TBU as against 2.6 TBU by the landless households considerably reduces their net income to only Rs.540.

However, due to the increased availability of dung for application as manure on account of availability of LPG, the large and small farmer households are able to maintain their net income levels even though there is shift in the crop production pattern. The small farmer households net income level goes up slightly.

Table 9.4: Net income changes if no fuelwood extraction is permitted and fodder extraction is restricted to only landless households.

Household Type	Current level (in Rupees)	Net income if LPG supply is allowed and no fuelwood extraction is permitted from the common lands and fodder extraction is permitted by landless only (in Rupees)
Large Farmer	65115	64699
Small Farmer	11420	12736
Landless	5173	540

9.1.5c The likely scenario if no fuelwood and fodder is extracted from common lands and LPG is supplied as alternative source of fuel.

The model was run under this scenario to see how this sort of situation can be overcome by different households with no fuelwood and fodder extraction from the common lands and with non availability of fodder to buy from the market. However, in this case, no feasible solution could be found by the model since landless households are critically dependent upon the supplies from the common lands. Paying for their cooking fuel as well as being unable to feed the livestock and the reduced employment levels, drive them to a situation of starvation. The model is built to satisfy particular energy requirements of the households and since these energy requirements were not fulfilled (in the absence of money to pay for food and LPG by the landless households) the model cannot solve and provided an infeasible solution.

Although such a situation is unlikely to happen, it provides enough indications as to what would be the likely result under such a scenario.

9.1.6 The likely scenario under a dynamic situation under both open-access and common property

To examine the likely effect of increasing population numbers of both human and livestock, the model was run over a period of twenty five years. Increases in population numbers of humans was provided progressively at the current annual growth rate of 1.8% per annum (source: Census of India, 1991). Livestock numbers were also increased progressively at 3.4%, based upon the annual growth in livestock population for southern Haryana (Source: Livestock census, 1987).

Instead of splitting and increasing the number of households it was assumed that the number of households would remain the same with only number of members increasing in each household. This assumption is in line with the current joint family system prevalent in the case study area. A condition was imposed that the entire household needs (such as food energy and fuel energy requirements) are fully satisfied by all the households. This model was run under both open-access and common property situations. The changes in the net income of the village are profound under both these scenarios (Figure 9.27). After the tenth year with the continuing increase in the population numbers of both human and livestock, the situation gets in to a difficult position. From year 10 onwards there will be a continuous decline in the net income levels under the common property situation. The model does not run beyond ten years under open-access as it creates infeasible solutions since the entry of one or more persons into the landless households does not satisfy the minimum prescribed food energy requirements. The same is the case with common property situation after 15 years. Hence, results are presented only until 15 years for common property and 10 years for open-access situations.

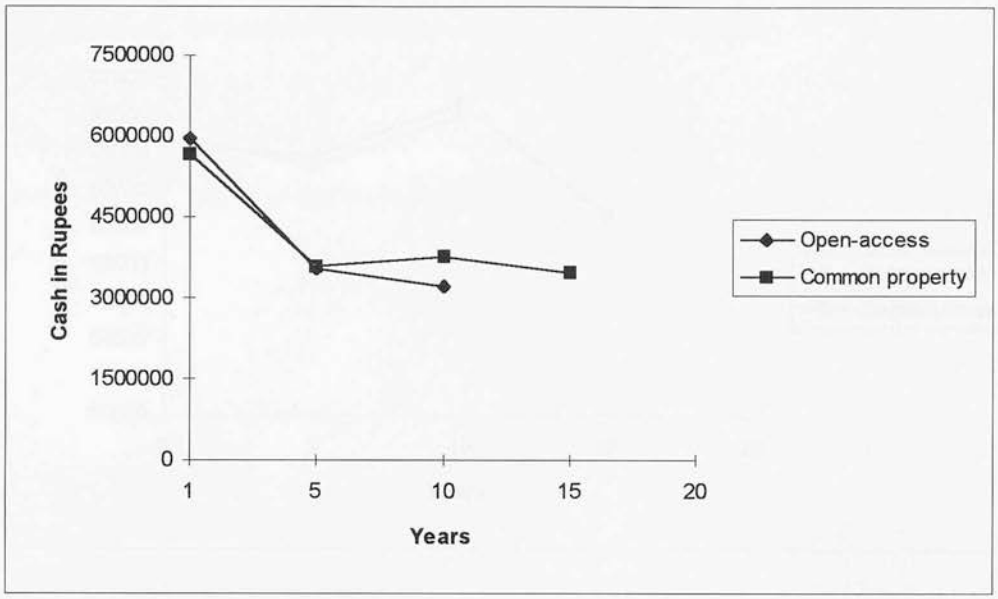

Figure 9.27: Village net income changes under dynamic situation

This situation clearly explains that if population growth is not controlled urgently it would lead to chaos and ultimately results in a general increase in poverty and environmental collapse irrespective of whether open-access or common property is pursued. The results of both these scenarios are presented and discussed for different types of households.

9.1.6a Large farmer households under dynamic situation

Large farmer households can accommodate the increase of more members in to their households. Since they own large farms they can even accommodate an increase in livestock numbers. Figure 9.28 shows how net income levels were predicted to change over the period for large farms.

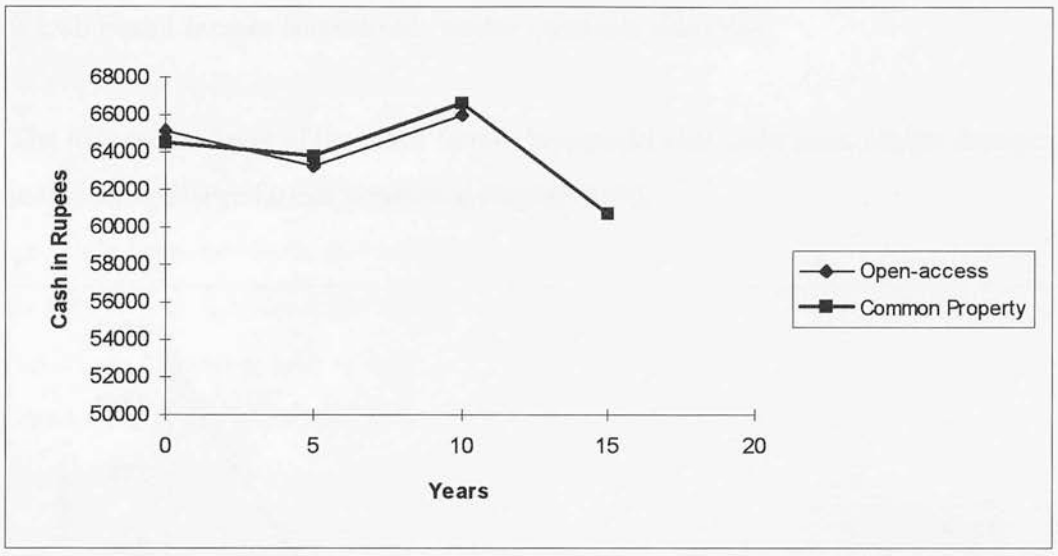

Figure 9.28: Net income of large farmer household under dynamic situation

Under both open-access as well as common property the net income levels decrease from year 1 to year 5 on account of increases in population numbers and the need to feed both human as well as increased livestock populations. From year 5 onwards the net income level increases under both the scenarios. Even though there is an increase in human population putting a drain on the net income level of the households this is more than offset by the increased livestock numbers to which there is sufficient fodder. As the milk production level increases on account of this increase in livestock from 2.6 TBU to 3.6 TBU revenue increases. The increased number of TBU's also raises dung production and application of more dung to agricultural crops increases the production levels. This in turn increases the revenue of the household. The scenario is the same for the open-access and common property situations, with a slight increase in income in the common property scenario on account of an increasing availability of fodder and fuelwood from the common lands. Beyond year 10, as number of persons increases in the household the net income level starts decreasing, even under common property situation, as the marginal productivity of livestock no longer sustains food demands.

9.1.6b Small farmer households under dynamic situation

The net income level of the small farmer household also undergoes similar changes as in the case of large farmer household (Figure 9.29).

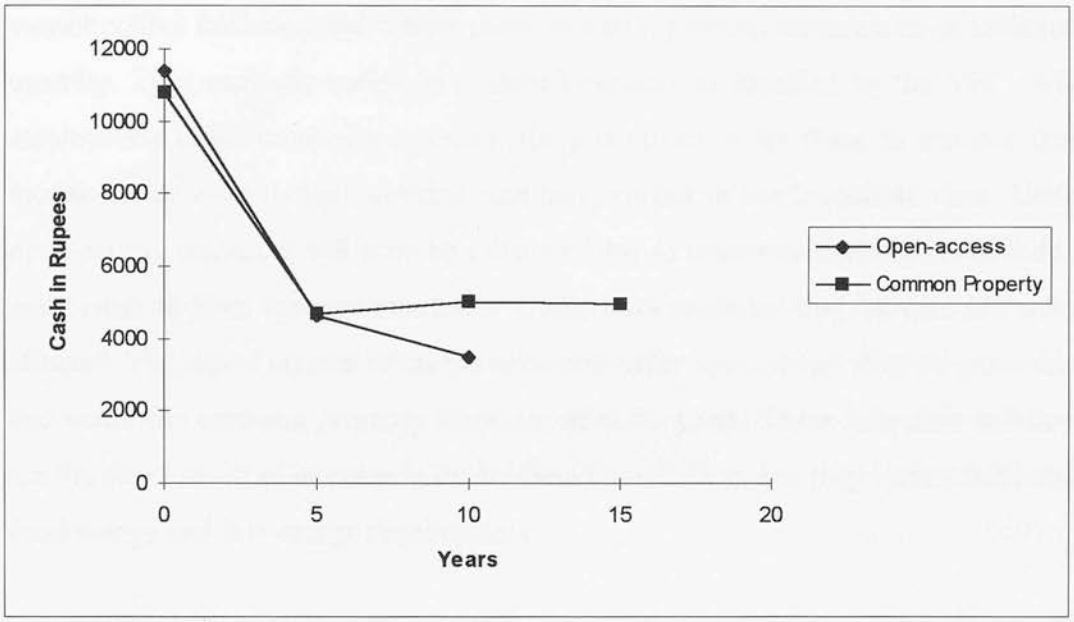

Figure 9.29: Net income changes of small farmer household under dynamic situation

Under the open-access situation the net income level declines gradually from Rs.11420 to Rs.3466 in 10 years with the increasing human and livestock numbers. Increase in livestock numbers does not create any increase in the net income levels as in the case of large farmers since their livestock is already under fed and there is no more scope to increase the availability of fodder from the farm land. The net income level under common property also decreases in the first five years on account of restrictions in removal of fodder and fuelwood from the common lands, but registers an increase in the net income level marginally up from Rs.4678 to Rs.5036. This increase is attributable to the increased supplies from common lands. The income level declines marginally under common property from Rs.5036 in the tenth year to Rs.4936.

9.1.6c Landless households under dynamic situation

Landless households are the worst affected if any increase in the number of members in the household takes place (Figure 9.30). With access regulations in force they cannot collect fuelwood and fodder under common property situation in an unlimited quantity. They can only collect in a limited quantity as specified by the VFC. With employment levels remaining constant, there is no scope for them to increase their income levels even though working members number in the household rises. Under open-access, resources will soon be exhausted due to excessive exploitation of fodder and fuelwood from the common lands. Under both scenarios they become the worst affected. The model creates infeasible solutions under open-access after 10 years time and under the common property situation, after 15 years. These infeasible solutions are the direct result of increase in the landless household size as they cannot fulfil their food energy and fuel energy requirements.

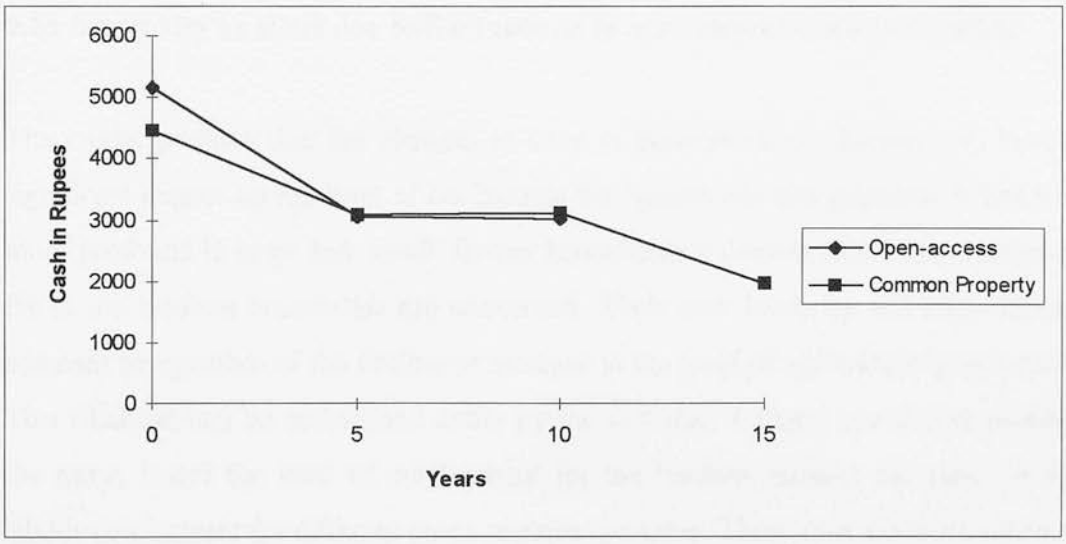

Figure 9.30: Net income levels of landless households under dynamic situation

It can be safely concluded that under such a dynamic situation, people will be better of if they control the population and adopt a common property regime in place of an

open-acces regime. This situation might change with the falling population growth level with the spread of better education and awareness about limiting the family size and the increasing adoption of family planning methods. In the coming years population growth will definitely come down as it has been the case in the last two decades. The key to the success of the common property regime and people's participation in participatory development will depend upon the extent to which population growth can be reduced.

