Centre for International Environment and Development Studies
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PEOPLE, RESOURCES AND SUSTAINABILITY

A study of resource management in Baltistan, Pakistan

by

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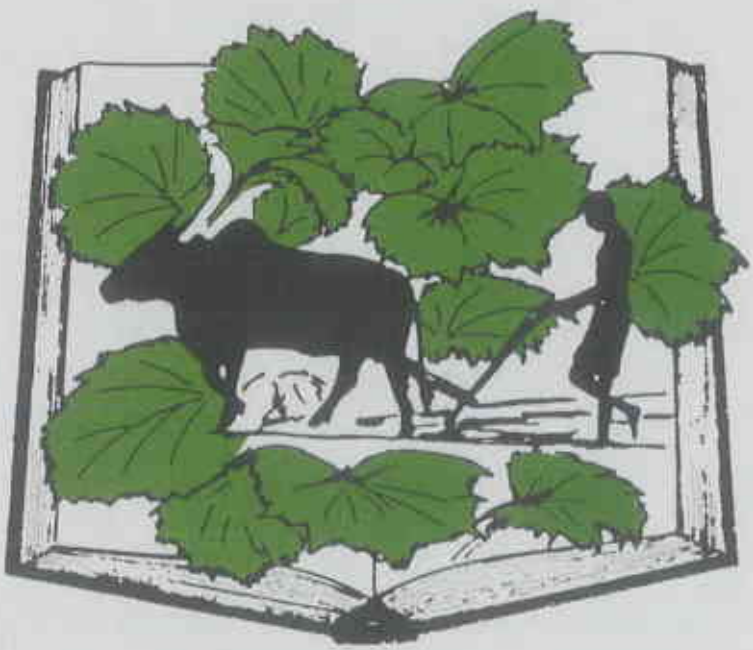

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE (MANAGEMENT OF NATURAL RESOURCES AND SUSTAINABLE AGRICULTURE)

AGRICULTURAL UNIVERSITY OF NORWAY

DECLARATION

We, Tehmina Roohi and Lucie Jerabkova, declare to the senate of the Agricultural University of Norway that, except where acknowledged, this thesis is a product of our own work and effort and it has not been submitted for any academic degree to any other University.

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DEDICATED

To the brave people of Northern Areas of Pakistan,

who are endeavouring to survive in an extreme environment

and

are tolerating a chronic ignorance from the government of Pakistan

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ABBREVIATIONS

AKRSP	Aga Khan Rural Support Programme
AKHS	Aga Khan Health Service
LB & RD	Local Bodies and Rural Development Department
NAPWD	Northern Areas Power and Water Development
PARC	Pakistan Agricultural Research Council
PTDC	Pakistan Tourist Development Corporation
FAO	Food and Agriculture Organisation
UNDP	United Nation Development Programme
IUCN	International Union for Conservation of Nature and Natural Resources
VO	Village Organisation
WO	Women Organisation
PPI	Productive Physical Infrastructure
LSS	Livestock Specialist
VPPS	Vegetable Production and Protection Specialist
NGO	Non-Government Organisation
SCZ	Single Cropping Zone
TCZ	Transitional Cropping Zone
MDCZ	Marginal Double Cropping Zone
DCZ	Double Cropping Zone
SLU	Small Livestock Unit
AEZ	Agroecological Zone
PAEZ	Potential Agroecological Zone
CIF	Crop Intensity Factor
HYV	High Yielding Variety
C : W	Consumer Worker Ratio
KKH	Karakoram Highway
FYM	Farm Yard Manure
SSR	Summer Sex Ratio
L/S	Livestock
HH	Household
IPDM	Integrated Pest and Disease Management

DEFINITIONS

Summer sex ration	Number of men present during summer per 100 women
Index of land utilisation	Land utilised / (Land utilised + Land initialised)
Index of land degradation	Land degraded / (Land utilised + Land degraded)
Index of FYM utilisation	Potential production / Real amount added to field
Index of fuel availability	Potential fuel available (calculated) / Fuel required (responded)
Index of fodder availability	Fodder available / fodder required (for six months of winter)
Index of labour availability	Total labour available / Total labour required
Relative women workload	Women man days / men man days

LOCAL TERMS

bari	the right of a particular person to irrigate land at a particular time
nullah	big water stream, often also refers to the village settlements in the valleys
ul	artificially developed pasture in the rangelands through extension of irrigation channels
ulama	religious heads of communities

CONVERSIONS

1 kanal = 0.05 ha

1 mond = 40 kg

1 Rupee = 0.025 US$

ABSTRACT

In general this study attempts to highlight the conditions of subsistence communities living in four different agroecological zones of Baltistan, that lead to unsustainable use of certain resources both in terms of their over-exploitation and under-utilisation. This study establishes that the variations among the needs of the communities, availability of the resources and the use of resources are not an absolute function of the agroclimatic differences among the zones rather are more influenced by the access of the communities to the town market and their level of awareness. Nevertheless their needs and priorities vary from community to community. Study reveals that the majority of the local people eke out their living from their existing natural resources through the establishment of integrated farming practices. In their prevalent limits of knowledge, farmers are well aware of the comparative advantages of resources. It is evident from the more dependence of high mountain communities on livestock and that of lower mountain communities on crop cultivation. However, in the face of increased needs there has been identified an alarming pressure on the resources. Biophysical indicators of unsustainability are invariably the function of environmental fragility, degradation of local institutional management systems and mismanagement of resources especially forests and rangelands resulting from labour shortage and youth alienation from traditional sociocultural practices of harnessing living. Furthermore, it concludes that overall socio-economic conditions of the communities are positively connected with their accessibility as well as their ability to respond rationally to the changing socio-economic needs, without abandoning their traditional practices. Fragile environment of the mountains and cultural fragility of their inhabitants are highly subjected to deterioration by unsuitable social and economic interventions. There is an overriding need to develop alternative local income generating activities, to alleviate general poverty and consequently alleviate pressure on natural resources because their degradation leads to serious regional as well as national environmental and economic problems.

1 INTRODUCTION

1.1 Rationale For The Study

Pakistan is one of those countries, which have been endowed with rich diversity of natural resources, including water, land, forests, wildlife and fisheries among renewable natural resources, and minerals, precious stones, coal and biogas among non-renewable resources. For the renewable resources, as the harvest rate had been lower in the past than the rate of regeneration, together with proper management, the question of degradation of these resources was not of major concern. However since last two decades conservation and management of natural resources has received major importance both on local/regional and on national level.

Agriculture makes the backbone of national economy, contributing 32% to the total GDP. It accounts for 70% of the total export earning and provides employment to 55% of the country's population (Chaudhary, 1986). Unfortunately the resource of the cultivated land is degrading heavily since last two decades, due to increased floods, water logging, salinity and alkalinity. 47 million tons of annual top soil lost represents degradation occurring at 1/4th the global pace (UNICEF in GOP, 1992). Less than 20% of the 88 million hectares of the country (including AJK and Northern Areas), has been left with the potential for intensive agricultural land use (GOP, 1992). Area affected by different degrees of only water erosion is about 11.2 million hectares (Zia and Rashid, 1995). Unluckily in Pakistan self-sustaining tradition of soil conservation practice and research do not exist. Therefore there are few watershed management specialists (Haigh, 1990).

Most of the land is irrigated by three major rivers of Indus, Chenab and Jhelum, through dam construction. Due to the excessive sedimentation and floods, river courses are changing, eroding abundance of cultivated land on their beds and dismantling human settlements (Ali, 1987).

As all of these three rivers take their origin from the mountains, therefore their performance and further their productivity absolutely depends on the state of bio-physical environment in the mountains. Any disturbance in the bio-physical state of the mountains, i.e. change in climate (fluctuations in precipitation and temperature), deforestation and loss of vegetation indirectly affects the environment or resource base in the plane areas. Watershed lands in the upper Indus river and its tributaries suffer from both unfavourable soils and water conditions and management. As erosion in these areas accelerates, soil is washed down into the reservoirs, which provide water for irrigation and produce hydro-electricity. The excessive amount of sedimentation in water reservoirs of dams is reducing their life. Terbela dam reservoir lost 14%

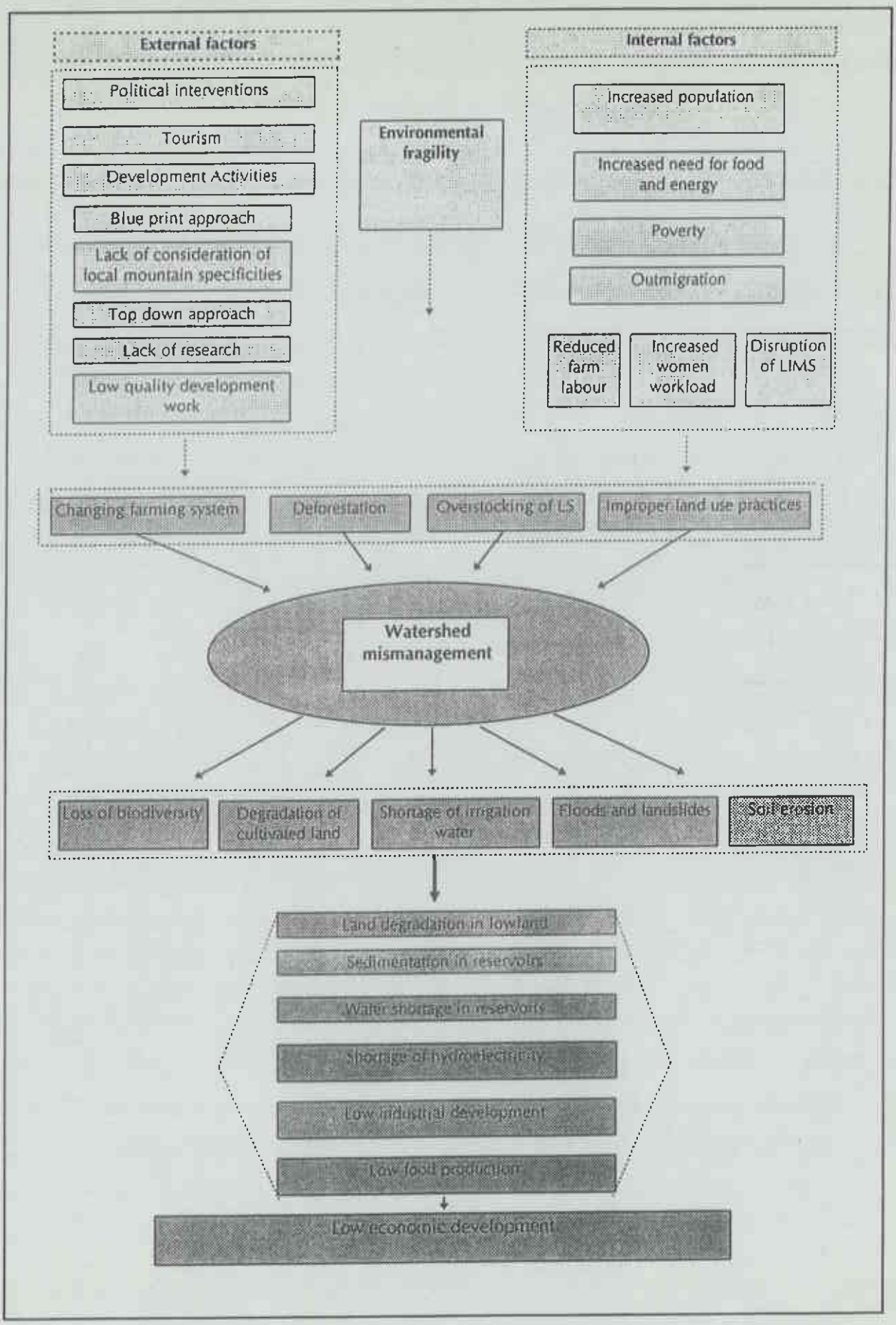
of its storage capacity within a decade after its completion (GOP, 1992). The life expectancy of 600 million Mangla reservoir, expected to last 100 years, has decreased to 57 years or even less (Szechowycz and Queswi in Swaify et al., 1982). Maximum amount of country's energy is generated from these dams. A high rate of land degradation results in low food production and ultimately affects country's economy. Similarly low electricity production brings about the same consequences. It can be estimated, how intensively and extensively these national environmental and then consequential economic crisis are linked with the environment of the mountain regions. This linkage provides a logic to select this mountain region for study.

A second major reason is the negligence of the government to develop the region in physical, social and economic terms either due to its inaccessibility or due to some socio-political reasons. As a direct outcome, majority of the local people have been living in extremely poor socio-economic conditions. These local communities, who are absolutely dependent on their environment, have started harvesting their resources above the level of maximum sustainable yield. Mismanagement of these resources i.e. deforestation, loss of vegetation, loss of wildlife in the mountain region does not only exert its negative impacts in their place of origin but also on the whole country.

Therefore it is important to investigate into the factors, that lead to resource degradation in the mountain regions. The main objective that underlies this research is to assess the interrelation of the marginal communities with their resource base, Dani (1989) describes their relation as people are said to be the de facto watershed managers. The vast majority of communities in the peripheral regions directly eke out their living from these resources and live off the land. Isolated endemic mountain habitats offer a great potential of natural biodiversity (medicinal and food plants) and that of crop cultivars and livestock breeds, offering potential benefits in terms of genetic variety and disease and pest resistance. As a global gene bank, mountains represent food security and future resources for humanity (Byers and Sainju, 1994).

Their precious resources are passing through a process of degradation due to both internal and external causes. Latter are incorporated by their intact human communities, that change their behaviour to these resources as a response of changing environmental and socio-economic conditions. Because besides environmental fragility, the socio-cultural and socio-economic diversity of the indigenous communities is also highly prone to degradation. However the susceptibility of natural resources to the internal and external causes of degradation has not been estimated. Causal studies have been carried out on demographic patterns and agricultural systems but they do not reflect integration of natural resources and the impact of human

Figure 1.1 Causes and impacts of watershed mismanagement



intervention. For instance the basic information about the changing situation regarding farming practices, the extent of pressure on the rangelands, the degree of dependency of local communities on local forests, cultivated land and alpine pastures to fulfil their subsistence needs, has never been inquired. Similarly, how they utilise their human capital to harness energy from productive resources and what are their current problems regarding life sustenance and sustainability, require more investigation.

1. 2 Problem Statement

The remotest village folks of Northern Areas of Pakistan are facing a chronic poor quality of living standard, that has been accentuated by gradual degradation of natural resources i.e. cultivated land, private pastures and forest, common resources, wildlife, fisheries and water resources. Till 1978 before the opening of KKH, Northern Areas of Pakistan remained highly inaccessible, and the state of degradation was intangible before three to four decades. However it became significant due to rapidly growing population, absence of economic alternatives (poverty), and due to the breakdown of feudal system. This system performed for sustainable management of natural resources and its breakdown led to the diminishing natural resource base (Hussain, 1992).

Apart from this state management system, there existed a local resource management system on the village level, that ensured sustainable exploitation (Nazir, 1996) of natural resources. The importance of community management of natural resources has been emphasised by Cernea (1992) and also by Merrey (1994), who directly relates factors, like low productivity, water logging and salinity, to local level mismanagement. The local institutional management was affected by both internal as well as external interventions aimed at poverty alleviation and uplift of living standard of the communities, incorporated without the consideration of fragile physical and cultural environment. Polito-economic interventions aggravated the resource degradation, as Blaikie (1985) argues that soil degradation and erosion are the results of the decisions about land use made by the land users, that cannot be isolated from the political economic context.

Generally all mountain regions are characterised by fragile physical environment, which is more prone to both autogenic as well as allogenic disturbances (Pirazizy, 1993). The features of Baltistan can be described in terms of mountain specificity (Jodha, 1990). In the face of these mountain specificity, local communities have inherited a unique social and cultural pattern, that was established through a period of centuries and was in harmony with their environment. This system of production or in other words subsistence economy was heavily dependent on the production and harvest from the natural resources. IUCN (1996) gives a short account of how

the inhabitants of Hushe and Skoyo Karabathang valleys in Baltistan are dependent on their natural resources. Rural communities directly obtain their living from their natural resources such as soil and its cover, water, forests, animals and fisheries (C.S.E., 1990). Their farming system is closed, complex and highly diverse, with high integration between different components of the production system.

An isolated, rugged mountain environment offers a small but complicated set of production resources to its inhabitants, that can support their sustenance in certain limits of requirements. Improper allocation, overexploitation of the resources and consequently degradation of natural resources, starts with the advent of augmented fundamental human needs (food, fibre and energy) for basic life support. Yanhua et al. (1992) also emphasises, that irrational use of resources accelerates the process of degradation. The existing production from the natural resources cannot meet their increased demands; a response of increased population resulting in higher dependency on the market.

Increased population, poverty, external interventions, degradation of local institutional management system and higher pressure on natural resources give rise to a high level of mismanagement of productive resources. Latter does not only imply the overexploitation but also represents the underutilisation of alternative resources due to unawareness, mass illiteracy, outmigration and poor access to development sources. Poverty together with backwardness, rapid environmental degradation, stagnant agricultural technology, lack of alternative income sources and employment opportunities and logistic constrains in terms of productive infrastructure support and external linkages present components of an integrated set of problems in mountain areas (ICIMOD, 1993).

Higher fuelwood demand and overstocking of livestock, coupled with lawlessness and absence of institutional support for improvement has accounted for high mismanagement of alpine resources, resulting in loss of plant biodiversity, loss of vegetation, reduction in wildlife population and excessive deforestation, ending up with increased propensities of floods and landslides. The forests play an important role in maintaining the water channels and water reservoirs (Hamilton and King, 1983; Anderson, 1987). Overstocking of livestock does not only exert pressure on the forests (Sharif, 1995) but also gives rise to competition between food and fodder production and encroachment into the marginal lands exacerbate the environmental problem (A.I.D., 1990)

Increased food demand is resulting in adoption of intensive agricultural practices, which are detrimental to the environment because most of them are accompanied by lack of consideration of mountain specificity and lack of adequate knowledge and expertise for their application. Channer et al (1993) outlined the negative ecological impacts of China's agricultural

development and exploitation of mountain areas for short term benefits. Fisher (1995) describes that food security can be better guaranteed by the adoption of sensible market strategies than by focusing on subsistence, however it also involves environmental problems. Another noticeable problem is the rapidly generating need for cash income, for purchasing food grains to fulfil the hunger gap, which forces many young male members of the remote villages to migrate permanently or seasonally to the town areas or to the down country. It gives rise to labour shortage in the villages, leading to increased women workload and enhanced mismanagement of the resources (ICIMOD, 1993). Reduced labour input to the production system causes a decline in yield, which had already dropped as a consequence of degradation of local socio-cultural and socio-economic institutional management system, provoked by the diversion from the traditional productive activities. A situation of unsustainability has become highly notable in terms of local food insecurity, increased women workload, loss of biodiversity, improper trade off between different farm components and increased propensities of floods and landslides.

Paradoxically, apart from the fact, that most of the resources are being overexploited, many of the resources are being underutilised. Their use can give tremendous boost to the local economy. For instance niche comparative advantages are yet to be further explored. Tremendous amount of energy of water can be harnessed to generate hydropower. Aitken et al (1991) describes that it can raise living standard of local people, by reducing unemployment and outmigration and reduce the pressure on resources, particularly the forest. Despite the presence of various water reservoirs, tremendous potential of commercial fish farming is being overlooked. In many areas like Shiger, hectares of land are lying uncultivated due to labour shortage and lack of investment. Horticulture and wildlife (flora and fauna) as pointed out by recent records of IUCN, offer potential economic benefits to the communities if managed properly. Tourism is another very important area, which has generated a large proportion of employment in the region, apart form its negative effects of subsistence disruption.

The foregoing discussion stresses upon three imperatives, conservation of natural resources, sustainable development and improved efficiency in the use and management of resources. Pakistan's national conservation strategy (GOP, 1992) lays emphasis on these issues at large. Sustainable development as defined by FAO (1988), is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generation. Such sustainable development (agriculture, forestry and fisheries) conserves land, water, plant and animal genetic resources, is environmentally non-degrading and technically appropriate.

In Baltistan, many of the development agencies, like AKRSP, IUCN and different government departments have been endeavouring to achieve the ends of development and especially AKRSP and IUCN carry the slogan of participatory approaches. However the region is neglected by the government and most of the development plans for the other provinces of Pakistan are not mandated for this region. Keeping in view the seriousness of the problem, there is a pressing need of great consideration of the physical, economic and social development of the region by the government, to save both upland and lowland environment and to keep the pace of national economic development.

This region represents a case of fragile human and physical environment, where the situation of unsustainability can be observed easily. Currently, Baltistan falls within the greater Himalayan region, to which some authors continue to attribute the rapid growth rates and environmental degradation (Karan in MacDonald, 1996). It is also important when the local poor communities are blamed to cause degradation of natural resources, to look into the causes behind this verdict. Therefore a situation analysis becomes imperative to investigate these factors for presenting a baseline of ideas and concepts that can alleviate the intensity of unsustainability by improving human relation with their environment.

1.3 Objectives of the Study

The fundamental objective of this research is to identify people's needs and priorities in relation to their interaction with natural resources, for sustainable development.

Specific objectives:

i) To assess the level of socio-economic differentiation of communities in four agroecological zones

ii) To identify the major private and communal resources under use and to compare their management

iii) To determine which of these resources are being overexploited to fulfil the needs of food, fuel, fodder and FYM and where potential exists to enhance their utilisation, through comparison of potential production and actual harvest

Table 1.1 Logical framework for the research project

Serial number	Objectives	Indicators	Mode of Verification (MOV)
1	Assessment of socio-economic differentiation of the households	Food intake of the household, health status of family members, income per household, family size, land holding, food expenditures, C:W ratio, number of children going to school	Formal interviews with individual households Records of health and education departments
2	Identification of private and communal resources	Cultivated land, area under fruit and forest trees, protected areas	Village level formal interviews and informal interviews with government officers Government records from revenue department, and forestry and fisheries department
3	Assessment of management of private and common resources	Crop intensity factor, propensity of landslides and floods, land fragmentation and degradation, percentage of animals taken to summer pastures, duration of stay of animals on summer pastures, free grazing in the village, labour availability, technology used on the farm	Participatory workshops Formal and informal interviews Field observation of cultivated land Physical verification of water channels and nullahs and that of local forests and pastures AKRSP records
4	Analysis of resource utilisation and production	Animal herd size, land per SLU, area under crops, forest and fruit trees, family size, family labour, food procured from the market, fuelwood produced locally, amount of FYM added to cultivated land	Formal inter and intra village interviews Analysis of field data Records from revenue department Field reports of AKRSP and IUCN

1.4 Methods

In Baltistan, as being a mountain region, there are climatic variations at different altitudes. There prevail different cropping patterns and consequently farming systems determined by both agroecological as well as socio-economic factors. Therefore people's needs and constraints also vary among the zones. To avoid generalisations, to obtain a comprehensive differential picture of mountain communities with regard to their resource use pattern, and assess the level of sustainable use, different variables have been attempted to compare in different agroecological zones. The whole region has been divided into four agroecological zones depending upon altitude, climate, potential cropping intensity, length of growing season and source of irrigation

- double cropping zone (less than 2,000 m)
- marginal double cropping zone (ranging from 2,000 m to 2,300 m)
- transitional cropping zone (from 2,300 m to 2,600 m)
- single cropping zone (higher than 2,600 m)

The villages selected for this study potentially come from all these zones (Fig. 4.1).

1.4.1 Sampling Procedure

Information was collected on two different levels, inter-village and intra-village, to compare differences among production resources (cultivated land, livestock, fruit trees, forests, pastures etc.) and their management.

On the first level villages were selected from each zone, through stratified random sampling (3 form SCZ, 6 form TCZ, 11 form MDCZ and 10 from DCZ), forming total sample size of 30 villages. The size of the village samples was not equally distributed among the four zones. The reason for selecting smallest size form the SCZ, was its highest inaccessibility. As the detailed case study of 30 villages was not possible, as a second sample, one representative village was selected from each zone.

- Yuljik (Sirmik valley) from double cropping zone
- Arifabad (Gamba valley) from marginal double cropping zone
- Chogodrong (Sadpara valley) from transitional cropping zone
- Ginnyal (the valley of Gultari) from single cropping zone

On the inter-village level, village was the sample unit, whereas in the second case, household was taken as the sample unit.

The detailed case study, made in the second sample of villages, was aimed to analyse the differences among local institutional management systems of their resources and gender division of labour and to assess the variations among different indicators of sustainability, prevailing at

four different agroecological zones. Household level study was confined to compare socio-economic differences of the households within each village and among the four villages. All the households from these four villages were interviewed.

1.4.2 Data Collection

1.4.2.1 Primary Data

Formal interviews

Three types of questionnaires were constructed, two for village level study i.e. inter-village questionnaire for thirty villages and one questionnaire for detailed information from four representative villages. Latter consisted of two sections, first dealt with the matters of local institutional management systems on the village level, to analyse the comparison of management system, level of their degradation and to look into factors that affect this system, and the second section comprised open ended questions pertaining to the assessment of the extent of biophysical, and social sustainability of the village. The purpose was the measurement of seriousness of the problems and how the factors, which bring about unsustainable conditions vary among various zones. Third questionnaire, on the inter-household level, emphasised mainly to investigate the level of socio-economic standard of the households.