9.2 Sensitivity analysis of the model

An attempt has been made to understand as to how stable the model will be if either the yield levels of agricultural crops increase or decrease over the current level by 20% and the prices of agricultural products and labour increase by 20%. Decreases in prices could not be anticipated since normally such a thing never takes place and the prices in the past fifty years have always shown an upward trend (Dantwala, 1996).

9.2a Sensitivity analysis due to fluctuations in agricultural crops yield levels

The model predicts that the changes in level of agricultural production can have a significant impact on the level of net income the households can generate. While it is more profound in large and small farmer households it does not have any change as far as the landless households are concerned. Their cash levels by and large remain constant irrespective of the decline or increase in the level of agricultural production. This situation can be understood easily by the fact that the land use almost remains the same, hence the level of employment for the landless remains the same as the labour requirement for different crops remains the same. These runs are undertaken at the current level of extraction of fodder and fuelwood from the village common lands. Increase in agricultural production is anticipated at 20% on account of better monsoon and other favourable conditions. Similarly a decline of 20% in agricultural production level is anticipated if there is a drought or flood. The model remains fairly stable under these changing scenarios (Figure 9.31).

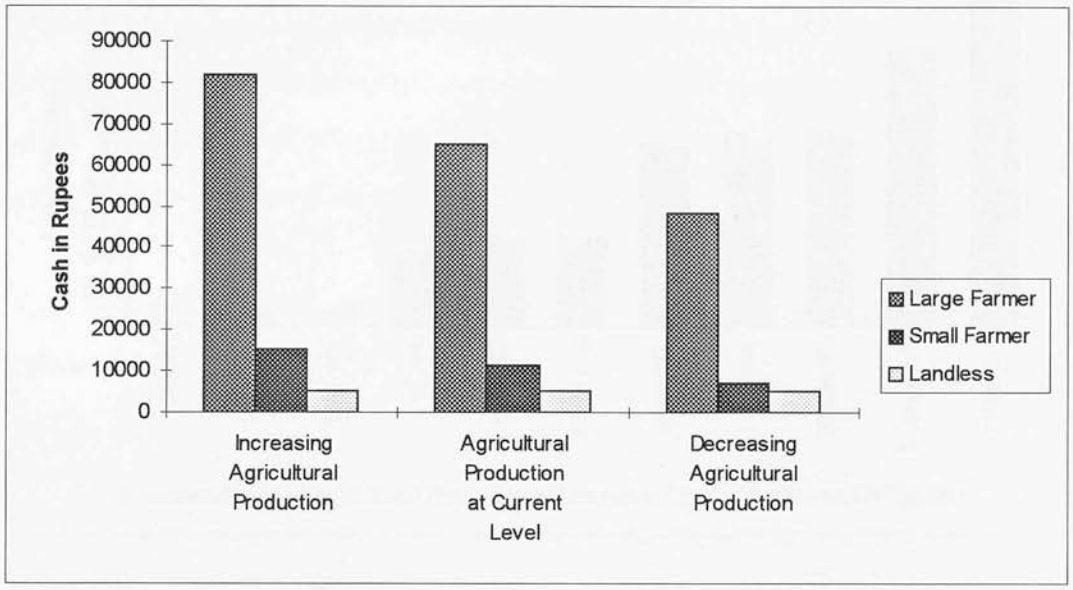

Figure 9.31: Sensitivity to different agricultural yield levels (net income at the household level)

The landuse pattern does not undergo any significant variation whether the production levels of agricultural crops change by 20% either way. The model is therefore fairly stable in its' projections in both the scenarios and does not predict any significant changes in the landuse pattern as far as Large Farms are concerned (Figure 9.32).

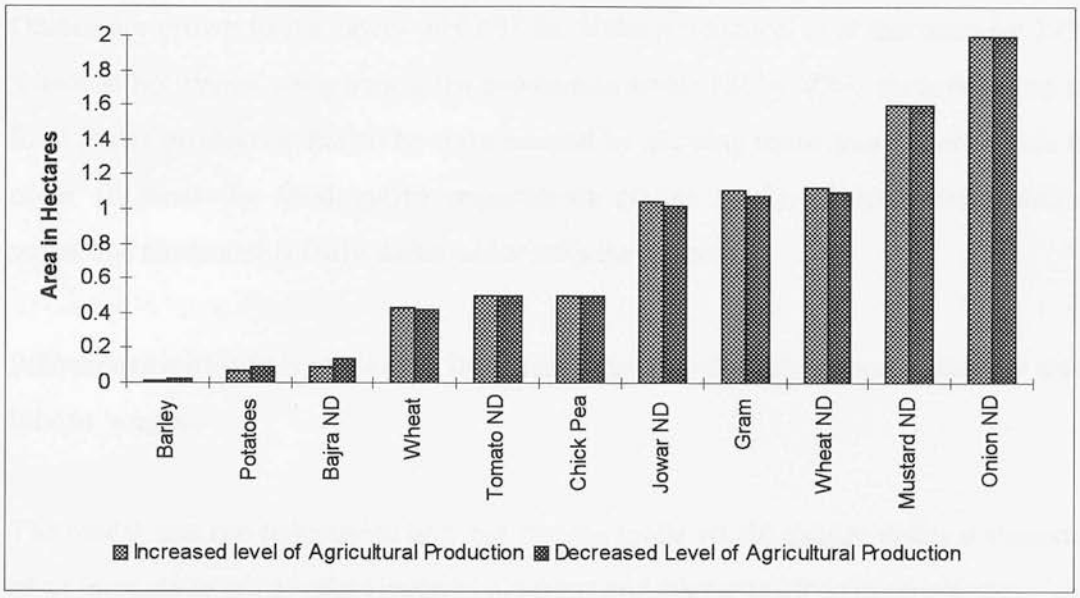

Figure 9.32: Land use pattern of large farm

The model does, however, predict some change in to landuse as far as Small Farms are concerned (Figure 9.33).

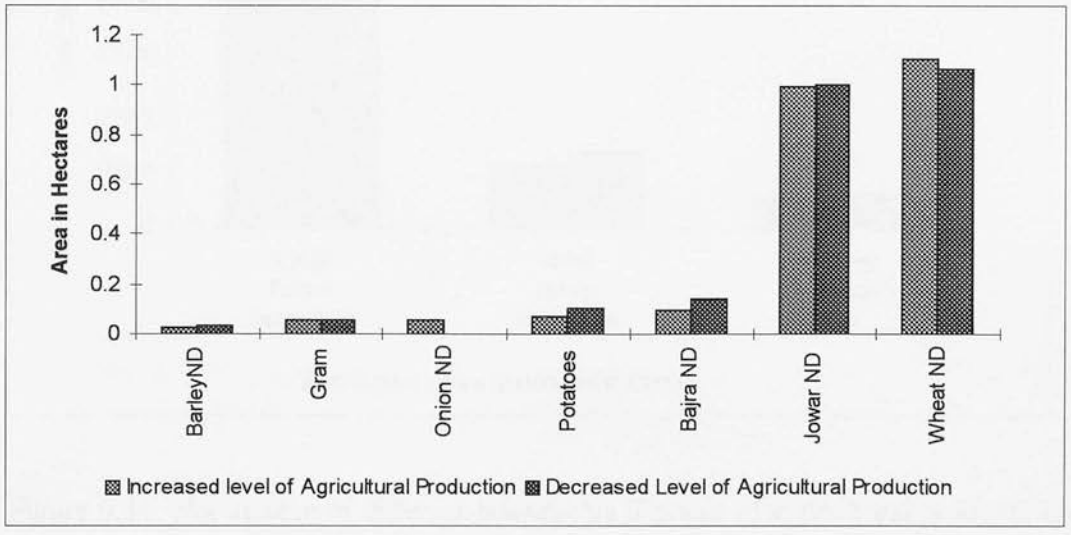

Figure 9.33: Land Use Pattern of Small Farm

Onions are grown to the extent of 0.057 ha. if the production level increases by 20% where as no onions are grown if the production levels fall by 20%, since the drop in food grains production has to be compensated by allotting more area under cereals in order to meet the food grains requirement of the family. Despite these minor variations the model is fairly stable under both the scenarios.

9.2b Sensitivity analysis due to increase in prices of agricultural products and labour wages.

The model was run to examine how net income levels would change under a scenario of an increase in prices of agricultural products and labour at 20% (Figure 9.34).

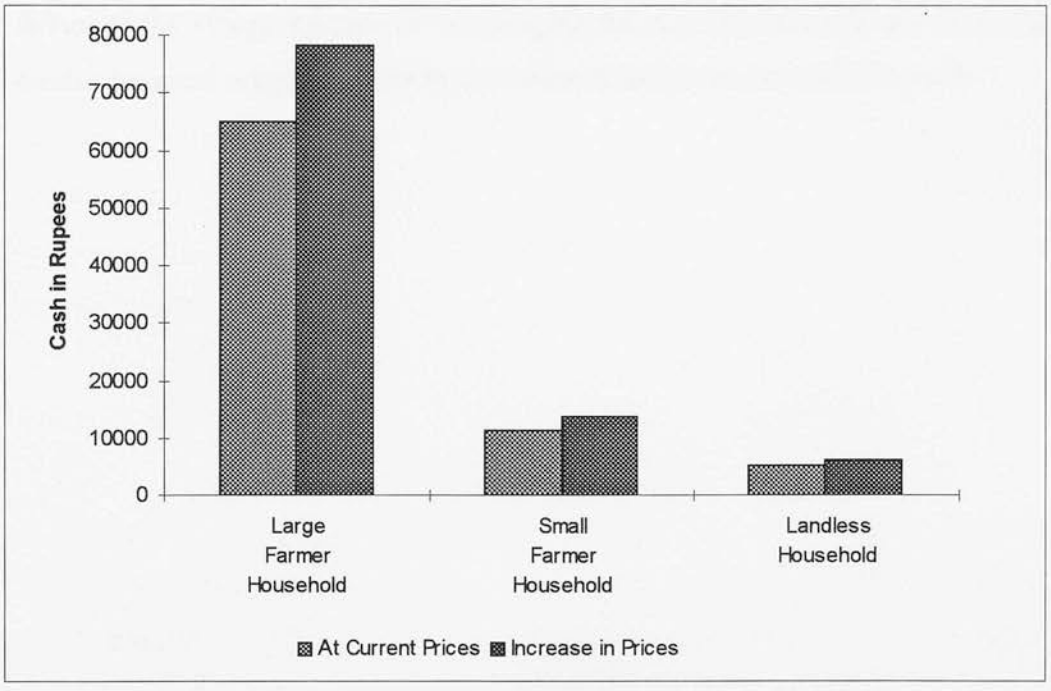

Figure 9.34: Net income of different households if prices of agricultural products and labour increase by 20% over the current level

The model is fairly stable to price changes and corresponding increases in the incomes can be seen if the products they produce can fetch them more money. At the same

time landless households also substantially benefit from the increase in labour prices. It can be safely anticipated that the prices of agricultural products keep increasing every year as a result of increase in support prices by the government from time to time. Similarly the labour wages also go up periodically and are dictated by the minimum support price announced by the government from time to time under the provisions of the Minimum Wage Act. These increases in labour wages are due to the increase in inflation level.

9.3 Summary

In this chapter the scoping studies results are presented and discussed. The application of model under different scenarios enabled the analysis of success and failure of the village institutions in managing the common lands. In the next chapter conclusions and suggestions for future research are presented and discussed.

Chapter X

Conclusions

10.1 Conclusions and implications of the study findings

The participatory development process currently being undertaken in the southern region of Haryana state, India has been critically analysed in this study. The scoping studies undertaken to forecast the likely scenarios under open-access and common property were presented. The study illustrated the importance of historical, legal and political factors determining the outcomes under open-access and common property regimes. A single objective linear programming model incorporating multiple objectives as associated constraints was used in conducting scoping studies. This model incorporated the household dynamics of different land holding classes, their interactions with the private property resources as well as common property resources. Reflecting the entire village community in a single model, facilitated analysis of the situation. The socio-economic survey undertaken in 1995-96 used to derive the coefficients used in the model.

The work confirms the hypotheses that:

(i) it is possible to define specific circumstances wherein the common property protects the natural resource base effectively;
(ii) there exists a level of complimentarity between common property resources and private property resources in the case study area;
(iii) that socio-economic and cultural factors favour converting open-access regimes to common property rather than to private property.

The historical perspective explained how traditional management of common property resources was taken away from the village communities, and after the dismal failure of the state management communities are being encouraged to take over the

management of their natural resources. Further, factors responsible for the degradation of common property resources were identified and the legal aspects affecting the CPR management were explored by analysing various acts.