To obtain information from thirty villages, extensive field trips were arranged to all the villages. For the administration of the inter-village questionnaire, meetings with group of people from each village were arranged. This group was identified after explaining the purpose to the villagers from the particular villages, and consisted of five to fifteen individuals, usually males. Sometimes women and children also joined. Almost in every interview after the completion of the questionnaire, informal conversation was carried out to get a general idea of the village natural resources and verify the responses. These interviews were facilitated by research assistant.

For acquiring the detailed information from four villages about the local institutional management system and indicators of sustainability, one resource person from each village was identified, who had considerably high involvement in all village affairs and was regarded as an influential person. The services of this resource person were hired to serve as a mediator, to access groups of people, to arrange meetings with them and simultaneously perform the job of interpreter. All intra-village information was collected from groups of people belonging to different age groups of both the genders.

Questionnaires pertaining to inter-household interviews were subjected to small groups from all the households including two males and two females or two males and one female. They were assisted by the research assistants, recruited from the same village.

Participatory methods

Informal group interviews were carried out to compare local institutional management systems of the villages, involvement and concern of the community about the conservation of their natural resources bellow and above the channel, and the potential to improve these systems. The information pertaining to the gender division of labour was also collected through these informal interviews. In the first case the group of respondents comprised only males but it consisted of both genders for the accomplishment of the second task.

The indicators of sustainability were also studied through informal group discussions. A set of biophysical as well as socio-economic indicators, was designed after field observations and short informal meetings with different individuals. During the meetings, group discussed each variable and gave a final response, which was documented for analysis.

Two participatory workshops were arranged in each of the four villages. First was organised in the beginning of the diagnostic process. It was an introductory ceremony, where both men and women were gathered separately and were explained the objectives of the whole study. A second workshop was arranged in each of the corresponding villages at the end of the investigation process. The objective of this workshop was to identify their needs and constraints for optimal management of their natural resources and to identify potential for their overall development.

Impact diagram was applied to inquire into the effects of more male involvement in off-farm employment giving rise to labour shortage in the villages, where it was perceived as a major problem.

Women groups were facilitated to draw *seasonal calendars* of their activities. The purpose of seasonal calendars was to see the differences of women activities and variations in the distribution of those activities throughout the year and how activities varied in terms of their importance, in all the four zones. Seasonal calendars also provided the information about the month when women are extremely busy in the farm activities and when they are comparatively less occupied.

Pre-testing of the questionnaires

A pre-test of all the questionnaires, designed during the development of research proposal, was made in the field to remove their weaknesses. They had to be redesigned to get

comprehensive quantitative and qualitative data. To fulfil the requirements of the objectives, one formal questionnaire about local institutional management systems was completely transformed into an informal questionnaire.

Recruitment of the research assistants

For the detailed study of the four villages, one literate person was selected from each of the villages and his interim services were hired. He facilitated to gather household and village level information, arranged and solicited the group meetings for informal interviews and workshops with village men as well as village women groups and helped in carrying out PRA. For the collection of data from 30 villages, one research assistant was recruited permanently for four months. He assisted in selection of people, who had considerable information about the village, and carrying out informal interviews with this village group.

1.4.2.2 Secondary Data

Secondary data was collected from different sources including Directorate of Agriculture, Livestock and Fisheries, KARINA, Department of Biological Sciences Islamabad, Department of Forestry and Wildlife, Department of Meteorology, Revenue department, Family planning office, LB&RD, NAPWD, Social welfare office Skardu, PTDC, Traffic office, Police department, Directorate of Education and Health, AKRSP office Gilgit and IUCN office Skardu, Gilgit and Islamabad.

1.4.3 Data Analysis

1.4.3.1 Quantitative Analysis

For the ease of calculation most of the data was simplified into indices for further analysis. In order to estimate resource overexploitation or underutilisation, Total potential of food, fodder, fuelwood and FYM production was calculated and was compared with the responded production. Similarly human resource utilisation (in terms of labour) was calculated and comparison was made between potential availability and responded labour availability. A number of assumptions were made (Appendices I, V, VI) for calculating potential figures. These assumptions were built on the basis of extensive farmer interviews to get realistic figures for computation.

Numerical variables

Descriptive statistic was used to calculate means, quartiles, minimum and maximum of individual variables. ANOVA was applied to analyse significant differences of variables among

groups of villages. For this study, level of significance was set at $\alpha = 0.1$. These groups were mainly agroecological zones, but in cases when the factor did not show significant variations among AEZ more reasonable groups were formed on the basis of certain criteria (for example on the basis of potential wood production in the case of fuel calculation) and were further tested.

Regression analysis was used to study relation between variables and to assess the degree of their effect on various responses, for example fuel and fodder availability, labour availability or herd size

Example of regression model: $y = a + bx$

Where: y - income from the farm per household

x - number of small livestock units per household

Qualitative data, like presence or absence, quality, trend and intensity of a variable, was categorised and coded. Furthermore some of the numerical data (e.g. family size, index of fodder availability) was also categorised by specifying ranges. Percentage of villages falling into different categories was calculated by Tally.

Contingency tables were constructed to measure the dependency of one categorical variable on the other.

1.4.3.2 Qualitative Analysis

Most of the qualitative data was converted into categorical data and subjected to statistical analysis (e.g. method of pest control). However some proportion of qualitative information, where statistical analysis was not possible, was compared through descriptive analyses. It was used mainly to compare different patterns of farming system management.

The responses of indicators of sustainability, gathered during informal group interviews, were scored according to a scale ranging form - 4 to + 4 (-4,-3,-2,-1,0,1,2,3,4). Scores were given on the basis of qualitative measures of the extent of change (+ive / -ive) over a period of 30 years. Scores ascending from 0 to 4, show a move to a good standard of the indicator, while descending from 0 to - 4, show a shift to degradation or unsustainability. The overall scores of biophysical and socio-economic indicators were summed up separately to declare the level of sustainability of the four villages.

Both the results and discussion of the research have been presented in chapter 3 and 4.

2 DESCRIPTION OF THE AREA

2.1 Geography of the Region

Baltistan (Northern Areas of Pakistan) is situated at the junction of Karakoram and Himalayan mountains, 34° to 45° north of equator and 75° to 77° east of Greenwich. It is one of the most beautiful regions, stretched on 26,000 km^2 of land, inhabited by almost 0.4 million people. In its east Kargil and Ladakh (occupied by India since 1960), in west regions of Gilgit and Diamer, in north Chinese province Sinchianc and in its south the regions of occupied Kashmir are located.

The region is bisected by the Indus river. In the north of Indus, the Karakoram range rises in a serried wall with over hundred peaks higher than 7,000 m and in the south of Indus, the uninhabited Deosai plateau separates Pakistan from India. The world second highest peak K-2 and world's largest glacier Siachin are also situated in Baltistan.

The features of the whole region of Baltistan can be described in terms of mountain specificity (Jodha, 1990). It has diverse landscape, large ecological variations occur over very short distances, which shape diverse human culture and societies. High peaks, deep gorges interspersed with narrow valleys, steep slopes, bare rocks, glacial moraines, scree deposits and river terraces are the main landscape features in the area (PARC, 1984). Geographically it consists of the valleys of Skardu, Shiger, Kharmang, Khaplu and Gultari. The altitude of human inhabitation varies from 1,800 m to 3,650 m.

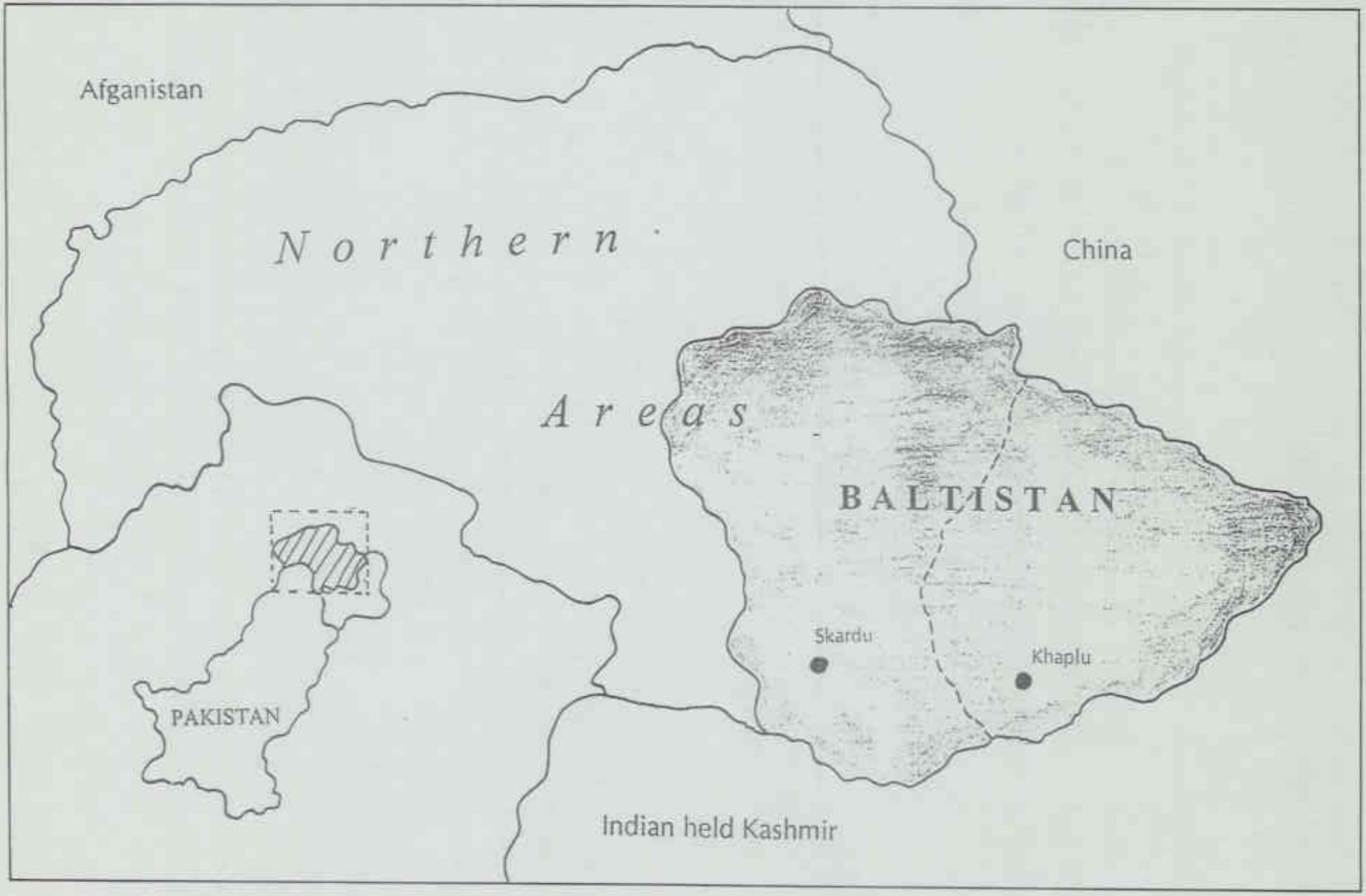
2.2 Environmental Characteristics

The environmental characteristics of Northern Areas have never been comprehensively compiled, except Whiteman (1985), who outlined some of the agroclimatic parameters.

2.1.1 Climate

Almost all natural resources, forests, rangelands, wild flora and fauna, natural pastures, water streams and soil, apart from anthropogenic factors (socio-economic, socio-cultural and socio-political), for their maintenance and production highly depend on the climatic factors (Whiteman, 1985). Northern areas and Chitral fall under the criterion of dry continental Mediterranean climate (Hamid et al., 1969).

Figure 2.1 Map of the Study Area



The area receives severe cold from the month of November till February, April and May are pleasant, summer starts in June and ends in August, followed by autumn which lasts till November. During winter there is acute water shortage, water freezes in the pipelines, and the whole water supply system is disturbed. Even the tree stems tear apart. Severe cold affects economy of the region as a whole to a great extent, because despite high poverty, people have to spend a lot of cash to purchase fuelwood or other energy sources.

2.2.2 Precipitation

Being a rain shadow area, Northern Areas receive very small amount (200 mm per year) of precipitation. The quantity, distribution, reliability and intensity of rainfall affect crop and fruit production both in terms of quality and quantity. Revegetation of natural shrubs (Juniper shrub at the altitude of 1,000 m) and grasses on the rangelands (sparse summer pastures at 3,000 m height) is supported by precipitation. In the high mountains above 6,000 m, at least 2,000 mm of precipitation falls in the form of snow. Its subsequent melting sustains human settlements in the area, which is otherwise a mountainous desert. The amount of precipitation in the form of snow during winter highly affects the quantity and distribution of spring water (Whiteman, 1985).

For the farmers, rainfall brings more problems than benefits including delayed crop maturity, crop and fruit diseases, foliage diseases, army worm in spring, channel blockages, rendering the threshing floors unoperational, chilling of livestock, spoiling of dried hay and straw stacks. From the very beginning of this decade, there is a sudden change in the frequency, seasonality and mass of the rain, there is an increase in the rains in the late winter that prolong through the whole spring. During 1996 many farming activities were disturbed due to continuous prolonged spring rains. It caused heavy land sliding in different areas (e.g. in Gole), imposed excessive crop damage and dismantled many houses.

2.2.3 Radiation

Radiation is a very important factor differentiating habitats. The area has a high incident radiation, especially in summer when 70% of the maximum possible sunshine hours are received. Furthermore, the intensity of radiation increases at higher altitude. As a consequence of high radiation, light penetrates much more deeply into the tree canopies, therefore shaded crops are less seriously affected.

2.2.4 Temperature

The latitude together with altitude determine the seasonal range in temperatures, reducing the mean value and increasing the diurnal range, which is excellent for crop growth. Topography adds a third cause of local variations. Mean annual temperature is 8° C. Maximum summer temperature 45° C and minimum - 45° C in winter is recorded in some settlements (AKRSP, 1995).

Table 2.1 Meteorological parameters in Skardu

Months	Mean monthly precipitation	Mean monthly temperature	Wind	Sunshine	Evaporation
	mm	min/max C	m/s	% hours	mm/mo
January	20.7	-8.0 / 2.6	0.3	31	14
February	23.6	-5.2 / 5.1	0.5	37	21
March	40.1	1.3 / 11.4	0.8	49	50
April	26.1	6.6 / 17.9	1.0	58	83
May	29.2	9.6 / 21.6	1.0	62	115
June	7.3	13.8 / 28.3	1.1	70	136
July	12.2	16.9 / 31.2	1.0	59	144
August	11.6	16.6 / 31.1	0.9	62	105
September	6.2	12.2 / 26.6	0.9	65	91
October	7.9	5.2 / 20.3	0.6	66	50
November	5.4	-1.6 / 11.7	0.3	64	19
December	11.9	-5.7 / 5.5	0.2	38	11

Source: FAO (1994)

2.2.5 Wind

At an altitude belt between 2,000 m - 2,500 m, very strong up-valley winds occur with consistent blowing at the speed of 5-6 m/second, accentuated by the valley profile configuration (Whiteman; 1985). Active aeolian deposits are noticeable in the valley of Khaplu and some truly magnificent sand dunes near Skardu, where heating effect in the wide Indus basin causes strong convectional winds in the evenings. Besides its desiccating effects, wind causes premature fruit drop. Strong winds during the month of June can greatly reduce the apricot crop. However a certain amount of wind is also desirable for threshing after harvesting the crops.

2.2.6 Water Supply

Throughout the Northern Areas, irrigation water is obtained from gravity-fed channels, which collect melted water from mountain streams and direct it to the villages bellow in the valleys (FAO, 1994). Water availability depends on the pattern and rate of melting and topographical

location. The demand for irrigation water in a particular village is determined by the width and aspect of the valley and the rate of evaporation. A high rate of evaporation is followed by increased water demand and a subsequent excessive application of water causes leaching of nutrients.

2.2.7 Soil

In Northern Areas, main rivers and numerous side valleys (nullahs) dissect through wide variety of volcanic, sedimentary, igneous and metamorphic rocks of different origin and associated minerals, as parent material for soil. The types of soils include residual and colluvial soils, soils of the alluvial fans, that of river terraces, moraine, lava eruption, gravity transported, wind blown and landslide deposits. (Khan et al. in Gohar, 1994). Most of the soils are not infertile as they have been built up from deposition, rather than developed in situ through normal breakdown and weathering of bedrock of one type. Soils of old river terraces are more productive as they are slightly fine textured and deeper.

Cultivated soils derived from regosols (entisols), with commonly 0.3 1 m of silty to sandy loam, overlies unconsolidated subsoil of stones and boulders. The agricultural productivity of entisols varies depending on their location and properties. Entisols developed on alluvial flood plains are among the worlds most productive soils (Brady, 1990). Due to low clay and organic matter content, the cat-ion exchange capacity is low. The pH is commonly in the range of 7-8. Due to moderately high conductivity under natural unirrigated conditions both salinity and alkalinity reach a toxic level for plants. Levels of phosphorus and potassium are adequate, sulphur levels vary greatly and could be limiting on some soils. The soils are not deficient in trace elements. Due to the higher accumulative effect of leaching in double cropping areas, lucerne in the crop rotation and the trees on the boundary can help in the recovery of the nutrients. (PARC, 1984)

2.3 Socio-economic Characteristics

Any existing society shapes its socio-cultural patterns after centuries of its adaptation to the natural environment with ethno-linguistic imprints, demographic parameters, health status of the members and the level of knowledge and skills learnt from within or without, which affect its norms to manage their resources. Social status of its members is also affected by the polito-administrative structure. The understanding of these socio-economic characteristics of a community is very important because the members as individuals or collectively as

communities keep on changing their behaviour towards the resources, they are utilising spatio-temporally.

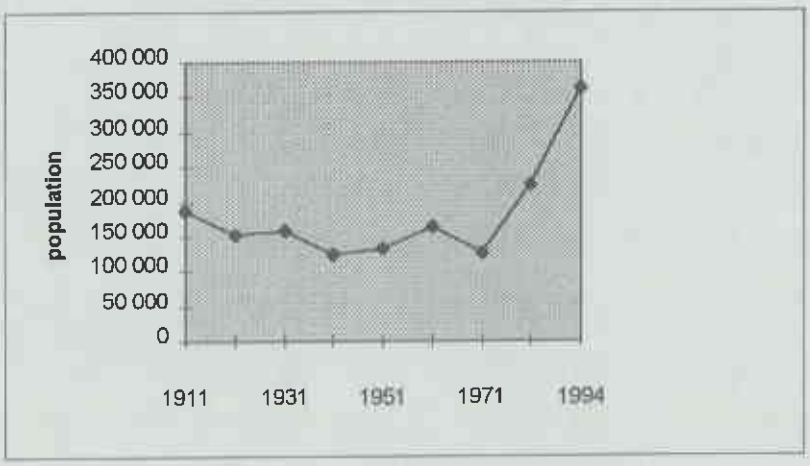
2.3.1 Ethno-linguistic and Religious Aspects

Majority of Balti come from mixed races of Arians, Mangoles and Tibetans. The present population of Baltistan consists of 93% of Baltis, out of which 88% are ethnically similar to Tibetans reflecting Tibetan customs and habits (Nazir, 1996). Second ethnic group is Brosho, consisting of people, who emigrated from Chillas and inhabited the upper nullahs of Sadpara, Kharmang, Gultari and Rondu. They are originally Arians and are called "Broqpa" by Balti people. They speak Shina and have unique culture and customs. Another minor ethnic group is that of Kashmiri, who strictly practice their own etiquette (Hassan, 1995). Almost 95% of the population speak Balti language while others use Shina and Kashmiri. Total population of Baltistan consist of 60% of Shia, 30% of Noor Bakhsia and 10% of Sunni Islamic concepts (Nazir, 1996).

2.3.2 Demography

The first population census was carried out in 1911, then it was repeated after every decade till 1981 and the last population estimate was made in 1994. The findings of AKRSP's mission estimates of population in Baltistan are given in Table 2.2

Figure 2.2 Population of Baltistan



Source: Nazir (1996), Ali (1995)

The sex ratio, i.e. the number of men per 100 women in Baltistan is 115. The growth rate during the period of 1972-1981 and 1981-1985 was 3.8 % and 3% respectively. This high growth rate is a result of high level of fertility and relatively decreasing mortality, among children under five (Steerfland et al, 1995) .

In the past, Balti used to travel to Tibet and today's India for trade purposes (Dani, 1989). Nonetheless, outmigration increased as more options became available, for instance migration to the down country increased after the opening of KKH, to receive higher education and in search of labour. There is also a trend of migration to the main town of Skardu because it has become a socio-economic centre. These town migrants increase the number of land absentees in their native villages. The influx of army for security purposes and that of Pathans for business, has increased town population.

Table 2.2 Population distribution in Baltistan

Total population	341 171
Number of villages	234
Population / village	1 458
Total number of households	42 646
Number of households / village	182
Average household size	8

Source: AKRSP (1994)

Male outmigration results in increased women work burden and responsibilities (Streefland et al., 1995). Nevertheless the increased cash income generated from outside employment has upgraded the living standard of some proportion of the population.

2.3.3 Health Status

2.3.3.1 Medical Services

There is one big hospital in the town of Skardu, one small in Khaplu, Daghoni, Siksa, and Keris. There are 39 dispensaries in the district of Skardu, out of which only 8 have been authorised with doctors. In the district of Khaplu there are 19 dispensaries. The health and hygienic conditions are extremely poor, especially in remote villages. In general, the quality of health services is very poor despite of increased number of dispensaries. Most of the health problems are caused by insufficient, low nutrition and unhygienic food, which affect the productive efficiency of people. Infectious diseases like ascariasis, giardiasis and bronchitis, anaemia, rheumatic diseases and asthma and iodine deficiency are found commonly. Women suffer from malnutrition, micro-deficiencies and tuberculosis. Infant mortality rate is 120/1,000 and a maternal mortality is 600-800/100,000 (FAO, 1994).

Some NGO's are working in the sector of mother and child health care but their services are not extended to the rural areas. A branch of Family Planning Association of Pakistan was

established in 1992. It has Family Welfare centres in Skardu, Shiger and Khaplu with one field office in Skardu. It has trained some WO members as traditional birth attendants, and lady health visitors and in the area of mother and child health care. It provides mobile contraceptive services. AKRSP cooperates with it by providing the services of its social organisers to extend this programme.

2.3.3.2 Water and Sanitation

Most of the rural population rely on springs, rivers, streams and irrigation channels for drinking water. Piped water sources either inside or outside the house are available to extremely small proportion of the rural area. The number of pit latrines is appallingly low and knowledge and practices of proper sanitation are practically non-existent in Baltistan. Social action programme of Government of Pakistan (SAP), has generated funds for improving health and sanitation conditions in Baltistan. LB&RD is the main implementing institution for improving water and sanitation conditions in the region.

Most of the prevailing diseases like cholera, diarrhoea, parasitic and skin infections are water borne and contribute to chronic malnutrition. They are the first causes of morbidity and mortality among children and generally affect the whole population (FAO, 1994). AKHS has conducted many studies in some areas of Baltistan under the code of "Health and Sanitation", with the objective of evolving better techniques to improve health and sanitation but it is not intended to the proper decomposition and disposal of the night soil.

2.3.4 Educational Status

Education is important to keep harmony in the socio-cultural dynamics of the society, with its environment. It is imperative to develop skills and adoption of improved technologies and their inter-generational transfer. The available education facilities do not even fulfil the minimum criteria of proper education. Male literacy rate in the region is 8% whereas only 3% of women population are literate. Women education is also ignored because of higher investment and less benefits, and cultural (early marriages) and religious misconceptions. Lack of education facilities for the girls and the need for labour on the farm in the face of off-farm male employment and cultural norms, dictate women lack of freedom to move outside the village.

2.3.5 Tourism

Baltistan, the land of world's second highest peak K-2 and more than 20 peaks over 6,000 m, is mountaineer's paradise. It also contains the largest glaciers in the world, Baltoro, Siachin and

Biafo. It has also number of beautiful lakes, like Kachura and Sadpara and small lakes on Deosai plain. The natural diversity enhances the aesthetic value of this area. Tourism does not appreciate only the topography and natural diversity of wild fauna and flora but also the cultural values of the local communities. Quality of both the physical and social environment is attractive for tourists (O'Neil and Mock, 1996). Northern Areas receive 70% to 75% of the regulated foreign tourism in Pakistan. It has generated local employment as tourist guides, cooks, porters, waiters in the hotels and transporters. Tourism in Northern areas and Chitral is the largest earner of foreign exchange and one of the largest components of economy but there is a need for promoting ecotourism.