The theoretical aspects such as Garett Hardin's tragedy of commons, the game theoretic models and the logic of collective action that define the ways of viewing the commons problems were presented. Certain aspects relating to the CPR management were clarified. The conclusions reached from the literature formed the basis of understanding the theoretical issues concerning the institutional building and the issues essential for the establishment of the community regulated access management system in place of an open-access situation. The perils of open-access and the prospect of a proper CPR management were explained.

People's participation level was quantified. Success index of the plantations was developed, and a comprehensive Resource Condition Index was developed in order to analyse the effectiveness of the institutions.

The survey results demonstrated that various aspects such as social, economic and cultural factors were crucial for the establishment of common property institutions. The results show that the empowerment of village institutions was essential for managing their common property resources. Provision of technical and financial support from the government and its role as 'enabler' rather than 'doer' is important in the context of participatory development process. The key factor in the Aravallis has been the institutional development at the village level for managing the common property resources and the involvement of all the sections of the society in evolving the commonly agreed restrictions/rules and their enforcement at the village level.

The regression analysis indicated that the participation of people was important but probably not enough on its own. The statistical evidence showed that there was a strong positive relationship between the proportion of resources committed to and the success of maintaining common property resources. Without effective 'Policing' of the

common lands through the commitment of resources, participation itself is unlikely to guarantee successful maintenance of common property resources.

The development of a single objective Linear Programming model was useful in incorporating the household dynamics and their interactions with the private property resources as well as the common property resources.

The main advantages of the LP formulation included the generation of many management alternatives that may aid conflict resolution in the VFC's with regard to efficient management of common property resources of the village, evaluation of management strategies and forecasting likely scenarios under open-access and common property regimes.

The major conclusions that emerged from the scoping studies were:

a. Pursuing open-access was untenable. All the households would be negatively affected. Large farmers would be least affected, whereas the small farmers and landless households would suffer significantly. Landless households would suffer a reduction in their net income by over 15%.

b. Under a common property regime the natural resource base would be protected and would continue to benefit the large farmers, small farmers and the landless households in a significant way. Under this scenario small farmer households gain the most. Their income levels increase by 21% over a period of 25 years. The scoping studies under open-access and common property scenarios indicate that the entire village would gain if all the people co-operate, and would lose substantially if the open-access situation was allowed to continue. It is in their mutual interest that they all pursue a regulated access management system towards their common property resources.

c. If tree plantations were undertaken on common lands under common property situation the net income of different households increase considerably over a period of time if plantations are raised and well protected.

d. The scoping studies undertaken by restricting fuelwood extraction or fodder extraction from the common lands by certain classes of households suggest it was unlikely that such a scenario might arise as no one would like to have differential access to the common lands.

e. Introduction of an alternative fuel source, like LPG, was found to be significant as this would change the landuse patterns and substantially raise the net incomes of the individual households.

f. The likely scenarios under open-access and common property with unrestricted population growth suggest that if population growth (human and livestock) were not controlled quickly it would lead to chaos and ultimately result in a general increase in poverty and environmental collapse irrespective of whether open-access or common property were pursued. It can safely be concluded that people will be better off if they control the population and adopt to common property regime in place of an open-access regime.

Rehabilitation of village common lands in Haryana is a unique experiment which has no parallels in the participatory development in India. The Joint Forest Management (JFM) programmes currently being undertaken in various states of India is on government owned forest lands. The JFM is a response to the policy initiatives prescribed in the National Forest Policy of 1988 whereby people living in and around the reserved forests and protected forests owned by the government offer protection to the forests in return for a share in the usufructs. The National Forest Policy 1988 states that;

"the life of tribals and other poor living within and near forests revolves around the forests. The rights and concessions enjoyed by them should be fully protected. Their domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the first charge on forest produce."

One of the basic objectives governing the new National Forest Policy was to create a massive people's movement to minimise pressure on existing forests. In order to implement the policy prescriptions the Ministry of Environment and forests, Government of India issued a set of guidelines on June 1, 1990 concerning the involvement of village communities and voluntary agencies in the protection and development of degraded forest areas on the basis of their taking a share of the usufruct from the areas they agree to protect and develop. These guidelines formalised the concept of Joint Forest Management and provided an operational framework for involvement of people in the management of degraded government owned forest areas. So far, 14 state governments have issued notifications providing for collaborative relationship with local communities under these JFM guidelines (SPWD, 1993). The slow expansion of the JFM may be explained to the fact that most of the states issued notifications only recently. Despite this slow coverage till now, the JFM movement has brought a revolutionary change in the forestry sector. All the state governments in India treat the issue of people's participation in forestry sector as a strategy for protection of degraded forest areas with the co-operation of local communities. Accordingly all the state governments' notifications keep the control over management of JFM areas with themselves and solicit the participation of village communities only in protection of forest areas in lieu of usufructory benefits. It is, therefore, not surprising that more emphasis is being accorded to creation of village protection committees and seeking their co-operation in protection of such areas. However, it would be too simplistic and perhaps harmful in the long run to regard the issue of people's participation as a mere strategy for protection of degraded forest areas. These areas were degraded over a period of time, because local communities continued to draw bio-mass for their requirements from these areas irrespective of whether the state governments accorded them usufructory rights or

not. Lack of involvement of local communities in management proved to be a disincentive and these areas in practice became open-access areas. In order to be more effective the JFM programme has to progressively increase the participation of local communities in management of forest areas near habitations and empower and equip them to manage such areas on a sustainable basis with the government agencies playing a role of facilitator rather than controller. The fundamental questions, like who controls and manages natural resources and for whose benefit these resources are going to be managed, are the important issues of the JFM which need to be explicitly stated.

JFM can be successful only if common property resources of the villages such as village common lands are protected and regenerated. The rural economy still being agrarian in character and a large amount of rural energy needs are met through the drawl of bio-mass from forest areas and common property resources in the form of fuelwood, fodder and non-timber forest produce. However, over the last few decades CPR's have shrunk in area and their productivity has also reduced substantially, which in turn has led to increased subsistence pressure on the forest areas (Jodha, 1992).

The case study presented in this work shows a way towards the participatory development of common property resources. The common property resources contribution to the village economy and the importance of their development did not find any encouragement from the government so far. The pressure on forests can be considerably eased if people can meet their fuelwood and fodder requirements from their CPR's.

Unlike Sal forests of West Bengal most of the JFM areas in India are in a degraded condition and may not be ready for final harvest in the next 15 years. Even if these areas are felled, the returns may be too poor to satisfy the aspirations of village communities (Sharma, 1994). The major conclusion emerging out of the present research is that government is working as a facilitator in the institutional development

as an 'enabler' rather than 'doer' in developing the common property resources. 'Policing' the common lands is also equally important in order to effectively restrict the intentions of the free riders acting with self interest.

Creation of forest user groups and handing over of the national forest to communities is being attempted in Nepal in the last two decades (Hobley, 1996). The creation of a category of forest owned, utilised and protected by local communities has now been recognised as being the only realistic means of halting the slow degradation of forests in the middle hills of Nepal. This process need not be repeated in India. Community forests were nationalised in Nepal in 1957 where as, community forests were restored to village communities in the form of panchayath lands in India after independence in 1947 (Pradhan, 1995). The present case study shows the way Haryana villages can develop the CPR's for their welfare. The results of the research show the importance of the creation and development of a village level organisation which can deal effectively with the development and management of the common property resources.

10.2 Limitations of the present study

Due to paucity of funds and time limits the survey sample could not be more than 5 percent of the households in the surveyed villages. A larger sample size may have increased the statistical significance of the results.

The weighting process adopted in calculating people's participation level was highly subjective matter and for this reason may be open to criticism. Despite this potential weakness the study did quantify the participation. The resource condition index developed could also be criticised and other parameters could be included within it in order to make it more meaningful. However, the development of the resource condition index as a uniform measure was crucial to analysing the effectiveness of village institutions.

The model was also weak in some aspects. For example, the paucity of specific data relating to the case study area made estimation of model coefficients difficult. Most of the data for deriving the coefficients was taken from the survey. Detailed specific data relating to current landuse was surprisingly scarce. In addition, other disadvantages of LP include: (i) it may be difficult to decide which of the several objectives are fulfilled in different strategies when so many management alternatives are presented to the decision maker, (ii) the technique is not truly multi-objective but rather single objective with associated constraints, (iii) there are situations when some of the activities may take a zero or a very high level. This problem can be overcome by assigning lower and upper bounds to the objectives to be maximised or minimised. The main limitations of an LP model are divisibility of variables, linearity of constraints, additivity, and non-negativity of activities (Pannell, 1997). However, Dent, et al (1986) observed that, "the limitations imposed by the assumptions of linear programming are more perceived than real; given sufficient time and ingenuity it is possible to achieve a high degree of realism in representing a complex situation."

Despite these limitations and weaknesses, LP proved to be a useful tool in representing a complex system in a single matrix. Unlike humans, an LP model is free to consider all strategies without preconceptions or prejudices. The LP model allows the modeller to put technical and biological information into an economic context and to quantify the economic, technical, and biological trade-offs in the system (Pannell, 1997). Often the amount of information available about a system may be so complex that managers may not be able to make coherent management decisions. The LP model fills this need well for large problems and is a valuable tool for developing an understanding of the subtleties and interactions of a complex management system (Pannell, 1997).

In this study, model validation/verification relies on the logical framework with which the model was built. Most of the data was either collected during field survey or taken from the published sources. Model validation was done based on the construct method. Validation by construct means the validity of the model is assumed based on

its logical construction. In the absence of recorded data the validation could not be possible. Ideally speaking each of the coefficient values in the matrix should be validated individually. But in reality, this was not entirely possible in the absence of recorded data on many of the coefficients.

Most of the data were judged to be reliable as they were based on either records or observation or estimates and experience of the households participated in the area. Village landuse patterns and crop production parameters were not available. The data regarding the activities on common lands were obtained from the Forest Department records. Specific data was not available in respect of demand for various products. The survey results provided the much needed information in specifying the coefficients. Due to the limitations in the availability of the recorded data the model is assumed to be valid by the experience and knowledge of the researcher concerning the area.

Despite these limitations the model is a useful tool for analysing the different scenarios of CPR management. This is also a novel application of mathematical modelling which has not previously been applied to study the effect of participation in CPR management and to the outcomes of open-access and common property. These outcomes are extremely useful in understanding the institutional success in management of common property resources. No single optimal solution to the problem exists. Under different scenarios the model generates a different set of outcomes and each scenario has to be judged from its usefulness from the management point of view. The model developed can be used to judge the institutional success or failure in managing the common property resources.

10.3 Suggestions for further research

There is a need to explore further possible management options based on different level of inputs on the common land and the farm lands. More data collected on the basis of field experimentation and work studies would have made the model more

useful. For example, plantation species in different combinations and different agroforestry techniques to augment the fuel and fodder resource supplies from the farm lands would have given a wide range of potential options to choose from. Only through the multidisciplinary team work can problems of resource management be solved.

Any such follow up work should involve a multi-disciplinary team comprising experts from various fields of rural development. This team should be as broad based as possible, but it should, at least include a forester, a sociologist, a political scientist, a soil scientist, an agronomist, an economist, a farmer and a modeller in order to make this model a more meaningful tool for testing the efficacy of different options available to them.

The development of a success index, a resource condition index and a people's participation level are definitely steps forward and there is scope for their further improvement. It is also the first time that the concept of modelling has been applied to test the effectiveness of the institutions under open-access and common property. Despite the limitations presented in section 10.2 the modelling can be made more elaborate to accommodate further activities in order to make the model reflect every activity of the households.

Thus far the research work in common property resource management has been done in isolation. The political scientists looked at the commons problem from the institutions point of view. The social scientists looked at the problem from the social point of view (Ostrom, 1990). The economists looked at the problems from a theoretical basis rather than empirical basis. Similarly, the literature is full with econometric models and game theoretical models which do not explore the empirical applications to the real world problems (Jodha, 1992). This research work fills the gap in integrating theoretical concepts in to a modelling framework and testing the effectiveness of the open-access and common property regimes.

Bibliography

ANDERSON, T.L. and HILL, P.J. (1977). *From free grass to fences: transforming the commons of the African West.* **In** G. Hardin & J.Baden, eds. Managing the commons, W.H. Freeman Press, Sanfransisco, California.

ANDERSON, L.G. (1978). *The relationship between firm and fishery in common property fisheries*. Land Economics, 104-05.

BARNARD, C.W. and NIX, J.S. (1979). *Farm Planning and Control (2nd Edition).* Cambridge University Press, Cambridge, Massachusetts.

BELL, B.B. (1977). *Mathematical Programming in Forestry*, Journal of Forestry, June 317-319.

BENEKE, R.R. and WINTERBOER, R. (1973). *Linear Programming Applications to Agriculture*, Iowa State University Press, Ames.

BERKES, F., ed. (1989). *Common property resources: Ecology and community-based sustainable development.*, Belhaven Press, London.

BOKIL, M.S. (1993). *A study of the utilisation of common lands and the impact of the Aravalli Project (Haryana), Survey Report No. 2,* Government of Haryana, Gurgaon.

BRANDIS, D (1897). *Indian Forestry*, Oriental University Institute.

BROMLEY, D.W. (1985). *The Common Property Challenge.* In. Proceedings of the Conference on Common Property Resource Management. National Academy Press, Washington D.C, Pp. 1-5.

BROMLEY, D.W. (1985). *Closing Comments at the Conference on Common Property Resource Management.* In. Proceedings of the Conference on Common Property Resource Management. National Academy Press, Washington D.C, Pp. 593-598.