2.3.6 Polito-Administrative Structure

The Northern Areas of Pakistan have not been constitutionally given the status of a province. Administration consists of the Chief Secretary and Deputy Chief. The former is appointed by government, where as the later is locally elected. Since two years a Secretariats of Food and Agriculture and Health and Education have been established in Gilgit. In Baltistan, there are deputy directors of health, education and agriculture, now directly responsible to the respective secretariat. Administratively, it consists of two districts, Skardu and Ghanche, which have been further subdivided into five subdivisions, Skardu, Kharmang, Shiger, Khaplu and Mashabrum. Skardu is the central town and the capital of the region. A local level representative government consists of union councils, comprising elected members from many villages. As being local representatives, their essential responsibility is to make actions for public welfare, after identifying development projects on the village level. They also settle some civil disputes. The elected representatives of the union councils in turn constitute the district council, the most important element of the government decision making at the field level. It has power of taxation and operates the annual budget, allocated by the federal government. The executive head of district government is district commissioner, who coordinates all the line departments i.e. agriculture, forestry, local bodies and rural development (LB&RD) and public works etc. The projects generally selected by the union councils, include infrastructure projects such as schools, dispensaries, irrigation channels and link roads but their allocation is mostly influenced by socio-political discrimination.

2.3.7 Evolution of Local Socio-cultural Institutional Management System

Management is the process of allocating resources in order to achieve some objectives (Kassam et al., 1993). Like in every society, in Baltistan, there also prevailed a system of

managing the natural resources and resolving the social conflicts, since very ancient time. Once even the food was collectively cooked in one pan and all the resources belonged to the community with no concept of individual property. This system continuously passed through changes according to the human social and economic needs (Nazir, 1996).

Through the system of water distribution, rules and regulation had been promulgated and were obeyed by everybody. At the time of introduction of organisational set-up, this system was given an administrative institutional support and was protected by law. Similarly there existed a collective management system of animal husbandry. It included collective livestock grazing and breeding management etc. "Lorapa" and "Chorava" were the selected persons to take care of the implementation of the rules and regulations, concerned with the management of livestock grazing and water distribution on the village level. Both were collectively remunerated for their services. It was the time when some people from influential dynasties, established their states in different parts of Northern Areas, and were titled as mirs and rajas. The most popular of all these rajas, was Ali Sher Khan Anchan, who established a very strong sovereign and incorporated great deal of development works, including a large dam on Sadpara lake. In 18th century, Dogra army succeeded in occupying this region, which was liberated after a long war between local people and Dogra in 1948. Dogra raj despite its treacheries to the locals, introduced and implemented a system of land reform.

According to the customary system a supervisor called "numberdar", was nominated collectively, to look after the organisational work. His decisions were accepted by everyone. It represented the primitive democratic system. A local influential person, known as "Trangpa", was nominated to resolve the inter and intra-village conflicts with collective decisions. Jirga was the title of local committees, consisting of elected members from different nullahs in one village and being involved in administrating village level affairs. Most of the local institutional management systems have disappeared and those prevailing till date are degrading (Nazir, 1996).

A recent development is the evolution of participatory grassroot system to identify needs, allocate and mobilise resources, implement and manage village infrastructure and to set in motion a process of self-sustainable development. These are community institutions formed by the extensive motivational work of AKRSP. Generation of financial capital through regular savings for further development of local economy is the fundamental principle of these grassroot institutions.

2.4 Land Tenure System

Two types of major land tenure systems can be recognised in Baltistan, private property and state property. Latter is further divided into three categories with respect to its utilisation.

2.4.1 Private Resources

Private resources include agricultural land used for crop and fodder production, private forests and pastures and fruit orchards together with residential areas. Before the land reform, rajas and mirs had proprietor rights over cultivated land and used to collect malia from communities for cultivation. However after the implementation of land reform (1971) by the then government, the proprietor rights were transferred to the individuals of communities. On the private land villagers have cultivation, plantation, irrigation and harvesting rights, established through proprietor rights, ensuring better management of this property as compare to common resources.

2.4.2 State Resources

2.4.2.1 Commonly Used Resources (common resources)

These resources include wastelands, alpine forests and pastures and large and small water sources. Proprietor rights are reserved with the government, while the communities have been sanctioned usufruct rights to obtain fodder and fuelwood from the rangelands and water for irrigation from water sources. Encroachment into the rangelands for cultivation is regularised, those individuals or communities who develop rangelands through construction, diversion or extension of irrigation channels, they are allocated its property rights.

2.4.2.2 Protected Resources

These mainly include alpine forests, plains and some lakes. Exploitation of resources from the protected areas (national parks or sanctuaries) is disallowed. However illegal hunting and fishing is banned throughout.

2.4.2.3 Open Access Resources

They include some of the alpine pastures, rocks and water streams, where no legal usufructs rights have been allocated to the communities, but they are not band to be exploited.

2.5 Private Land Use Practices

Agriculture is the largest economic activity in the region providing a major proportion of income and consumption to over 80 % of the household (Khan and Khan, 1992). Cropland has

been developed adjacent to the villages on plains, mountain terraces and alluvial fans located in valley bottoms or along the river banks. The land use practices adopted by the communities are strategic, subsistence, and represent a closed, mixed and integrated farming system. A high degree of trade off exists among various components to produce enough grains, milk and meat to fulfil the household consumption requirements. Farming systems in four different AEZ, vary depending upon different environmental characteristics (chapter 2.2).

In the DCZ, wheat is the dominant crop followed by maize and vegetables as a second crop. In MDCZ and TCZ, wheat is treated as a single crop, while barley is the first crop followed by sorghum, buckwheat or any other minor crops. In SCZ, barley is cultivated as the only crop with wheat. Its utilisation varies according to the food habits, availability of wheat grains and need for fodder. In MDCZ and TCZ most of the minor crops are harvested as livestock fodder. Majority of the farmers produce local seeds of the cereal crops themselves, but high yielding varieties of wheat have also been introduced by the PARC and AKRSP. A small proportion of farmers in Shiger and Skardu, import maize seeds from Gilgit and use it as fodder. In Rondu it is used for household consumption at lower altitudes. Area allocated to vegetable, fodder and potato is given in Table 2.3.

Table 2.3 Present area under different crops in Baltistan

Crops	Area (ha)			
	Skardu		Khaplu	
Wheat	11 000		4 000	
Maize	500		50	
Barley	2 800		3 000	
Millet	1 200		800	
All cereals	15 500	(74)*	7 850	(68)
Fodder	1 150	(5.5)	1 150	(10)
Vegetables	300	(0.5)	250	(1)
Potatoes	800	(5)	400	(5)
Fruit	3 250	(15)	1 850	(16)

Source: FAO (1994)

* percentage of total area

Lucerne, turnip and shaftal (Trifolium resupinatum) are main fodder crops. Former is indigenous semi-perennial crop and yields 3 to 4 harvest every year. It can colonise the land even at high altitudes, and grow spontaneously, where irrigation water floods uncultivated land (Whiteman, 1985). Shaftal is annual fodder crop, limited to the DCZ. Some crops are intercropped traditionally, for instance barley with turnip, barley with potato and barley with oats.

Due to the absence of well established fruit market, no separate fruit orchards exist on the private land. Fruit trees scattered in and around the crop fields together with non-fruit woody biomass are grown on the marginal lands (Gohar, 1994), and represent the traditional agroforestry land use system in the region. Fruit trees cover almost 10-15% area of the cultivated land of which only apricot consists of 60% of the fruit trees. In some areas, where the fruit production is in surplus, it is marketed but only in dry form. Nevertheless, in those valleys where horticultural activities are not commercialised, poor management (pruning) of fruit trees results in a very low yield. Forests trees are cultivated for the household need for timber, fuel and fodder. Recently people have been motivated to establish separate forests. At most of the instances, private pastures lie with the private forests, where natural perennial grasses are found. In those cases, where almost all the animals are transferred to the alpine pastures, grasses from the private pastures are harvested and stored for winter. Livestock, in the subsistence farming system of production, is an activity that requires the exploitation of all private and common resources, especially the pastures, both common village as well as state alpine pastures for grazing. Pastures in the down hills are grazed during winter and that in the up hills are grazed during summer. The duration, for which livestock is kept on the alpine pastures varies from valley to valley depending on the access to rangeland.

Table 2.4 Livestock population in Baltistan

Type of animal	Number of animals	Percentage
Cattle	171,006	20
Sheep	294,201	35
Goat	381,101	45
Total	846,308	100

Source: Directorate of Animal Husbandry (1986)

2.6 Common Resources

2.6.1 Natural Forests

Agroclimaticaly, with few exceptions, the entire region of Baltistan is devoid of proper natural forests. The total area under forest is approximately 11,000 ha, natural forests found on 9,300 ha, are limited to a few forest patches in the temperate, sub-alpine and alpine zones including species of conifers (Pinus willichiana, Abies pindrow), oaks, junipers, birch. (Betulla utilis) and willows (Sharif, 1995). Montane dry temperate forests exist throughout Baltistan between 1,500 and 3,300 m.

Protected forests are found in the valley of Rondu and Kharmang. In these forests local communities have concessionary rights for livestock grazing, fodder and fuelwood collection and timber extraction, subjected to silvicutural availability (FAO, 1994). Silvicultural practices include improved felling, removing of damaged trees, reseedling and replanting the gaps devoid of natural regeneration. In fact, there exist conflicts on the status of protected forests, between the local people, who claim ownership and the government. Since 1990, government imposed ban on felling and cutting of forest trees in the whole region.

Table 2.5 Common multi-purpose trees/shrubs in Northern Areas

Scientific name	Common name	Uses
Alianthus sp.	Alianthus	FU, FE, CO
Artemisia sp.	Sagebrush / Jhau	FU, FE
Dodonia viscosa	Santha / Ghuraski	FU
Eleagnus angustifolia	Russian olive / Bair	FE, FU, CO
Eucalyptus sp.	Lachi	FU, CO
Fraxinus xanthoxyloides	Kasunder	FU, FE
Fruit trees	Various	FO, FU, FE, CO
Hippophea sp.	Souq / Zouq	FU, FE, FN
Morus alba	Mulberry / Toot	FU, FE, FO
Populus sp.	Safaida	FU, FE, CO
Prunus ebernea	Jangli Badam	FU, FE
Quercus sp.	Bani / Banj	FU, FE
Robinia pseudoacacia	Walaiti Kiker	FU, FE, CO
Tamarix aphylla	Frash	FU, CO
Salix sp.	Baid	FU, FE, CO, FN, BA

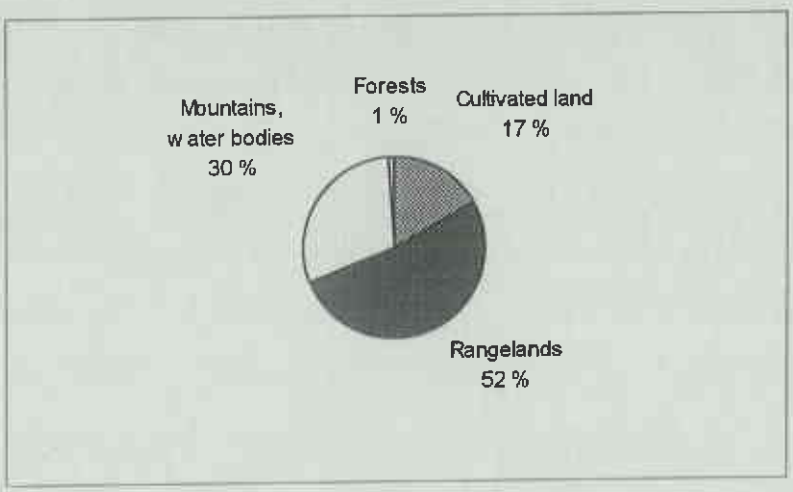
Source: FAO (1994)

Note: BA - basket making, FE - animal feed, FN - fencing, FO - human food, FU - fuel
CO - construction

2.6.2 Rangelands

In Pakistan, the local term for rangeland is "chiragah", which is erroneously considered as wasteland and is synonymous with desert or arid land. The National Committee on Rangeland Management in 1973, defined rangelands as "uncultivated areas (although sometimes disturbed by unthoughtful cultivation), that support natural or seed herbaceous or shrubby vegetation with or without trees" (Muhammad, 1989). According to Muhammad (1989), the vegetation of Trans-Himalayan grazing land can be divided into four range types i) Foothill ranges ii) Dry temperate ranges iii) Valley depression grazing lands and iv) Alpine pastures.

Figure 2.3 Land use classes in Baltistan



Source: Sharif (1995)

2.6.3 Wildlife

There is high biodiversity of medicinal wild plants, that are almost found on every alpine plain or sloppy pastures and around water streams and lakes. A great deal of diverse wild fauna has been recorded in the region. However due to the absence of any management plan, most of the species of wild fauna have become endangered (Table 2.6).