BROMLEY, D.W. and CERNEA, MICHAEL M. (1989). *The Management of Common Property Natural Resources: Some Conceptual and Operational Fallacies.* World Bank, Washington, Pp 66.

CHAMBERS, R. (1997). *Whose Reality Counts? Putting the first Last.* Intermediate Technology Publications, London.

CHAMPION and SETH (1968). *A revised survey of forest types of India. Forest Research Institute*, Dehradun, Symbol No. FRI-122.

CHOPRA, K., KADEKODI, G.K., and MURTHY, M.N. (1990) *Participatory development: People and common property resources*, Sage Publications, New Delhi.

CIRIACY-WANTRUP, SIEGFRIED and R.BISHOP. (1975). *Common property as a concept of natural resource policy.* Natural Resource Journal **15(4)**, 713-727.

CIRIACY-WANTRUP, S.V. (1985) *"Common Property" as a Concept in Natural Resources Policy.* Ciriacy Wantrup, S Boulder, London: **W-37**.

CLAYTON, M.H. and RADCLIFFE, N.J. (1996). *Sustainability: A Systems Approach.*: Earthscan Publications Limited, London, Pp. xiv + 258.

CONVERSE, J. M. and STANLEY, P. (1988). *Survey Questions*. Sage publications, London.

CROWE, B.L. (1995). *The Tragedy of the Commons Revisited.* Science **166**, 1103-1107.

CSE. (1985). *The state of India's Environment (1984-85). The second citizen's Report,* Centre for Science and Environment, New Delhi.

DANTWALA, M.L., (1996). (edited by Visaria, P., Majumdar, N.A. and Sundaram, T.R.) *Dilemmas of Growth: The Indian Experience.* Sage Publications, New Delhi.

DAHLMAN, C. (1980). *The Open Field System and Beyond.* Cambridge University Press, Cambridge.

DANTWALA, M.L. (1996). (edited and with an introduction by VISARIA, P., MAJUMDAR, N.A. AND SUNDARAM, T.R.). *Dilemmas of Growth: The Indian Experience.* Sage Publications, New Delhi. Pp. 403.

DASGUPTA, P. (1993). *The Economics of Destitution.* London School of Economics Suntory Toyota International Centre for Economics and Related Disciplines Working Paper: DEP 43 , Pp 66.

DAULAY, H.S. (1994). *A Comparative Study of Livestock and Fodder Resources of the Aravalli Project.* Government of Haryana, India.

DEMSETZ, H. (1967). *Towards a theory of property rights.* American Economic Review **57(2)**, 347-359.

DENT, J.B., HARRISON, S.R. and WOODFORD, KB (1986). *Farm Planning with Linear Programming: Concept and Practice*, Butterworths, Sydney.

DENT, J.B. and BLACKIE, M.J. (1979). *Systems simulation in agriculture.* Applied Science Publishers Ltd., London. Pp 99.

DREZE, JEAN and SEN, AMARTYA (1995), *India: Economic Development and Social opportunity*, Oxford University Press, Oxford.

DUTTA, P.K. and SUNDARAM, R.K. (1993). *How different can strategic models be?.* Journal of Economic Theory **60(1)**, June, 42-61.

DUTTA, P.K. and SUNDARAM, R.K. (1993). *The Tragedy of the Commons?.* Economic Theory **3(3)**, 413-426.

DWIVEDI, BN, (1994), *Fuelwood and other Energy Supply and Demand in Rural India*, Paper presented at the International Workshop on India's Forest Management and Ecological Revival, New Delhi, Tata Energy Research Institute.

DYKSTRA, D.P. (1984). *Mathematical Programming for Natural Resource Management.* McGraw Hill Book Company, Newyork.

FAO. (1992). *Forest Resources Assessment, 1990: Tropical Countries, Forestry Paper No. 112.* Food and Agricultural Organisation, Rome.

FEENY, D., FIKRET BERKES, BONNIE J. MCCAY and JAMES M. ACHESON, (1990). *The Tragedy of Commons: Twenty-two Years Later.* Human Ecology **18(1),** 1-19.

FSI, (1993). *The status of Forests Report.* Forest Survey of India, Ministry of Environment and Forests, New Delhi.

FSI, (1987). *The status of Forests Report*. Forest Survey of India, Ministry of Environment and Forests, New Delhi.

GARDNER, G. (1978). *Social Surveys for Planners*. The Open University, Milton Keynes, England.

GASS, S.I. (1983). *Decision aiding models: Validation, assessment and related issues*, Operations Research, 31 (4): Pp 603-631.

GOH. (1995). *Stitistical Abstract of Haryana 1993-94*, Economic and Statistical Organisation, Government of Haryana, Chandigarh.

GOI. (1980). *Forest Conservation Act*. Ministry of Environment and Forests, Government of India, New Delhi.

GOI. (1988). *The National Forest Policy*. Ministry of Environment and Forests, Government of India, New Delhi.

GOI. (1989). *Agroclimatic regional planning - an overview*. Planning Commission. Government of India, New Delhi.

GOI. (1990). *Involvement of Village Communities and Voluntary Agencies - regeneration of degraded forest lands*. Ministry of Environment and Forests, Government of India. New Delhi.

GOI. (1991). Agricultural Statistics at a glance. Directorate of Economics and Statistics, Government of India, Ministry of Agriculture, New Delhi.

GOI (1993). *India, a reference manual*, Government of India Press, Ministry of Publications, New Delhi.

GOI. (1994). *Census reports for 1991 census*. Government of India Press, Ministry of Publications, New Delhi.

GOI (1996). *India, a reference manual*, Government of India Press, Ministry of Publications, New Delhi.

HFD, (1988). *Project for Afforestation of Aravalli Hills,* Government of Haryana, Chandigarh, India. Pp 114.

HARDIN, G. (1968). *The Tragedy of Commons.* Science **162,** 1243-1248.

HAZELL, P.B.R. and NORTON, R.D. (1986) *Mathematical Programming for Economic Analysis in Agriculture*, Macmillan, New York.

HITCHCOCK, R.K. (1980). *Tradition, Social Justice, and Land Reform in Central Botswana.* Journal of African Law **24**, 1-34.

HOBLEY, M. (1996). *Participatory Forestry: The Process of Change in India and Nepal.* Overseas Development Institute, London.

ICAR, (1990). *Handbook of Agriculture*, Indian Council of Agricultural Research, New Delhi.

JODHA, N.S. (1992). *Common property resources: A missing dimension of development strategies.* World Bank Discussion Papers, Washington D.C. pages xii, 87.

JODHA, N.S. (1989). Management of Common property resources in selected areas of India. **In:** Dani, A. Campbell, J.G. (eds.), *Local Institutions and Resource Management,* ICIMOD, Kathmandu, Nepal.

JODHA, N.S. (1988). *Grazing Commons and Common Ills of Livestock Economy of India, Abstracts Vol. II*, Third International Rangeland Congress, New Delhi.

JODHA, N.S. (1987). A case study of the degradation of common property resources in India. **In:** Blaikie, P. And Brookfield, H. (Eds.), *Land Degradation and Society*, Methuen, London.

JODHA, N.S. (1986). *Common property resources and rural poor in dry regions of India*. Economic and Political Weekly, Vol. 27.

JODHA, N.S. (1985). *Population Growth and the Decline of Common Property Resources in Rajasthan, India.* Population and Development Review, June 1985, pages 247 64.

JOHNSON, O. (1972). *Economic analysis, the legal frame work and land tenure systems.* Journal of Law and Economics **15,** 259-276.

JOSHI, VIJAY and LITTLE, IMD (1994). *India: Macro Economics and Political Economy*, Oxford University Press, New Delhi.

KALA, J.C. (1992). *Common lands: Management perspectives and emerging trends.* Indian Forester, 118 (5): Pp 379-384.

KAUL, O.N. (1992). *Forest and Grassland biomass burning in India*. Proceedings of the International Symposium on Global Change (IGBP), Japan.

KAUL, R.N. and SRIVASTAVA, J.P.L. (1994). *Greening of the common lands in the Aravallis*, Government of Haryana, Gurgaon.

KEENY, R.L. and RAIFFA, H (1976) *Decisions with Multiple Objectives: Preferences and Value Trade-offs*, Wiley, New York.

KORTEN, F. (1987). *The policy framework for community management,* In. Community Management: Asian Experiences and Perspectives. (D. Korten. Ed.). Kumarian Press, Hartford, Conn.

LIBECAP, G.D. (1989). *Contracting for property rights,* Cambridge University Press, Newyork.

LLOYD, W. (1833). *Two lectures on the checks to population*, Oxford University Press, Oxford.

MAGRATH, W. (1989). *The challenge of the commons: The allocation of non-exclusive resources*, World Bank, Washington D.C.

Malhotra, K.C. and Poffenberger, M. (1989). *Forest Regeneration through Community Protection: The West Bengal Experience.* West Bengal Forest Department. Calcutta.

McCARL, B.A. and APLAND, J. (1986), *Validation of Linear Programming Models*, Southern Journal of Agricultural Economics. 155-164.

McCARL, B.A. (1984). Model Validation: An overview with some emphasis on risk models. Review of Marketing and Agricultural Economics, 52(3): 153-173.

McGRANAHAN, G. (1991). *Fuelwood, subsistence foraging, and the decline of common property.* World Development **19(10)**, 1275-87.

McKEAN, M.A. and OSTROM, E. (1995). *Common Property Regimes in the forest: Just a relic from the past.* Unasylva **180**, Vol 46, 3-14. FAO, Rome.

McKEAN, M.A. (1992). *Success on the commons: a comparative examination of the institutions for common property resource management.* Journal of Theoretical Politics., **4(3)**: 247-282.

McKELVEY, R. (1985). *Decentralised regulation of a common property renewable resource industry with irreversible investment.* Journal of Environmental Economics and Management **12(4)**, 287-307.

MENDOZA, G.A. (1987). *A mathematical model for generating land use alternatives for agroforestry systems*. Agroforestry systems, 5: 443-53.

MOBBS, E.C. (1941). *The early history of India's forests*. Indian Forester, LVII(5): Pp 231-42.

MORELAND, W.H. (1920). *India at the death of Akbar, An economic study*. McMillan and Co. Ltd., London.

MUNRO, G.R. (1982). *Fisheries, extended jurisdiction and the economics of common property resources.* Canadian Journal of Economics, August, 405-25.

NADKARNI, M.V. (1994). Management of Common Property Resources, Paper presented at the International Workshop on India's Forest Management and Ecological Revival. Tata Energy Research Institute. New Delhi.

NIN. (1991). *Handbook of Nutrition.* National Institute of Nutrition, Hyderabad, India.

NBSS and LUP. (1990). *Agro-ecological regions of India.* National Bureau of Soil Survey and Landuse Planning, Indian Council of Agricultural Research, Nagpur, India.

NCA. (1976). *Report of the National Commission on Agriculture-Part IX, Forestry.* Government of India, New Delhi.

NCAER. (1988). Haryana Wood balance study, National applied and Economic Research, New Delhi.

NCAER. (1979). *Estimates of Fuel Consumption in Rural Areas*, National applied and Economic Research, New Delhi.

NETTING, R. (1981). *Balancing on an Alp,* Cambridge University Press, Cambridge, Newyork.

NHANTUMBO, I. (1997). *Multi-objective rural landuse planning: Potential for social forestry in Maputo, Mozambique*. PhD theses, University of Edinburgh.

NHANTUMBO, I., DENT, J.B., KOWERO, G.S., and OGLETHORPE, D.R. (1997). *Regional Model for rural landuse planning: An application of Goal programming*. Paper presented at the seventh symposium on systems analysis in forestry resources in May at Michigan, USA.

NKOWANI, K. (1996). *Modelling Land/Resource-use Options open to small holder farmers in the Northern region of Zambia: A Multiple Objective Programming Approach.* PhD Theses, University of Edinburgh, UK.

NORTH, D.C. (1990). *Institutions, institutional change and economic performance.* Cambridge University Press, Newyork.

NWDB. (1990). *Developing India's Waste lands*. Ministry of Environment and Forests, Government of India. New Delhi.

OAKERSON, R.J. (1985). *A model for the analysis of common property problems.* In. Proceedings of the Conference on Common Property Resource Management, National Academy Press, Washington D.C. Pp. 13-29.

OBSERVER RESEARCH FOUNDATION (1995). *India: 1995-96, Observer Statistical Handbook*, Observer Research Foundation Press, New Delhi.

OLSON. M. (1965). *The logic of collective action. Public goods and the theory of groups*, Harvard University Press, Cambridge, Massachusetts.

OSTROM, E. (1990), *Governing the Commons*, Cambridge University Press, Cambridge, Newyork. Pp 280.

LLOYD, W. (1833). *Two lectures on the checks to population*, Oxford University Press, Oxford.

PALIT, S. (1991). *Participatory Management of Forests in West Bengal*, Indian Forester, 117 (5): Pp 342-349.

PALMQUIST, R.B. and PASOUR, E.C., JR. (1982). *Common property externalities: isolation, assurance, and resource depletion in a traditional grazing context.* American Journal of Agricultural Economics, November, 783-84.

PANNELL, D.J. (1997). *Introduction to Practical Linear Programming, John Wiley & Sons*, Newyork. Pp 233+xii

PASHA, S.A. (1992). CPRs and the rural poor, a microlevel analysis. **In** *Economic and Political Weekly*. November 14, 1992, Vol. **27**(46): 2499-2503.