Table 2.6 Wildlife diversity

Common name	Scientific name	Altitude range (m)	Abundance
Snow leopard	Pantera uncia	1600-5200	endangered
Brown bear	Urses arctos	3500-4800	endangered
Black bear	Selenartos thibetianus	1200-3900	endangered
Wolf	Canis lupus	1800-4500	vulnerable
Red fox	Vulpes vulpes	1200-4500	common
Lynx	Felis lynx	2700-4800	endangered
Musk deer	Moschus moschiferus	3200-4500	endangered
Himalayan ibex	Capra ibex	2500-5000	common
Blue sheep	Pserdios nayaur	4500-6300	very rare
MarcoPolo`s sheep	Ovis ammon polil	4000-6400	endangered
Urial	Ovis orientalis vignei	1200-1800	endangered
Astore markhore	Capra falconeri falconeri	1600-3100	endangered
Kashmiri markhore	Capra cashmiriensis		endangered
Golden marmot	Marmota caudata	3400-5000	common
Monal pheasant	lophophorus impejanus	3000-5000	endangered
Chukore	Alectoris chukar	1600-4000	common
Common otter	Lutra lutra		very rare
Stone marten	Martes fonia		very rare
Chinesse wild ass	Equis kiang		endangered
Hare	Lepus sp.		common
Himalayan snowcock	Tetraogallus himalayensis		common
Snow partridge	Lerwa lerwa		vulnerable
Golden eagle	Aquila chrysaetos		very rare

Source: WWF (1994) and Ali (1995)

This rapid degradation of wildlife resources has created great concern among the people of conservation school of thought and international organisations to protect them from complete elimination. In Baltistan, Nir and Askoli, Rondu and Sadpara and Deosai plateau have been declared as game reserves, game sanctuaries and Deosai Wilderness Park, respectively.

2.7 Institutional Support for the Management of Natural Resources

There are two kinds of agencies, that have established their institutional interventions for sustaining and improving production from community and private resources, i.e. government and non government institutions. Most prominent among latter is Aga Khan Rural Support Programme (AKRSP). The main focus of AKRSP is poverty alleviation and improvement of community living standard.

2.7.1 Aga Khan Rural Support Programme

AKRSP has formed grassroot institutions i.e. village men (VO) and women (WO) organisations, that represent a slogan of sustainable development through the collective participation of communities, which is the fundamental principle to achieve this end.

2.7.1.1 Agriculture

Major emphasis is on the improvement of the production through the use of semi- intensive technologies (i.e. chemical fertiliser, high yielding varieties of cereals and vegetables), enhanced credit facilities and improved access to the market. Due to AKRSP's motivation and institutional support, many subsistence farms have been transformed into semi-commercial farms. Rapid land alienation process has been partially controlled by virtue of increased income from the farm through the adoption of improved packages of vegetable production and marketing. Most of them aim at increasing women's income, to raise their social status. However AKRSP has challenges in terms of equal and adequate extension of skills and knowledge and innovation of environment friendly technologies (disease resistant crop varieties, proper use of chemical fertilisers, pesticides and insecticides), because of fragile biophysical properties of the environment, to make its intervention more sustainable.

Fruit

Intervention is reserved to the introduction of improved exotic varieties of superior quality and high production fruit plants and extension of appropriate methods of fruit dehydration, storage and marketing. To provide improved saplings, farmer fruit nurseries have been

established. AKRSP has challenges of controlling the diseases and pests through extension of biological and cultural methods instead of pesticides, motivation of farmers to improve the management of indigenous fruit crops, and preservation and improvement of indigenous fruit materials.

Forest

AKRSP is involved in the development of farm forestry through the introduction of fast growing multipurpose tree species. Integrated fuel and fodder production programmes have been implemented through the motivation of farmers to overcome the constraint of land scarcity, to reduce eroding effects of gullies erosion, to improve soil moisture and to control environmental problems indirectly by reducing the pressure on rangelands. It is also playing its role to create a mass awareness for environmental conservation through school campaigns.

Fodder

To overcome extreme fodder shortage in winter and early spring, fodder conservation techniques like silage preparation and urea straw treatment packages have been introduced. However, the adoption rate of both these packages is low in the region. Additionally, improved fodder varieties are being tried through participatory research, to evaluate their performance. Participatory research is also being conducted on integrated fodder and fuel production programmes, keeping in view the small land holding in the face of increasing demand of the farms.

Livestock

AKRSP's intervention addresses the issues of animal health, improvement of feeding and breeding management of livestock and subsistence and commercial poultry production (Roohi, 1994a). The establishment of a self-sustaining system of veterinary services and production input supply, through village livestock and poultry specialists, is the major objective of this section.

2.7.1.2 Human Resource Development

This area of intervention focuses on enhancing the technical and managerial skills and knowledge of the members of the communities, in different areas including agriculture, livestock, poultry, forest management, marketing and accounting. To make it sustainable, a system of compensating the resource person for his/her services by the community, has been established. It has been reported and observed, that a proportion of these specialists has become

inactive. Identification of constraints through a systematic evaluation programme and stress upon their quality rather than their number, would help to improve their performance.

2.7.1.3 Input Supply System

Previously, AKRSP had a central system of supplying equipment and materials to the communities but since last four to five years, it has been decentralised. For this purpose a special cadre under the title of "master trainers" has been developed on the grassroot level. This organised cadre functions with the extensive credit and technical support of the programme through the generation of an integrated programme of input supply and transfer of technology. Ranmoshy Tanseem Baltistan, with its six small branches, is one example of such a programme on the grassroot level.

2.7.1.4 Mountain Infrastructure and Engineering Services

This is one of the most important sectors, which is endeavoured by the government and AKRSP. It plays an important role in the sustainable development of mountain regions. The packages of productive physical infrastructures facilitate community mobilisation and are one time grant for centring the whole community around the motive of unity for development of social organisation on grassroot level. These PPIs include irrigation projects such as irrigation channels, siphon, pipelines, lift irrigation and storage reservoirs, communication projects such as village link roads, pony tracks, foot bridges and protective bunds against erosion. Maintenance of PPIs is the responsibility of the communities.

2.7.1.5 Adaptive Microtechnology

Demonstration and installation of appropriate technologies (nut crackers, ram carders, spinning wheels) on the grassroot level has always been AKRSP's major area for reducing women workload, to save their labour and time. However, this programme did not receive desired adoption by the communities.

2.7.2 IUCN

A community wildlife (wild fauna and flora) conservation programme has been recently launched by IUCN, in Baltistan. Initially, it has started its intervention in Hushe and Skoyo valleys. All the community is motivated by giving an incentive for physical infrastructure development. IUCN has a mandate of integrated natural resource management for conservation of biodiversity.

2.7.3 Government Institutional Support

2.7.3.1 Agriculture

Agricultural development programme initiated by the government includes two agricultural extension farms and 21 fruit nurseries. High yielding varieties of grains, fruit and vegetables have been introduced. Previously, input supply was the responsibility of this department but it has been recently privatised. The department organises field demonstrations to extend improved technologies. The development of the sector is bottlenecked by the lack of research programmes and funds, and low rate of adoption of HYV by the farmers due to of many socio-economic constraints. There is also lack of breeding programme to control high inbreeding of local wheat varieties. Nevertheless, there is a need to improve the quality of local wheat varieties and the traditional technical methods of soil conservation (soil fertility and maintenance of soil fauna and microbial activities). Such methods may include intercropping, preparation of improved quality FYM (compost), green manuring and crop rotation. Similarly apart from these technical developments, improper socio-cultural practices, like free grazing and overstocking, must be addressed.

Livestock

It is confined to veterinary services. To improve the existing cattle breeds, a programme of artificial insemination has been initiated. Under the head of animal husbandry department, one hatchery was established through the FAO programme of UNDP to promote local poultry production.

The Karakoram Agriculture Research Institute for Northern Areas (KARINA)

A small office administrated by one agricultural officer, has been established by KARINA (main office in Juglote), in 1994. This is the only research institution in Northern Areas under the auspices of PARC. The branch office of Skardu has started manipulating the problem of water shortage by introducing the methods of trickle irrigation for fruit orchard. It is also involved in participatory farmer research, carried out to evaluate the adaptability of high quality, disease resistant and early maturing grains, pulses and vegetables.

A high level of coordination and collaboration among AKRSP, government agricultural sector and KARINA is required for mutual facilitation to achieve their aims, in the area of research demonstration and extension of appropriate technologies.

2.7.3.2 Forest and Wildlife Division

Government of Pakistan established a separate forest division for Baltistan in 1956. It has made achievements in raising forest nurseries and afforestation along road and river sides. It has so far established compact plantations on an area of 1906 acres. However, department does not have any management plan for forestry and rangelands.

There is a separate department of wildlife under Northern Areas Forest Division, one wildlife divisional officer is working in Baltistan. The office was established after passing of Wildlife Preservation Act, 1975. The department however lacks trained staff and necessary facilities to conduct proper surveys to assess the extent of wildlife resources in Baltistan. Several areas like Nir and Askoli game reserves, Baltistan; Rondu and Sadpara game sanctuary and Deosai Wilderness Park, have been declared as protected areas and some are demarcated as wildlife sanctuaries. However none of them has proper management plan for the conservation of wildlife. In the absence of law enforcement, illegal hunting is continuously reducing the number of endangered species.

2.7.3.3 Fisheries

Fisheries Department was established in 1974 and the fisheries Act was formulated in 1975. According to this act any kind of fishing (professional, sport) is prohibited without licence, to regulate fishing and control its overexploitation. With the help of FAO, this department established two trout hatcheries in Hosho (Skardu) and in Bara (Khaplu), with one nursery in Mehdiabad (Kharmang) aimed at increased fish production. The department cultivated fish in number of accessible lakes, streams and nullahs to provide sport fishing opportunities to the tourists. Due to the establishment of these farms, fish production has increased but still cannot meet local fish demand. The organisational set-up of fisheries department cannot extend it to the commercial and enterprise scale to the local communities, as staff is not trained for this purpose. There is a need to train the staff in extension as well technical field of development.

2.7.3.4 Northern Areas Power and Water Development

Three major divisions operate under this institution including, Transport and Communication (roads, link roads and bridges), Water and Power (maintenance and construction of new irrigation channels, water and sanitation projects and establishment of microhydal projects) and division of Physical Planning and Housing (hospitals, government residence quarters, schools, colleges, buildings of fisheries and deposit work assigned by some other department on charges). This department is equipped with large number of trained staff. Development work is funded by the government of Pakistan. In Baltistan, the district of Skardu receives 27% and

Gangche receives about 12-15% of the total funds allocated to the department of Northern Areas. All infrastructure projects are implemented on tendered contract basis without community participation for planing and designing. Latter is confined to hiring of labour by the contractors only. The capital cost of these projects is very high. Once the project is completed, it is handed over to the community for operation and maintenance.

2.7.3.5 Local Bodies and Rural Development Department (LB&RD)

This department was set up to provide technical and administrative back up to the local bodies (union councils) for the implementation of the development works. After a specific scheme is identified by the members of Union Council, the department determines its technical feasibility and costs, and submits to the District Council. It is responsible for the implementation of small irrigation channels, link roads, bridges, and culverts, soil conservation works including protective bunds, water supply and sanitation schemes, and construction of schools and dispensaries. The cost of the projects is partially shared with the communities. Lack of funds as well as that of trained staff are major constraints of the department.

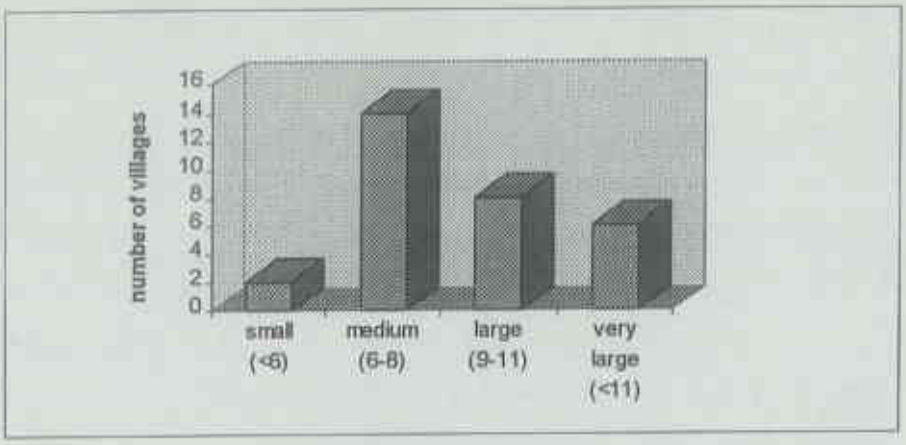
There is a great need for coordination among AKRSP, NAPWD and LB&RD for designing and implementation of PPI for sustainable development.

3 SOCIO-ECONOMIC DIFFERENTIATION AND HUMAN RESOURCES

3.1 Demographic Characteristics

The population of the villages under study, varies from 140 to 2500, but it is not distributed normally as 50% of the villages have population less than 360. The average population of men and women is found to be 35.3% and 29.9% respectively, whereas children occupy 34.8% of the total population.

Figure 3.1 Number of villages with various family size



Average family size has been found to increase with the decreasing cropping intensity under practice. The largest average family size (10.07) exists in areas of lowest cropping intensity, where children constitute the largest proportion (45.5%) of the population. In TCZ, men make the largest proportion of the population. The highest sex ratio has been found in TCZ, whereas lowest in SCZ (Table 3.1). It ranges from 72.7 to 180 with mean of 117.6, in the area under study.

Table 3.1 Family size and sex ratio

Agroecological zone (under practice)	Average family size	Sex Ratio
SCZ	10.07	103.96
TCZ	10.05	122.08
MDCZ	9.13	121.24
DCZ	7.26	108.61

The percentage population of adult men and women does not significantly vary in different AEZ, whereas the percentage population of children considerably vary.

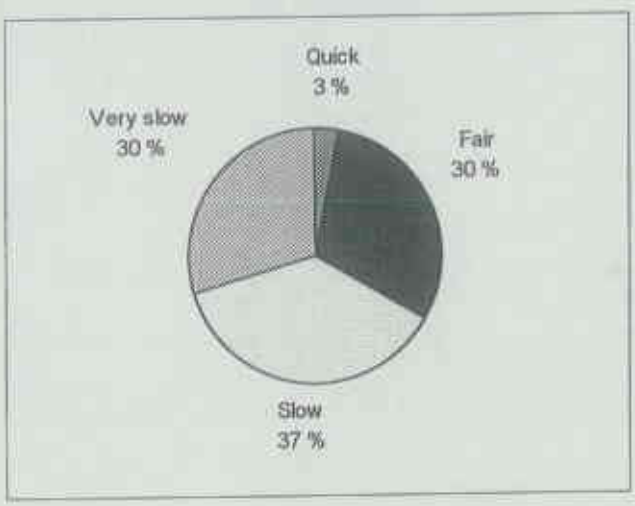
3.2 Access to the Market

In this study, market has been taken as the main market of Skardu town, because it is the only prominent economic centre in the whole region. The valley markets have not been considered because of their limited economic activities. On the basis of frequency of transport, distance and topography four categories of access to the market have been demarcated.

- Quick access - very small distance, very frequent transportation and highly accessible
- Fair access - fair distance, regular daily transport, easily accessible
- Slow access - comparatively large distance, regular but less frequent transportation, accessible throughout the year
- Very slow access - high distance, extremely slow irregular transport, inaccessible during winter

All the villages from the SCZ and 83% of the villages from the TCZ, have very slow access to the market. Each 50% of the villages from DCZ, have fair and slow access to the market. The villages of the MDCZ are distributed among all the categories of access to the market with 45.5% of the villages falling in the category of slow access, and 36.4% of the villages having fair access. On the whole, one village has highest access to the market and 30% of the total villages (Figure 3.2) have fair access.

Figure 3.2 Percentage of villages with varying access to the market



3.3 Development Differentiation

According to the analysis of indicators of development (Table 3.2), three standards of development (Table 3.3) were differentiated.

- poor development - presence of up to 35% of the development indicators
- medium development - prevalence of 35% to 65% of the development indicators
- good development - presence of 65% to 100% of the development indicators

The percentage of the villages equipped with the indicators of physical, human resource, social and institutional development is given in table 3.2. It was found that only 17% of the villages lie under the first category (good) of development. These include Risar Sixa, Karimpa Olding, Rizvia, Harkhore Bara Paen and Birchung Keris. First two villages have small land holding that seems to urge them to promote their physical infrastructure. They have a privilege of physical development by virtue of the presence of army due to their geographic location. Whereas in the last two villages, good development seems to be an outcome of better institutional support (VO) and village leadership. Rizvia is almost situated in the town thereby enjoys all kinds of development.

Table 3.2 Percentage of villages with various indicators of development

General indicators of development	Specific Indicators of development	Villages (%)
Physical Development	New land developed	60
	Drinking water pipes	50
	Fruit nursery	36
	Forest nursery	30
	Machines	40
Human Resource Development	Livestock specialist	60
	Veget. prod. & prot. sp.*	40
	Poultry specialist	30
	Marketing specialist	13
Social Development	Boys schools	83
	Girls schools	40
	Self development	63
	Medical facilities	70
Institutional Development	Village organisation	70
	Women organisation	37
	Govt. agricult. services	17
	Govt. veterinary services	40

* vegetable production and protection specialist

20% of the villages are poorly developed. The most prominent cause underpinning the reasoning for villages falling under the category of poor development, is found to be their poor communication to the town, due to their large distances and difficult terrain. These include

Tissardoko, Shigerthang, Tandalbrokgrong, Chogrolphrolsoq, Skildrung and Ginnyal. Due to inaccessibility most of them have poor institutional support[1]. Latter is also related to their misconception, for instances, there is strong resistance among the people of Chogrolphrolsoq to make a village organisation and receive development packages from AKRSP, because the whole community comes from Sunni concept of Islam, and they conceive a misapprehension that AKRSP is a missionary programme.

Table 3.3 Development standardisation

Development criteria	Good (%)	Medium (%)	Poor (%)
Physical	23	40	37
Human Resources	20	30	50
Social	37	53	10
Institutional	23	23	54
Overall development	17	63	20

The result of ANOVA between PAEZ and the physical, development, shows that there is no significant difference of physical development in DCZ, MDCZ and TCZ, except in the SCZ ($p=0.033$), which is the least developed of all. In case of human resource development, again SCZ seems to be less developed in comparison to others but does not vary significantly. Highest social development has taken place in the MDCZ ($p=0.05$) in contrast to others, where much differences do not occur. The result of Institutional development is similar to that of human resource development. The villages in SCZ, are significantly less developed ($p=0.069$), in the case of overall development (physical, human resource, social and institutional). The rest of all the villages are more or less found to be equally developed. There is a significant dependence ($p=0.091$) of the extent of social development on access to the market or in other words access to the town. The highest social development has taken place in the village with quick access to the market. Similar sounds true with the physical development but with lower affiliation with the market. The highest physical development has taken place in the villages with largest land per household, a vice versa effect stands valid.

There exists some inter-relationship of physical development with social development and vice versa. It is difficult to identify which comes first, each can bring about the other. Human resource development fairly depends on Institutional development.

There are no significant differences in overall development among the villages, with respect to access to the market. The villages with lowest land per households fall in the best category of overall development, whereas in the villages with the highest land per household, poor

[1] Institutional support refers to the community development interventions incorporated by AKRSP

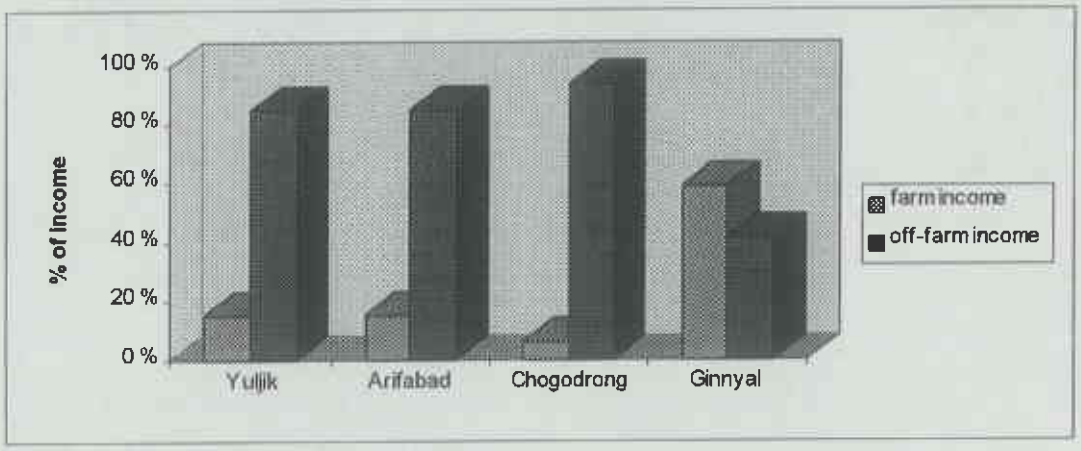
development has taken place. All these results imply, that development and underdevelopment are not the outcome of any single factor, multiple factors affect this variable e.g. accessibility, institutional support and the land holding per household.

3.4 Household Economy

3.4.1 Household Income Sources

The statistical analysis shows, that there are significant differences in the household income from the farm ($p=0.001$) and that of from off the farm ($p=0.079$), in four AEZ. Similar results were obtained by Bhati et al (1992) in Himachal Pradesh. The highest percentage of total income (58.5%) is obtained from the farm in Ginnyal, reflecting their higher dependency on the local resources for harnessing their living. In Chogodrong, highest proportion of income (93.7%) comes from off the farm, however in contrast to Yuljik, where most of the family members are permanently employed outside, in Chogodrong, they go for temporary miscellaneous jobs. A second highest proportion of the total household income is obtained from the farm in Arifabad.

Figure 3.3 Comparison of income from the farm and from off the farm



3.4.2 Household Income and Dynamics of Human Capital

Consumer worker ratio and index of labour availability have been identified as important factors that affect the income earned from the farm and that from off the farm. Consumers refer to all family member both adults and children. Workers consist of number of persons involved in any productive activity as responded by the villagers. Consumer worker ratio is lowest in Ginnyal, and highest in Yuljik. The workload is lowest in Chogodrong and highest in Ginnyal. Workload is profoundly influenced by the area under cultivated land. In Yuljik income from the farm increases with the increase in the C:W ratio, reason being that in this village, the workers are considered mainly those who are working outside the farm; conceptually perceived

difference based on less land holding and its small production: since employment means wages and not the subsistence activities (Anonymous, 1987), therefore increased C:W ratio clearly implies that more labour should be available to work on the farm, if the objective is to increase the income from the farm, for no farming component is mechanised. In reality the inverse relationship between C:W ratio and the income from off the farm supports this logic. The foundation of negative relation between index of labour availability and income from the farm (R-Sq. = 71%), in Arifabad, creates perplexity. As a justification, however it is argued that with the increased number of labour, in fact the number of consumers would increase, because more than 90 % of the food produced from the farm is allocated for household consumption and when labour would increase, in practice more units of food produced locally would be consumed and less would be available to sell in the market. It is also justifiable from the reality that most of the farm activities have been mechanised. Therefore the increase in units of labour input would give no extra benefit. A negative effect (R-Sq. = 55,5%) of C:W ratio on the income obtained from the farm in Chogodrong, implies that here those persons are considered workers, who physically work on land. The positive correspondence of farm income to the index of labour availability in Chogodrong, shows its dependency on the cultivated land. In contrast non-dependency of farm income on index of labour availability in Ginnyal, is due to its higher reliance on the livestock, which is traditionally less labour demanding.

3.4.3 Dynamics of Household Expenditures

Food

The highest cash income in absolute terms is spent on food in Yuljik in average, and nearly the same in Ginnyal, where the expenditures exceed the total income. The lowest amount of cash is spent on food in Arifabad (Table 3.4). In Yuljik food expenditures are directly related to the number of consumers and the income from off the farm (R-Sq. = 81%). In Arifabad, albeit high access to the market, there is 50% share of food produced each from the farm and purchased from the market to the household consumption. However it seems to be affected by some other factors. Both in Chogodrong and Ginnyal, food expenditures are the matter of income, but the case of former partly depends on the income from off the farm, whereas that of the latter strongly (R-Sq. 93,7%) depends on income from the farm. The reason for independence of food expenditures from the income from the farm in case of Chogodrong, is very small share of farm income (6%) to the total income. A contrary interpretation stands valid in case of Ginnyal, as farm is the major income source.

Usually three meals are prepared and consumed in DCZ and MDCZ, four in TCZ and five in SCZ. The reason for increasing number of meals with increasing altitude is higher energy

demand for biological maintenance and reproduction (Bayers and Sainju, 1994). The diversity of meals is highest in the villages with highest accessibility, which goes on decreasing with the increasing inaccessibility.

Fuel

People in Arifabad and Yuljik spend highest, almost equal amount of cash, on purchasing fuel from the market, whereas in Chogodrong, they spend the least cash. In Yuljik, there prevails a positive relation (R-Sq. = 93.6%) between fuel expenditures with area under forest and income from the farm, showing that the villagers are giving period to their private forest to mature and plan to use it sustainably in future. In Arifabad, fuel expenditures are inversely proportional to the area under forest showing that they fulfil their fuel needs from their own forest. As they established their forest long time ago, they try to fulfil their needs from it. However they do not exert pressure on it and fulfil their enhanced needs by increased purchasing from the market. In case of Chogodrong both income form off the farm and the area under forest, positively affect fuel expenditures. It manifests that people in Chogodrong are conscious to establish their private forests and prefer to invest for future use, similarly as in Yuljik.