PICARDI, A. and SEIFERT, W. A (1976). *Tragedy of the commons in the Sahel.* Technology Review **78,** 42-51.

PLANNING COMMISSION, (1993). *Population Estimates*, Government of India, New Delhi.

PLANNING COMMISSION, (1992). *Eighth Five year Plan, Vol.I*, Government of India, New Delhi.

PLANNING COMMISSION, (1982). *Report of the Fuelwood study committee,* Government of India, New Delhi.

POFFENBERGER, M. (1990). *Joint Management for Forest Lands: Experiences from South Asia.* Ford Foundation, New Delhi.

PRADHAN, A.S. and PARKS, P.J (1995). *Environmental and Socio-economic Linkages of Deforestation and Forest Land Use Change in the Nepal Himalaya* **In** Property Rights in a Social and Ecological Context, World Bank, Washington.

QUIGGIN, J. (1993). *Common property, equality, and development.* World Development **21(7)**, 1123-38.

QUIGGIN, J. (1988). *Private and common property rights in the economics of the environment.* Journal of Economic Issues **22(4)**, 1071-87.

QUIGGIN, J. (1986). *Common property, private property and regulation: The case of dry land salinity*. Australian Journal of Agricultural Economics **30(23)**, 103-17.

RAE, ALLAN N. (1994). *Agricultural Management Economics: Activity Analysis and Decision Making*. CAB International, Cambridge.

RAO, Y.S. (1992). Programme for Participatory Forestry Development in Asia, **In**: *Social Science Applications in Asian Agroforestry*, Winrock International, USA and South Asia Books, USA.

RIBBENTROP, B. (1900). *Forestry in British India*. Government of India Press, Calcutta.

ROMERO, C. and REHMAN, T. (1989). *Agricultural Decision Analysis with Multiple Criteria*. Developments in Agricultural Economics No. 5, Elsevier, Amsterdam.

RUNGE, C.F. (1986). *Common property and collective action in economic development.* World Development, **14(5)**, 623-35.

RUNGE, C.F., (1981). *Common property externalities: Isolation, assurance and depletion in a traditional grazing context.* American Journal of Agricultural Economics **63(4),** 595-606.

SAXENA, N.C., (1990*). Farm Forestry in North-West India: Lessons from the 1980's*. Ford Foundation, New Delhi.

SCHLAGER, E. and OSTROM, E. (1992). *Property-Rights Regimes and Natural Resources: A Conceptual Analysis.* Land Economics **68(3)**, 249-62.

SCOTT, A. (1955). *The fishery: The objective of sole ownership.* Journal of Political Economy **63(1)**, 116-124.

SEN, A.K. (1966). *Peasants and dualism with or without surplus labour*. Journal of Political Economy. LXXIV (5): 425-50.

SEN, D. AND DASS, P.K. (1987). *The Management of People's Participation in Community Forestry: Some issues*. ODI Social Forestry Network Paper No. 4d, June. ODI, London.

SETA. (1989). *Rehabilitation of Common lands in the Aravalli Hills, Haryana, India. Appraisal Report,* Commission of European Communities, Directorate General for Development, SETA, Brussels, Belgium.

SINGH, R.V. (1994). *Grazing and Forest Management in India*, Paper presented at the International Workshop on India's Forest Management and Ecological Revival. Tata Energy Research Institute. New Delhi.

SHARMA, R.A. (1990), *Socio-economic Planning for Social Forestry*, PhD Theses, University of Edinburgh. Edinburgh.

SHARMA, R. (1994). *Learning from experiences of joint forest management in India*, Forest, Trees and People News letter No. 24: 36-41.

SPWD. (1992). *Joint Forest Management: Regulations update*. Society for Promotion of Wasteland Development, New Delhi.

SRIVASTAVA, J.P.L. and KAUL, R.N. (1994). *Greening of the Common lands*, Aravalli Project, Government of Haryana, Gurgaon, India.

SRIVASTAVA, J.P.L. and KAUL, R.N. (1994a). *Joint Management of Common Lands: The Aravalli Experience*, Government of Haryana, Gurgaon, India.

STEBBING, E.P. (1921). *The Forests of India*, Vol. I-III. The May Flower Press. London.

STEVENSON, G.G. (1991). *Common property economics: A general theory and land use applications.* Cambridge University Press, Cambridge, New York and Melbourne. Pp 256.

SWANEY, J.A. (1990). *Common Property, Reciprocity, and Community.* Journal of Economic Issues **24(2)**, 451-62.

TAWNEY, R. (1912). *The agrarian problem in the sixteenth century*, Macmillan, London.

TERI. (1994). *Economics of Goat Grazing* (edited by V.Vara Lakshmi). Tata Energy Research Institute, New Delhi.

TIWARI, K.M. (1985) *Influence of policy and law on the forest resource management in India.* Indian Forester, **11(3):** 899-918.

WADE, R. (1987). *The management of common property resources: Collective action as an alternative to privatisation or state regulation.* Cambridge Journal of Economics **11(2)**, 95-106.

WADE, R. (1987). *The management of common property resources: Finding a co-operative solution.* World Bank Research Observer **2(2)**, 219-34.

WADIA, D.N. (1975). *Geology of India (Fourth Edition),* Tata McGraw Hill Publishing Co., New Delhi. Pp. 371.

WALLACE, M.B. (1983). *Managing resources that are common property: From Kathmandu to Capitol Hill.* Journal of Policy Analysis and Management Winter, 220-37.

WORLD BANK, (1978). *Forestry sector policy*, Washigton DC.

WORLD BANK, (1983). *World Development Report*, Washigton DC.

WORLD BANK, (1996). *World Development Report*, Oxford University Press, New york.

WORLD BANK. (1993). *India Policies and Issues in Forest Sector Development.* Report No. 10965-IN. Agriculture Operations Division, Country Development II, South Asia Regional Office, Washington DC.

WORLD BANK, (1997). *World Development Report*, Oxford University Press, New york.

VONDAL, P.J. (1987). *The common swamp lands of south-eastern Borneo: multiple use, management and conflict.* **In** B.J. McCay & J.M. Acheson, eds. The question of the commons: the culture and ecology of communal resources. University of Arizona Press, Tucson.

Appendix - 6.1

QUESTIONNAIRE FOR HOUSEHOLDS

1. Code number of the Respondent.

2. Name:

3. Age (Yrs.):

4. Sex: Male / Female

5. Religion: Hindu / Sikh / Muslim / Christian / Others

6. Caste:

7. Annual Income of the Household:

8. Education: Literate / Illiterate

8.1 If Literate level of Education

(Primary School/High School/Under Graduate/Graduate/PG

9. No. of Family Members

Adults..... Children .....

10 Do you have cattle and live stock.

Yes	
No	

10.1 If Yes, How many

Cows	
Bullocks	
Buffaloes	
Camels	
Goats	
Sheep	

11. Are you a:

Absentee landlord
Big Farmer (>4 ha.)
Small farmer (2 ha. to ≤4 ha.)
Marginal farmer (≤2 ha.)
Landless labourer/artisan

12. If you are a farmer, are you a

Owner
Tenant

13. Agricultural production

Surplus
Meets household needs
Less than household needs

14. Are you a:

Full time worker
Part time worker

15. Quality of land

Fully productive
Less productive
Unproductive

16. Irrigation status

Fully irrigated
Partially irrigated
Rainfed

17. Do you have trees on your farm land.

Yes	
No	

17.1 If yes What purpose do they serve:

Income
Household needs
Use of poorer land

18. What requirements are met by your farm land

Food crops required for the family
Fodder required for the cattle
Agricultural residues for fuel purposes
Small timber from the trees standing
Employment for the family members

19. Cropping pattern during the last year

No.	**Crop**	**Area**	**Total Prod. (Qts.)**
1.	Wheat		
2.	Bajra		
3.	Jowar		
4.	Mustard		
5.	Gram		
6.	Onion		

20. To what extent your fodder requirements are met from your farm land.

Surplus
Adequate
In adequate

20.1. If inadequate to what extent your fodder requirements are met from your farm land.

<25%	
25-50%	
50-75%	
>75%	

20.2. Where from you meet rest of the requirements.

From the village common lands
From the PF/RF
From the market

21. To what extent your fuel requirements are met by your farm land.

Surplus
Adequate
In adequate

21.1. If inadequate to what extent your fuel requirements are met from your farm land.

<25%	
25-50%	
50-75%	
>75%	

21.2. Where from you meet rest of the requirements.

From the village common lands
From the PF/RF
From the market

22. Do you use the village common land (Panchayath land, Forest)

Yes	
No	

22.1 If yes, for what purpose

Fuelwood
Grazing
Timber
Fodder
Small timber and poles
Other minor forest produce

23. What trees are standing in your own land.

No.	**Species**	**Fuelwood Produced during the last year (Qts.)**
1.	Eucalyptus	
2.	Sheesham	
3.	Keekar	
4.	Mesquite	
5.	Jand	
6.	Siris	
7.	Neem	
8.	Ber	
9.	Amrood	
10.	Rounj	
11.	Others.	

24. Did you sell the fuelwood produced by your own trees.

Yes	
No	

24.1 Quatity ---------- Quintals

24.2 Amount received ----------Rupees.

25. In case fuelwood or shrubs are collected (gathered)

No.	Place of its Collection	Quantity of Collection(Qts)
1.	Village Common lands	
2.	Road sides	
3.	Canal sides	
4.	Railway sides	
5.	Reserve Forests	
6.	Other farmer's fields	

26. Are you concerned of the degradation of the village common land. Yes / No

26.1. If Not, Why are you not concerned.

26.2. If yes, In what way common land degradation is affecting you.

Lack of sufficient fodder
Loss of tree cover
Non availability of fuelwood
Soil erosion
Non availability of timber
Loss of employment
Un productive livestock
Affecting the productivity of agricultural lands
Other environmental considerations
If any other, please specify

27. Why is the common land degrading?

Excessive tree felling
Mining / Quarrying
Over Grazing by livestock etc.
Extension of agriculture crops
VFC etc. has no control over the violators
Lack of co-ordinated management
Lack of sufficient investment

28. Are you aware of any village forest committee or any society that manages the village common land.

Yes	
No	

29. Who manages the village common land

Village forest committee
Gram Panchayath
Forest dept.
Revenue dept.
Others.

30. Are you member of the VFC etc. that manages the village common land

Yes	
No	

30.1. If not, why are you not a member

30.2. If yes,

30.2a. What are the duties of the member?

30.2b. What are the rights of each member?

31. What are the commonly agreed restrictions with regards to the usage of common lands by individual villagers.

32. In case of any violation of commonly agreed restrictions on the usage of the common land by the members is there any penalty.

Yes	
No	

32.1. If yes, what sort of penalty, please explain.

33. Who is responsible for the enforcement of commonly agreed norms.

Village forest committee
Gram panchayath
Forest Dept.
Judicial Courts
Any other committee of villagers

34. Are you willing to co-operate with the rest of the village in agreeing to commonly accepted regulations.

Yes	
No	

34.1. If not, What are the reasons for non co-operation.

I don't agree for any such arrangement
I don't think everybody has the same needs as I have
People from upper castes don't follow any norms
I am a grazier, I cannot survive without grazing my cattle on the common land.
Since I am landless I do not want to co-operate
I do not feel like co-operating
Any other.

34.2. If yes, What makes you to co-operate.

Fear of punishment/penalty
I like co-ordinated management since it ensures better management of common lands and the availability of the resources to all
Distribution of available resources is done equally amongst the households.
I was motivated by the Forest Dept. to co-operate
Degradation of the resource under open-access makes me to co-operate
I was motivated to co-operate by the VFC etc.
Any other, please specify

35. What are the benefits that you derive from the common lands/ village forests and in what quantites per year.

	Quantity(Kg.) /Year
Fuelwood	
Fodder for the cattle and livestock	
Grazing by the cattle and livestock	
Small timber for the agricultural requirements	
Charcoal	
Rope making grass	
Other minor forest produce	
Mining for construction material or soil	

36. Any other benefits in terms of cash etc. please specify

37. Is there any sharing mechanism of the produce from the common lands.

Yes	
No	

37.1If yes, what sort of sharing mechanism exists.

Through permits
Through quotas
Distributed equally amongst the households
Distributed equally amongst the individuals
No distribution at all. It is free for all since no sharing mechanism exists.
Any other, please specify

38. Who enforces the sharing mechanism

Village forest committee
Gram panchayath
Forest Dept.
Judicial Courts
Any other committee of villagers

39. Do you think proper distribution of benefits exists

Yes	
No	

40. Do you think your village common land needs to be planted with trees

Yes	
No	

41. Do you think tree planting is linked with religious sentiments

Yes	
No	

42. Does tree planting on common lands create assets.

Yes	
No	

43. Who should plant trees on the village common lands.

Village forest committee
Gram panchayath
Forest Dept.
Other N.G.O.'s
Any other committee of villagers

44. Are village panchayaths actively associated with the VFC's.

Yes	
No	

44.1 If yes, state the degree of association.

Low
Medium
High

45. Do you think women are actively associated with the VFC's

Yes	
No	

46. Marketing facilities for the forest produce is

Adequate
Inadequate
None

47. Do you have any conflicts in VFC decision making.

Yes	
No	

47.1 If yes, who helps in resolving the conflicts.

Village forest committee
Gram panchayath
Forest Dept.
Other N.G.O.'s
Any other committee of villagers

48. What type of issues cause conflicts in VFC decision making.

Benefit sharing
Maintenance of tree plantations
Harvest of the produce
Water sharing
Any other, please specify

49. Do you envisage reinvesting a part of the income, obtained from the current tree plantations raised by the Forest Dept. on your village common lands.

Yes	
No	

49.1. If yes, through whom

Village forest committee
Gram panchayath
Forest Dept.
Other N.G.O.'s
Any other committee of villagers

50. Do you feel like protecting the tree plantations raised by the government on your village common lands

Yes	
No	

50.1. If not, what are the reasons.

51. In what way do you think that the government should help for the village common lands improvement/rehabilitation.

By carrying out tree plantations and maintaining them for some time
By providing finances and technical know-how directly to the VFC's
With strict controls supported by stiff penalties and punishments.
By undertaking water and soil conservation measures
By providing adequate training to the villagers
Any other, please specify

52. Are you aware of the government efforts to improve and rehabilitate the village common lands.

Yes	
No	

52.1. If yes, what do you know?

53. Are you in touch with any Forest Dept. officials who are concerned with plantations in your village common lands. If so, who is in contact.

Forest Guard
Forester
Range officer
Any other official

54. What is their attitude towards you and the VFC

54.1. Is it friendly

Yes	
No	

54.2. Is it co-operative

Yes	
No	

55. What should be done to make them friendly and co-operative.

56. Do they encourage you to raise and protect the tree plantations on village common lands? If yes, in what way they encourage you.

57. Are you aware of any publicity and extension efforts of the Forest Dept. directed towards the village common lands improvements. If yes, what are they?

Appendix - 6.2

Questionnaire for the Officials

1. Your name
   (optional if you wish to be anonymous)

2. Your designation/rank

3. How many years of service you have put in so far. .....

4. In what capacity you have been concerned/connected with the management/rehabilitation of the village common lands, please explain.

5. People's participation in the rehabilitation/management of the village common lands has been the key phrase of developmental efforts from the government in the recent past. Do you think you could successfully enlist people's participation in the rehabilitation of the village common lands.

a. If yes, please explain your efforts and your experiences

6. In which villages do you think you could establish a successful community regulated access system to the village common lands.

7. Can you please explain the contributory factors for this success

(Please tick the measure, which ever is more appropriate)

No.	Item	Low	Medium	High
a.	Villagers are enterprising/rational			
b.	Villagers are co-operative			
c.	Sincere, receptive and well trained staff			
d.	Villagers get employment			
e.	Villagers get additional income			
f.	Presence of active panchayath			
g.	Presence of strong local leadership			
h.	Availability of land for plantations			
i.	Involvement of women			

Mention if others.....

8. In which villages do you think the establishment of the proper community regulated access to the village common lands and the successful rehabilitation of the village common lands could not be accomplished.

9. Can you please explain the contributory factors for this low level of success

(Please tick the measure, which ever is more appropriate)

No.	Item	Low	Medium	High
a.	Malfunctioning/absence of the VFC			
b.	Villagers are non co-operative			
c.	No good staff			
d.	Outsiders were provided employment			
e.	Fatalistic attitudes of the villagers			
f.	In active panchayath			
g.	Presence of weak local leadership			
h.	Non-availability of sufficient land for plantations			
i.	Non involvement of women			
j.	Insufficient grazing land for the cattle			
k.	No economic rationality among the villagers			
l.	Unsure of equal benefits from the produce			
m.	Communication gap between staff and villagers			
n.	Poor or no Joint Management Plan			
o.	Inadequate training of the villagers			
p.	Illiteracy			

10. Please suggest the normal contributory factors for proper establishment of the common property resource management/community regulated access system.

11. Do you think that rewarding the staff for their good work will improve their performance and involvement in enlisting people's participation and subsequently establishing co-ordinated community regulated management of the village common lands. If yes, please explain as to what should be the criteria.

12. Please state the main problems and improvements in constituting a representative village forest committee and drafting a good JMP for the common land management.

13. What do you think is the major requirement of the villagers from the common lands?

Grass fodder	
Fuelwood	
Small timber	
Other minor forest produce	
Grazing	

14. Can you please explain the level of awareness amongst the villagers towards their common land degradation/improvement.

Degradation level

High	
Medium	
Low	

Awareness towards Improvement

High	
Medium	
Low	

15. State main constraints in successful institution building at the village level.

16. Can you please explain how to improve women's involvement in the successful management of the common lands under the regulated access system.

Pictures of common land degradation and development

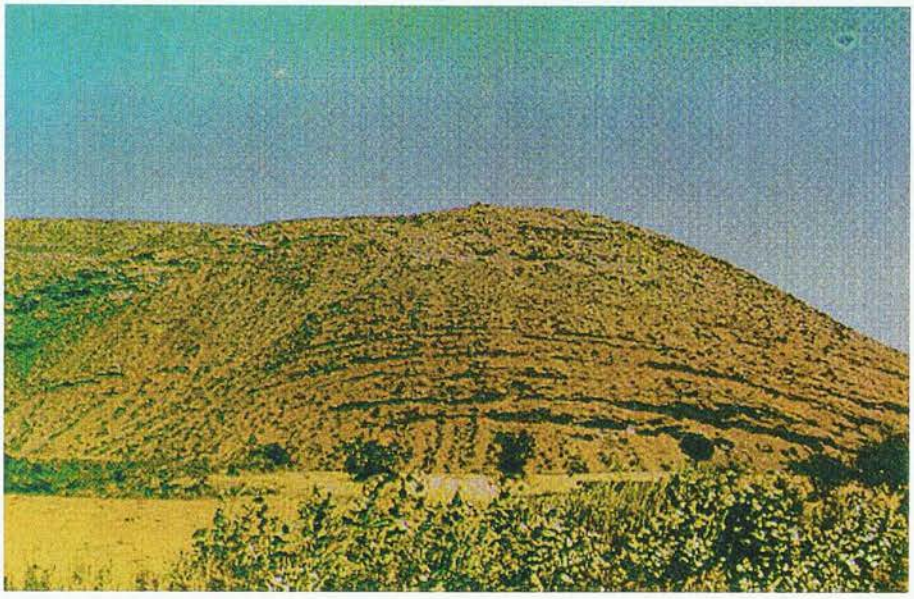

Photo 1. Degraded Common Lands devoid of vegetation

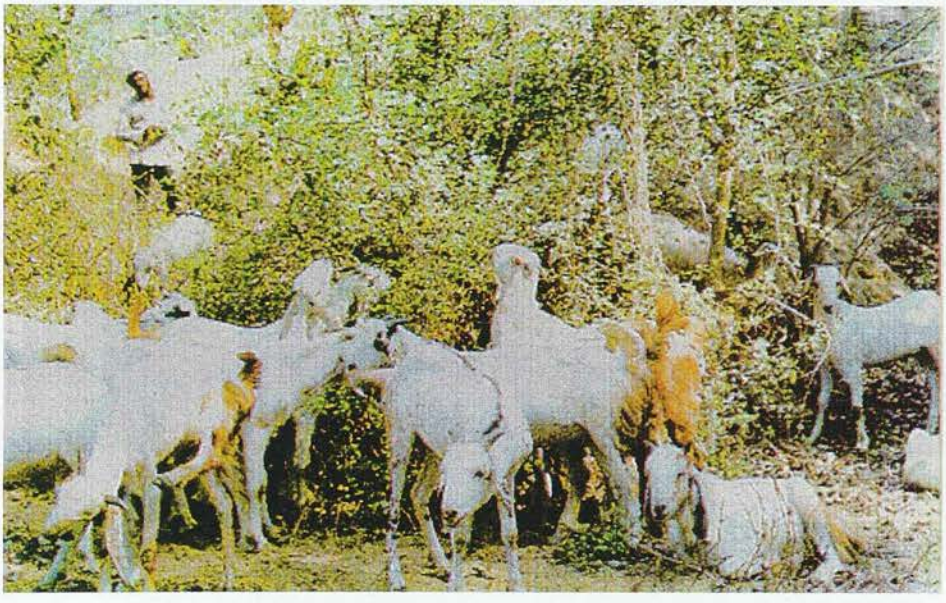

Photo 2: Grazing pressure on village common lands

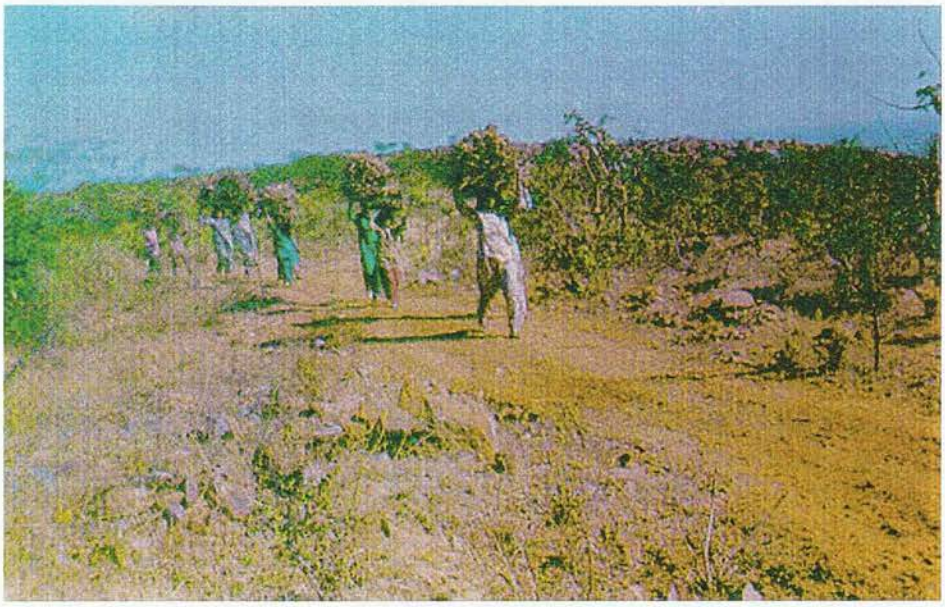

Photo 3: Villagers bringing fuelwood from common lands

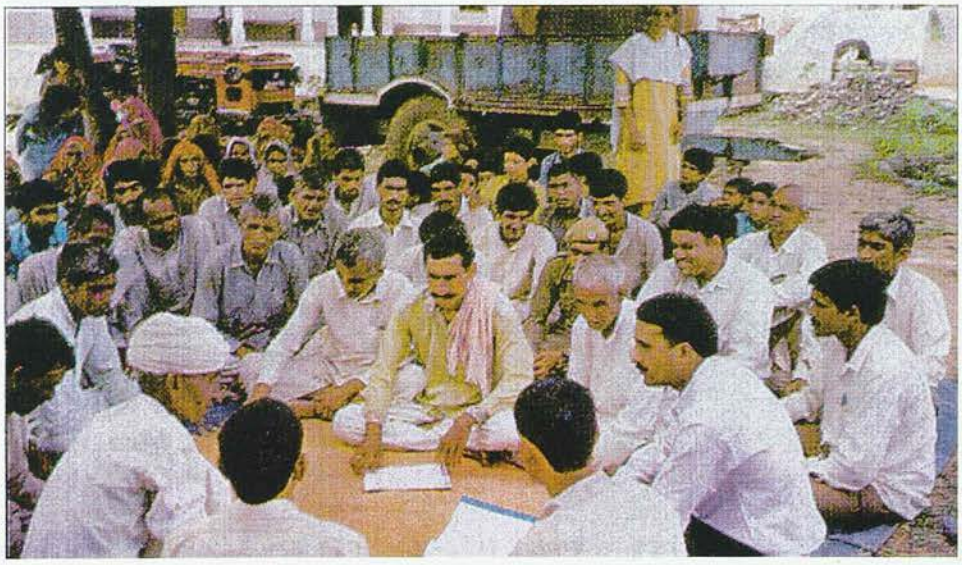

Photo 4: A Village Forest Committee general body meeting in progress

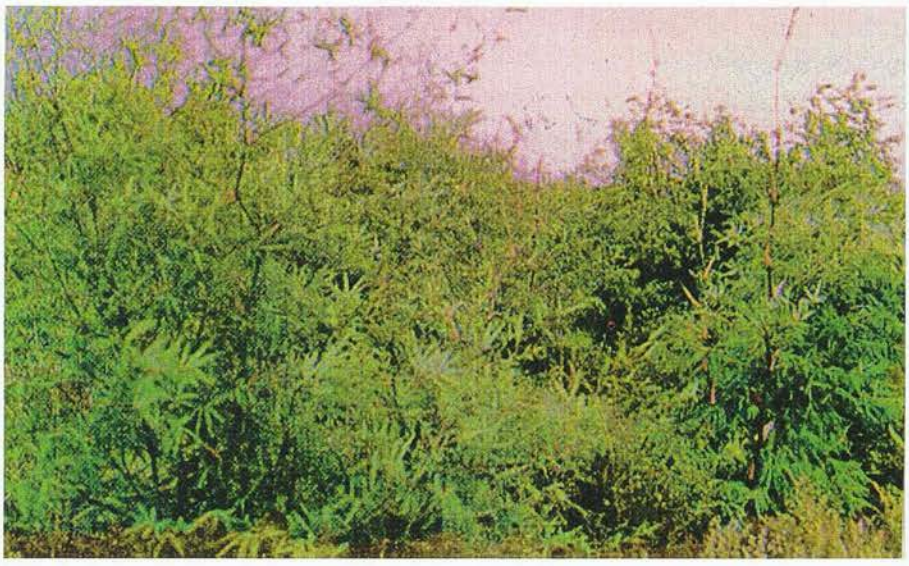

Photo 5: A two year old Bamboo plantation on village common lands

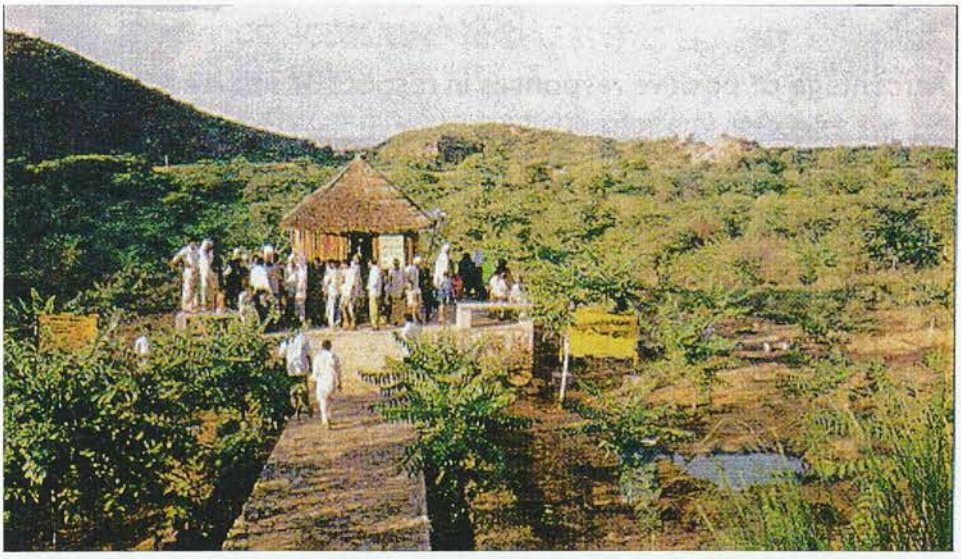

Photo 6: Village Forest Committee and the Forest Department officials meeting at a plantation site on village common land, Sonkh village.

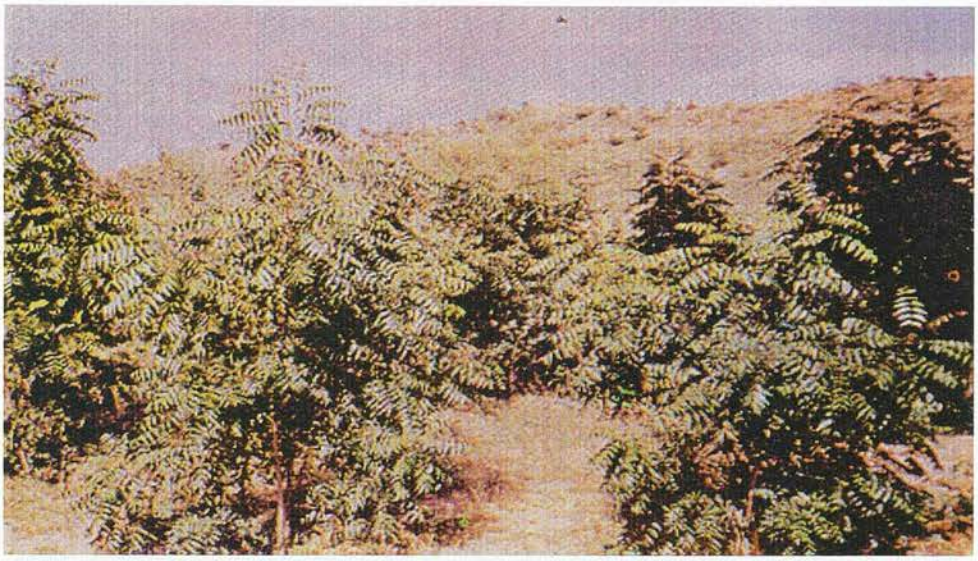

Photo 7: A two year old plantation of neem on Nayan village common lands.

Photo 8: Improved smokeless stoves being used by villagers in place of traditional smoky hearths. This allows poor villagers cook their food without resorting to use of expensive fuelwood. These stoves allow practically any biomass to be burnt with less smoke. These inexpensive mud made stoves are a result of participation.

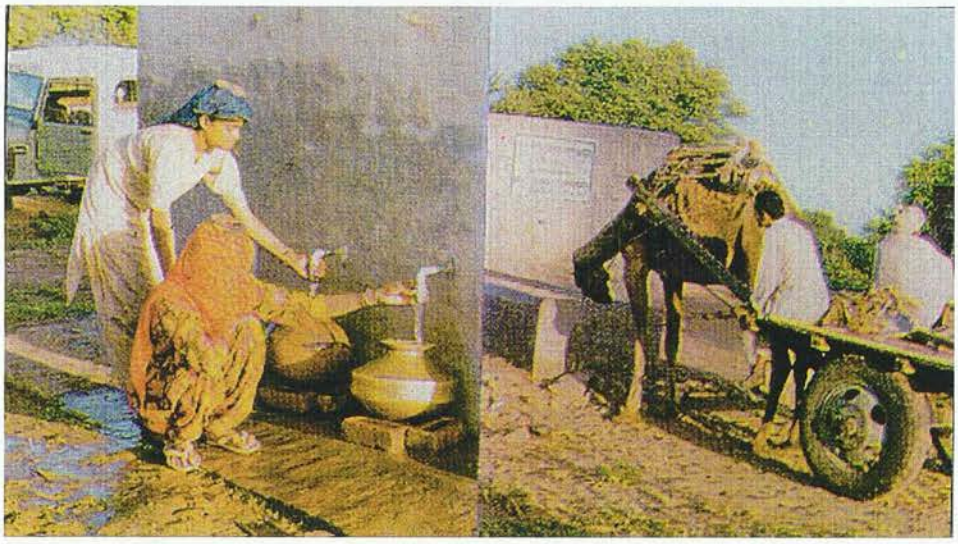

Photo 9: Drinking water facility for human and livestock created in a village using the incentive money provided by the Forest Department

Photo 10: Women's training centre where sewing machines were provided from the incentive money to train village women in sewing.

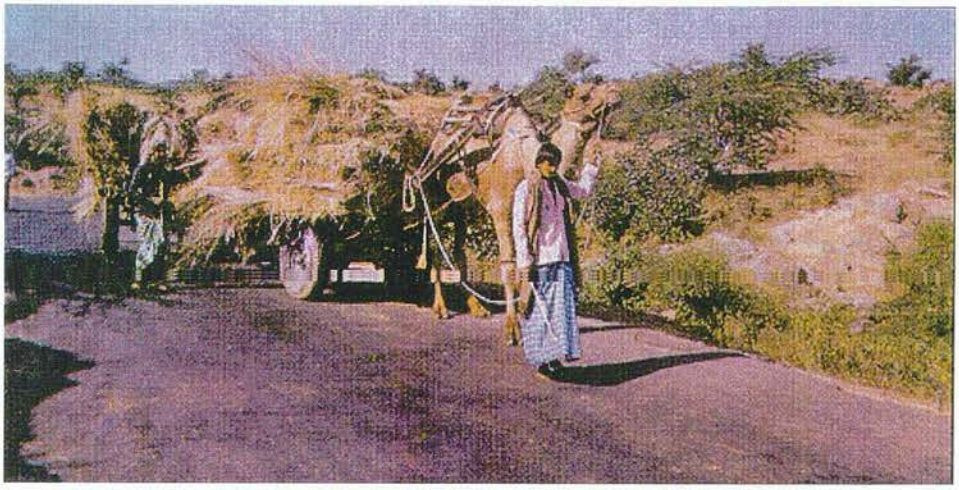

Photo 11: Villagers brining grass from the common lands for collection and storage. This stored grass will be distributed by the VFC during the lean season.

Publications

Common Property Resource Management in Haryana State, India - A success story of the Rehabilitation of Degraded Village Common lands*

P.V. Subhash Chandra Babu, J.B. Dent

Institute of Ecology and Resource Management, University of Edinburgh, West Mains Road, Edinburgh, EH9 3JG, UK.

Summary

Common property resources continue to be a significant component of the land resources base for rural communities in developing countries such as India. Despite significant contributions to the rural community, common property resources have experienced severe degradation, continuous erosion and are becoming transformed in to open access regimes due to increasing population pressure. For many villages in southern Haryana this has increasingly turned out to be the dual tragedy of environmental collapse and pauperisation of the already poor.

Southern Haryana consists of the oldest mountain range in India, the Aravallis. The Aravallis play a significant role in protecting the fertile Indo-Gangetic plains on their eastern side against invading sand drifts from the Thar desert. Increasing pressure from human and livestock numbers has taken a heavy toll of the vegetation leaving the Aravallis almost bare with consequent adverse environmental effects. This has resulted in reduced welfare of the inhabitants of the region, particularly the women, who have to travel long distances to collect firewood and fodder. Realising the enormity of the problem and the critical need to initiate action for greening the Aravallis, the Government and the people have come together to establish a participatory planning and development process at the village level.

Where the participatory process has resulted in establishing a common property regime in place of an open access system reversal of environmental degradation has been recorded together with improvement in welfare of local people. Mechanisms and processes involved in assisting local people to establish common property resource management will be discussed.

Keywords: Haryana, Common Property, Aravallis, Institutional Development.

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* **Paper presented at the Sixth Annual Conference of the International Association of study on Common Property held at the University of California, Berkeley, USA. June 5-8, 1996.**

Common Property Resource Management and Rural Institutions: Testing the Relationship between Resource Condition and the levels of Participation and Enforcement*

P.V. Subhash Chandra Babu[1], J.B. Dent[1], G. Edwards-Jones[2]

[1] Institute of Ecology and Resource Management, University of Edinburgh, West Mains Road, Edinburgh, EH9 3JG, UK.

[2] Rural Resource Management Department, Scottish Agricultural College, West Mains Road, Edinburgh, EH9 3JG, UK.

Summary

This paper provides an overview of the common property institutions at the global and micro level based on a case study from India. The results of the case study, which show clear benefits deriving from common property regimes, will be used to examine institutional development at the village level and the Government's role as an enabler in establishing the common property regime in place of an open-access situation. A composite resource condition index has been developed in order to measure the success of village institutions. Mechanisms and processes involved in assisting local people to establish common property regime are also discussed.

Keywords: Common Property, India, Haryana, Management, Institutions, Forestry.

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* **Paper submitted to the Journal, "World Development".**

Common Property Resource Management and the Role of Institutions*

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[1] Institute of Ecology and Resource Management, University of Edinburgh, West Mains Road, Edinburgh, EH9 3JG, UK.

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Abstract

Common property resources continue to be a significant component of the land resources base for rural communities in developing countries such as India. Despite making significant contributions to the rural community, common property resources have suffered severe degradation, continuous erosion and are becoming transformed in to open access regimes due to increasing population pressure. Southern Haryana consists of the oldest mountain range in India, the Aravallis. Increasing pressure from human and livestock numbers has taken a heavy toll of the vegetation on Aravallis. This has resulted in reduced welfare of the inhabitants of the region. Realising the enormity of the problem and the critical need to initiate action for "greening" the Aravallis, the Government and the people have come together to establish a participatory planning and development process at the village level.

This paper provides an overview of the common property institutions at the global level and at the micro level based on a case study from India. The results of the case study will be used to examine institutional development at the village level and the Government's role as an enabler in establishing the common property regime in place of an open-access situation. Mechanisms and processes involved in assisting local people to establish common property regime are also discussed.

Keywords: Common Property, Haryana, Aravallis, Management, Institutions

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* **Paper presented at the Joint Congress of International Union of Anthropological and Ethnological Sciences (IUAES) and the International Geographers Union (IGU) "Livelihoods From Resource Flows," held at the Linkoping University, Sweden, August 19-22, 1996.**

Socio-economic Planning in Common Property Resource Management*

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[2] Rural Resource Management Department, Scottish Agricultural College, West Mains Road, Edinburgh, EH9 3JG, UK.

Summary

Common property resources continue to be a significant component of the land resources base for rural communities in developing countries such as India. Despite making significant contributions to the rural community, common property resources have suffered severe degradation, continuous erosion and are becoming transformed to open access regimes due to increasing population pressure.

Southern Haryana consists of the oldest mountain range in India, the Aravallis. The Aravallis play a significant role in protecting the fertile Indo-Gangetic plains on their eastern side against invading sand drifts from the Thar desert. Increasing pressure from human and livestock numbers has taken a heavy toll of the vegetation, leaving the Aravallis almost bare with consequent adverse environmental effects. This has resulted in reduced welfare for the inhabitants of the region. Realising the enormity of the problem and the critical need to initiate action for "greening" the Aravallis, the Government and the people have come together to establish a participatory planning and development process at the village level.

This paper provides an overview of the common property institutions at the global and micro level based on a case study from India. The results of the case study, which show clear benefits deriving from common property regimes, will be used to examine institutional development at the village level and the Government's role as an enabler in establishing the common property regime in place of an open-access situation. A composite resource condition index has been developed in order to measure the success of village institutions. Mechanisms and processes involved in assisting local people to establish common property regime are also discussed.

Keywords: Common Property, Haryana, Management, Institutions, Forestry.

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* **Paper presented at the Annual Conference of the Agricultural Economics Society held at Edinburgh University, March 21-24, Edinburgh, Scotland.**

Common Property Resource Management in Haryana State, India*

P.V. Subhash Chandra Babu[1] and J.B. Dent[1]

[1] Institute of Ecology and Resource Management, University of Edinburgh, West Mains Road, Edinburgh, EH9 3JG, UK.

Summary

Common property resources continue to be a significant component of the land resources base for rural communities in developing countries such as India. Despite significant contributions to the rural community, common property resources have experienced severe degradation, continuous erosion and are becoming transformed in to open access regimes due to increasing population pressure.

The research work is aimed at evolving an alternative planning framework for better management of common lands, while ensuring the distributional equity of the benefits accruing from the village common lands without degrading their productivity. All aspects related to the socio-economic, cultural, legal, historical and environmental aspects are taken into consideration.

* **Poster presented at the Annual Conference of the Agricultural Economics Society held at the New Castle University, March 27-30, New Castle upon Tyne, England.**

Book Reviews Published

Dilemmas of Growth: The Indian Experience* by Dantwala, M.L., edited and with an introduction by Visaria, P., Majumdar, N.A. and Sundaram, T.R. New Delhi: Sage Publications, 1996. Pp. 403. £35.00 (hard back). ISBN 0 8039 9266 1, 0 8039 9267 X, 81 7036 499 X and 81 7036 500 7.

The process of economic growth all over the world has almost always been accompanied by tensions and even conflicts. Developed nations coped more easily with such strains because of their access to the resources of the erstwhile colonies. On the other hand, some developing countries have resorted to authoritarian rule to overcome dissent and dissatisfaction. India has chosen an unusually difficult development path, with a democratic form of government and a very large growing population of over 940 million. As a result India has faced an acute dilemma of growth vs. equity over the last five decades. Such dilemmas are likely to become sharper in the years ahead in the wake of the ongoing liberalisation process initiated in 1991.

The twenty-two papers in this volume, written by one of the India's eminent economists and perceptive social scientists highlight the major problems India has faced in its growth and development over the last fifty years. Grouped into six sections, these papers deal with values in economic thought; agricultural development and policy; planning for rural development; agricultural price policy; rural credit; and agricultural labour and employment. The selected papers demonstrate Dantwala's intuitive feel for the complexities of Indian economic scene. While each essay has a historical context, the thrust and approach retain their relevance as much now as when they were first written.

The section 'values in economic thought', highlights the concept of 'trusteeship', an alternative form of ownership, propounded by Mahatma Gandhi. It elucidates Gandhi's views on ownership and management of wealth. Apart from trusteeship, ethics and economics of socialism and an approach to eradicating poverty in India are discussed in detail in this section. While the expressions like 'socialist ethics' or 'value system' are difficult to define. Dantwala considers restraint of acquisitiveness, limitation of wants and the desire to share the gains from development as their basic components. An emphasis on reorientation of values as a precursor to the establishment of an egalitarian society is a distinguishing feature of Dantwala's approach to socio-economic change.

The section 'agricultural development and policy' addresses mainly two themes: the relative contributions of economic policy, technology and agrarian institutions to agricultural development and the issues of reconciling growth with social justice. The sections planning for rural development, agricultural price policy, rural credit and agricultural labour and employment explain the changes through which India has undergone during the planned period. The only drawback in the book is the lack of information on the impact of liberalisation programme launched in 1991 on various aspects such as rural credit, agricultural price policy and subsidies.

Authored by a sensitive observer of Indian society who has an intuitive understanding of India's complex reality and an egalitarian value orientation, this book will be valuable reading for anyone interested in the problems of economic and social development in India. In particular it will be of immense value to students and scholars in the fields of economics (especially agricultural economics), policy studies, development studies and sociology.

P.V. SUBHASH CHANDRA BABU
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* **Book Review Published in Journal, "Environmental Politics" Volume 6, Number 1. Spring, 1997.**

Sustainability: A Systems Approach* by Anthony M H Clayton and Nicholas J Radcliffe. London: Earthscan Publications Limited, 1996. Pp. xiv + 258. £35.00 (hardback); £15.95 (paperback). ISBN: 1 85383 319 3 and ISBN: 1 85383 314 2.

Life on earth has evolved into a unique, complex and beautiful phenomenon, in which there is both change and stability. The stability results from interlocking checks and balances, in which every species plays its role with little or no awareness of the true complexity of the ecological, biological, biochemical, geochemical and physical dynamics that constitute the system of which it forms a part. The rate and scale of human impact on the global ecology is such that it has now become necessary to think about these system dynamics, and whether it is possible that our species could engineer its own decline or even demise. This is the challenge of sustainability and goes far beyond mere environmentalism.

The question of sustainability affects all areas of human activity. It is well known that human activity can, potentially affect the global ecology in ways and to an extent not previously thought possible. Global warming, ozone depletion, soil erosion, deforestation, and species extinctions are all indicators of the extent to which human activity is now altering the conditions for life on earth. There is now concern that current and projected human demands might exceed the mineral and biological flow rates that planet earth can yield without adverse consequences, such as ecological, social and economic disruption. Similarly there is concern that the flow of wastes generated in meeting these demands could exceed the capacity of the global ecology to absorb these wastes without adverse consequences. Some of these problems might, if unchecked, eventually cause widespread damage to the human society. Some could conceivably threaten the survival of human species. Some of the more obvious environmental problems are reviewed in this book. It is important to note that the problem is not one of absolute shortages of energy, resources, or pollution absorption capacity. The problem is in the pattern of interaction and usage. It is in effect, a problem of poor management.

This book introduces complex adaptive systems, a new discipline that is transforming our understanding of the ecological and socio-economic systems that make up our world. It bridges theory and practice linking an underlying analysis to a coherent rationale and programme for change. It explains why a transition to a more sustainable way of life means abandoning the search for simple solutions and adopting a systems perspective, in which both problems and solutions are multi-dimensional, dynamic and evolving. It also explains why macroeconomic policy is the key to the transition, and how an agenda for fundamental regulatory and fiscal reform has to be combined with a new framework for decision-making. The book also suggests a set of criteria to allow political and economic decision-makers to assess their strategies in terms of their impact on sustainability, and puts forward a series of proposals for specific actions to enable a general transition to a more sustainable way of life.

The book is written as an introductory text to the systems perspective for readers at approximately undergraduate level and will be of immense value to students and scholars in the fields of ecology, rural development, economics (especially agricultural economics), policy studies, development studies and sociology.

P.V. SUBHASH CHANDRA BABU
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* **Book Review Published in Journal, "Environmental Politics" Volume 6, Number 2. Summer, 1997.**

Institutions for Environmental Aid* edited by Robert O. Keohane and Marc A. Levy. Cambridge, Massachusetts: The MIT Press, 1996. Pp. xii + 405; index. £38.50 (cloth back); £18.95 (paperback). ISBN 0 262 11213 2 and ISBN 0 262 61120 1.

The discrepancy between levels of environmental quality of rich and poor countries will continue as long as large differences in per capita income persist. This book draws on research from economics, international relations, and development assistance, as well as the growing literature on international environmental relations, to evaluate the effectiveness of international institutions designed to facilitate the transfer of resources from richer to poorer countries, in conjunction with efforts to improve the natural environment.

This book has case studies on the Global Environmental Facility, aid arrangements associated with the Montreal Protocol on the ozone layer, environmental operations of world financial institutions with respect to aid to Eastern Europe and efforts to save tropical forests, debt-for-nature swaps, and attempts to protect the Rhine river from ever increasing pollution. All these case studies have been presented in an elaborate and critical manner. Each case study contains descriptive, analytical and evaluative arguments. None of the case studies in the book represent an unqualified success. This book primarily asks whether the institutions for the environmental aid increase concern, improve the contractual environment between member states, and increase national capacity.

This book explains risky initiatives that have been undertaken under severe constraints and notes that financial transfer institutions can only work well when the interests of powerful actors intersect. But even if such complimentarity exists, lack of organisational or national capacity pervade the process. This book brings out the proposition that international politics are resistant to reform; and much of the activity within international environmental institutions is doomed to frustration. It also explains how political constraints make the action difficult and points out where and how it is possible for the dedicated people and well-structured organisations to make a difference.

This book is a carefully planned collaboration of people connected with the research on environment, economics, ecology, development studies, political science and international relations. The authors observe that although there is some evidence of effectiveness, conflicts of interests within and between states (and involving government and non-governmental organisations) are frequently debilitating; successful initiatives result from a combination of favourable constellations of interests and creative, dedicated leadership. The book also suggests a set of criteria to allow political and economic decision-makers to assess their strategies in terms of their impact on sustainability, and puts forward a series of proposals for specific actions to enable a general transition to a more sustainable way of life.

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* **Book Review accepted for Publication in Journal, "Environmental Politics" Volume 6, Number 3. Autumn, 1997.**

Societies and Nature in the Sahel* by Claude Raynaut, Emmanuel Gregoire, Pierre Janin, Jean Koechlin and Philippe Lavigne Delville. London: Routledge, 1997. Pp. xxiii + 351. £50.00 (hard back). ISBN 0 415 14102 8.

I have really enjoyed reading the book on an important environmental crisis that cought the attention of rest of the world in the past few decades. The Sahelian crisis has been with us for many years now but, until the late 1960's, the outside world was largely ignorant of the turmoil that was going on in semi-arid West Africa. The devastating drought of 1972 put an end to that. The terrible aftermath of that drought and the cumulative impact of those that were to follow has focused the attention of researchers, of aid agencies and of international political concerns. The growing awareness of the tragic consequences of these droughts, reflected in the collapse of pastoral systems, widespread impoverishment and destitution, the disruption of whole production systems and the threatening imagery of desertification, has drawn in the full force of international development assistance. The colossal amount of money, that has been provided through a multitude of aid programmes has yielded practically nothing. This failure of international assistance has been attributed to misidentification of the problem with simplistic references to desertification resulting from over population and consequent misuse of environment. More recently, international efforts have been directed towards a more holistic approach to an understanding of Sahelian realities, in which both physical and social sciences play a role.

There exists a vast amount of literature on this subject but, almost no research work examined the problem from a holistic point of view. This book provides an in-depth analysis of the diverse Sahelo-Sudanian environment. Drawing on a wealth of research and historical development, this book explores the possible links between the environment and social systems in the Sahel, integrating ecological, demographic, economic, technical, social and cultural factors. Examining the conditions for land occupation and natural resource use in the Sahel, this book offers a conceptual and practical approach to social organisation and environmental management in the face of rapid environmental change.

This book neither presents this entire region purely in terms of environmental constraints nor does it position its peoples as victims of uncontrollable outside forces. Instead, it adopts a scale of analysis that allows for the derivation of a number of characteristic situations. In a sense this is a typology, which combines the most salient features of the environment and of the societies that exploit it. This book attempts to explain the particular set of circumstances that determine these situations at the present time and the historical processes through which they have evolved. With a unique focus on the Francophone states, this book presents important implications for future intervention strategies in order to address the crisis of desertification across the sub-Saharan Africa.

This book will be valuable reading for anyone interested in the problems of economic, environmental and social development of Sahel region. In particular it will be of immense value to students and scholars in the fields of economics, policy studies, development studies, social anthropology and sociology. It may also be helpful for the administrators concerned with the development of Sahel region in providing a better insight into the problems that confront this region.

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* **Book Review accepted for Publication in Journal, "Environmental Politics" Volume 6, Number 4. Winter, 1997.**

Sustainability: A Systems Approach* Anthony M H Clayton and Nicholas J Radcliffe. London: Earthscan Publications Limited, 1996. Pp. xiv + 258. Price: £35.00 (hardback); £15.95 (paperback). ISBN: 1 85383 319 3 and ISBN: 1 85383 314 2.

Life on earth has evolved into a unique, complex and beautiful phenomenon, in which there is both change and stability. The stability results from interlocking checks and balances, in which every species plays its role with little or no awareness of the true complexity of the ecological, biological, biochemical, geochemical and physical dynamics that constitute the system of which it forms a part. The rate and scale of human impact on the global ecology is such that it has now become necessary to think about these system dynamics, and whether it is possible that our species could engineer its own decline or even demise. This is the challenge of sustainability and goes far beyond mere environmentalism.

The question of sustainability affects all areas of human activity. It is well known that human activity can, potentially affect the global ecology in ways and to an extent not previously thought possible. Global warming, ozone depletion, soil erosion, deforestation, and species extinctions are all indicators of the extent to which human activity is now altering the conditions for life on earth. There is now concern that current and projected human demands might exceed the mineral and biological flow rates that planet earth can yield without adverse consequences, such as ecological, social and economic disruption. Similarly there is concern that the flow of wastes generated in meeting these demands could exceed the capacity of the global ecology to absorb these wastes without adverse consequences. Some of these problems might, if unchecked, eventually cause widespread damage to the human society. Some could conceivably threaten the survival of human species. Some of the more obvious environmental problems are reviewed in this book. It is important to note that the problem is not one of absolute shortages of energy, resources, or pollution absorption capacity. The problem is in the pattern of interaction and usage. It is in effect, a problem of poor management.

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P.V. Subhash Chandra Babu

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* **Published in Journal, "Agricultural Systems", December 4, 1997. Volume 55, No. 4.**