Education

The highest cash income is spent on education in Arifabad, both in relative and absolute terms, whereas the lowest is spent in Ginnyal. In all the villages, education expenditures are directly proportional to the number of children attending the school. In case of Arifabad, it also depends on the total income (R-Sq. = 70.3%), whereas in Ginnyal, it depends only on income from the farm (R-Sq. = 92.3%). In case of Yuljik, its independence from the income, may be due to the highest access to the schools.

Health

In all the villages, low amount of cash is spent on this social component. The major reasons include unavailability of proper health facilities in the villages, distant location of health centres and the presence of government dispensaries, where ordinary medicines are available free of charges. In the entire region, a general lack of motivation to contact medical physician at the time of physical suffering, prevails, which partly contributes to the less expenditures spent in this sector. At most instances, the major source of treatment are spiritual people, majority of the people believe on charms given by them. In highly inaccessible villages like Ginnyal, reason for lowest expenditures is their traditional use of medicinal plants. In all the villages except in Ginnyal, health expenditures are positively related to the household income.

Social Relations

Among all the villages, people in Arifabad spend the highest cash on their relatives to keep them tied together, whereas lowest cash is spent on relatives in Ginnyal. It is evident that in Arifabad, the society is more interconnected and more united. Therefore the needs of the individuals are considered as the needs of the entire community. Most of the work is done jointly for collective welfare. In all the four villages, the expenditures on social relations depend on the income from off the farm.

Table 3.4 Household income and expenditures in different AEZ

Income / Expenditures	SCZ (Rs.) (%)	TCZ (Rs.) (%)	MDCZ (Rs.) (%)	DCZ (Rs.) (%)
Total income	**25143**	**34103**	**34278**	**68677**
Food exp.*	27190 (108)	23333 (68.4)	14919 (43.5)	27656 (40.3)
Education exp.	38 (0.1)	2450 (7.2)	3422 (9.9)	2203 (3.2)
Health exp.	69 (0.27)	1738 (5)	1404 (4)	1819 (2.6)
Livestock exp.	243 (0.97)	1123 (3.3)	1541 (4.5)	966 (1.4)
Agriculture exp.	95 (0.38)	354 (1)	2257 (6.6)	1619 (2.4)
Fuelwood exp.	705 (2.8)	436.3 (1.3)	3770 (11)	3600 (5.2)
Exp. on relatives	148 (0.59)	1483 (4.3)	2728 (8)	1988 (2.9)
Miscellaneous exp.	305 (1.2)	2553 (7.5)	1393 (4.1)	2497 (3.6)
Total expenditures	**28793 (114.5)**	**33472 (98)**	**31433 (91.7)**	**37261 (54.3)**
Savings	0 (0)	83 (0.2)	1148 (3.3)	29952 (43.6)

* expenditures

Livestock

The people in Arifabad spend the highest amount of cash on livestock, whereas the lowest amount is spent in Ginnyal. In Arifabad, perhaps it is due to the adoption of better disease management of animals, which is also affirmed by the fact, that the trend of diseases among livestock has considerably decreased or in other words diseases have been controlled. Livestock expenditures are affected by the income from off the farm. However it has been found that it is not directly related to the livestock production but to the access to the veterinary facilities. In Ginnyal, only sheep population affects livestock expenditures positively. In Chogodrong milk production corresponds with the expenditures on livestock. This relevance shows, that the highest expenditures are accrued by the remuneration given to the group, that is responsible for

collecting and processing milk on the pasture during summer. This finding implies, that if livestock is given higher attention and investments are increased, the production can be enhanced and surplus can be sold in the market.

Agriculture

The highest expenditures on agriculture are spent in Arifabad, and it is reflected from the adoption of intensive methods of cultivation, that they correspond to the use of chemicals, for controlling pests and diseases. It was reported that with the use of pesticides farmers can control the crop diseases. The least expenditures are spent in Ginnyal and Chogodrong. It s important to note that the farming practices are highly traditional and negligible adoption of intensive methods has taken place in both these villages. The second highest expenditures are spent in Yuljik, where three factors affect it positively (R-Sq. = 72.3%), i.e. income from off the farm, area under cultivated land and the amount of chemical fertiliser added to one kanal of land. In Arifabad, it also depends on the total income, and area under cultivated land. In Ginnyal, it depends only on the income from the farm.

However, the expenditures in this sector are not showing any relation with the trend in crop production in any of the four villages. The state of no correlation between the expenditures and the trend in crop production with reference to lower two zones, shows that farmers are not aware of the adequate knowledge for specifying their expenditures on different inputs of intensification (pesticides, chemical fertilisers and HYV) to increase their production.

Savings

The highest proportion of income, both in relative and absolute terms, is saved in Yuljik, whereas there is no trend of saving in Ginnyal. In Yuljik, it is positively related to the total income (R-Sq. = 99.4%),. It seems to be an outcome of social awareness and understanding of the importance of capital generation for economic development.

3.5 Socio-Economic Status of the Households

According to our criteria of computing the social standard (Table 3.5) of the villages, Chogodrong carries highest standard of all, reason being that no household suffers from very poor standard of living, and almost equal proportion of population falls within fair and good living standards. In Ginnyal 76.2%, and in all other villages, almost 50% of the population is living with poor social standard. Except 3.70% of the households in Arifabad, no household in any of the other villages, enjoys the best social standard. However, as far as the economic

Table 3.5 Categories of indicators of social status of the households

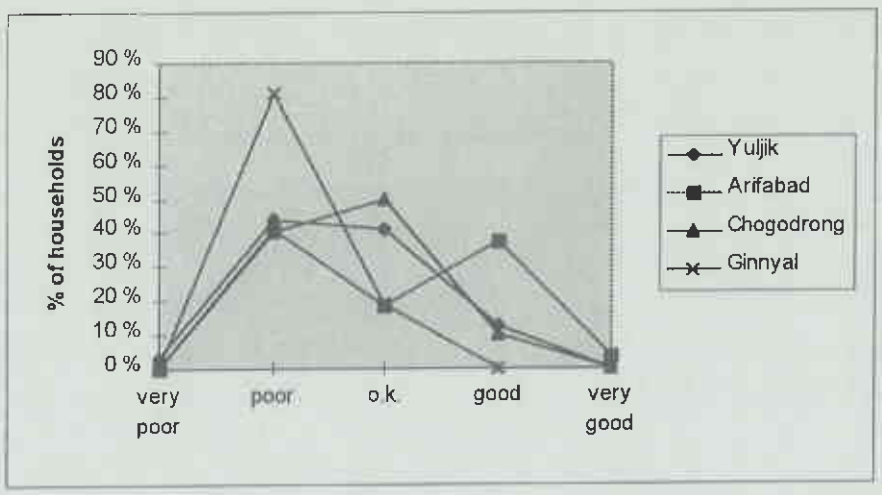
Category	Workload (kanal / worker)		C / W ratio	% of school going children	Expend. on food / person	Expend. on health / person	Expend. on education / child	No. of animals slaughtered / year
	DCZ	MDCZ, TCZ, SCZ						
very poor	> 6	> 5	> 5	< 20	< 1000	< 100	< 100	< 2
poor	5 - 6	4 - 5	5 - 3.5	20 - 40	1000 - 1900	100 - 150	100 - 150	2 - 3
O.K.	4 - 5	3 - 4	3.5 - 3	40 - 60	1900 - 2200	150 - 200	150 - 200	3 - 3.5
good	3 - 4	2 - 3	3 - 2	60 - 80	2200 - 3500	200 - 300	200 - 300	3.5 - 5
very good	< 3	< 2	< 2	> 80	> 3500	> 300	> 300	> 5

Table 3.6 Categories of indicators of economic status of the households

Category	Cultivated land per person (kanaals)				Income / person	Fruit area / person	Forest / person	SLU / person	Expend. on agriculture / kanal of cultiv. land	Expend. on LS / SLU	Savings / person
	DCZ	MDCZ	TCZ	SCZ							
very poor	< 0.4	< 0.7	< 1	< 1.4	< 1000	< 0.04	< 0.4	< 2	< 50	< 40	< 100
poor	0.4 - 0.9	0.7 - 1.2	1- 1.4	1.4 - 1.9	1000 - 2500	0.04 - 0.09	0.4 - 0.9	2 - 4	50 - 100	40 - 80	100 - 300
O.K.	0.9 - 1.1	1.2 - 1.5	1.4 - 1.6	1.9 - 2.1	2500 - 3500	0.09 - 1.2	0.9 -1.3	4 - 6	100 - 200	80 - 125	300 - 450
good	1.1 - 1.5	1.5 - 1.9	1.6 - 2.1	2.1 - 2.5	3500 - 5000	1.2 - 1.7	1.3 - 2	6 - 8	200 - 300	125 - 200	450 - 600
very good	> 1.5	> 1.9	> 2.1	> 2.5	> 5000	> 1.7	> 2	> 8	> 300	> 200	> 600

standard (Table 3.6) is concerned, Yuljik shows the highest level of economic standard, followed by Arifabad. The distribution of the households among different categories of the economic status within the villages of Ginnyal and Chogodrong, is such that both seem to have low economic standard. In both these villages, highest population (76%) bears low economic standard. Arifabad is the only village, where some proportion (18.52%) of the population has very good economic standard, on the other hand, in Yuljik, relatively highest population (40.62%) has fair living standard.

Figure 3.4 Percentage of households and socio-economic standard



The highest economic development in Yuljik, does not seem to be the outcome of its distance from the town. However it can be predicated, that it is the outcome of high literacy rate, higher involvement in the off-farm employment and greater exposure to the urban areas. As a consequence, people have high influence on the regional socio-political sphere. It is also evident, that more than 80% of the income is obtained from outside the farm. This situation is an outcome of the small land holding, less production from the farm, and high awareness to acquire social adjustment and improve economic status.

The computation of the overall socio-economic status of the villages, declares Chogodrong and Arifabad as the best of all, and the Ginnyal as the worst of all, with only 19.05% of the population having fair socio-economic standard, whereas no household lies in other two higher categories. In all the three villages except Yuljik, there is no household, that suffers from extremely poor socio-economic standard and only in Chogodrong, 50% of the households enjoy fair socio-economic status. This confounding result in case of Chogodrong predicates that many socio-economic factors like outmigration, high consumer worker ratio and high workload are

being considered as negative, and strength of local institutional management system and that of cultural adherence are healthy or important. It indirectly implies that for the improvement of overall socio-economic status of these indigenous communities through economic upgradation is important but not of sheer importance. Rather it is partially dependent on the decisions of the communities, how rationally they respond to the changing needs of their internal and external socio-economic environment, by keeping practical intact relation to their socio-cultural values.

3.6 Village Institutional Management System

In Arifabad, institutional management system is in the hands of a confraternity, i.e. religiously and socially accepted group of respected people, authorised to make all level of social decisions. They also decide about the development projects for collective welfare, e.g. construction of a culvert or establishment of a girls school. They play a vital role in the management of the natural resources and arbitrate the village level disputes. This confraternity has established a platform to design proposals for collective welfare, make proceedings to achieve their related objectives and have the capacity to present their problems to local government or administration, or even to outside development agencies for financial request. Being self motivated, they have established a village level NGO for social welfare.

In Yuljik, traditional local management system has completely deteriorated due to labour shortage and socio-cultural alienation, as internal factors and political intervention, as external factor. When government incorporated its political package, only rich people, having access to administrative centres, came ahead and were selected as village representatives, so the influence of the person, who was locally responsible to keep law of management and use of resources, was not accepted any more. This process of deterioration progressed gradually and has been completely abolished since three to four years. As the villagers claim, that they are self motivated and can contemplate to solve their problems, some wise people gathered from each Sirmik village and with the consent of the majority formed a "Tanseem" called "Tanseem Nojwanan-i-Falah-o-Behbood Sofia Noor Bakhsia". It is a registered organisation, a kind of village assembly, comprising ten members, and is responsible for resolving all the conflicts regarding village resource use, as well as other social concerns. Due to its satisfactory performance, it has acquired good reputation and appreciation in the National Assembly of Pakistan.

In Chogodrong, traditional local management system consists of three influential persons, who have promulgated rules and regulations pertaining to the management of almost all the natural resources, which are rarely violated by the villagers. It is working satisfactorily most probably due to less external intervention, by virtue of less access to the town and lower

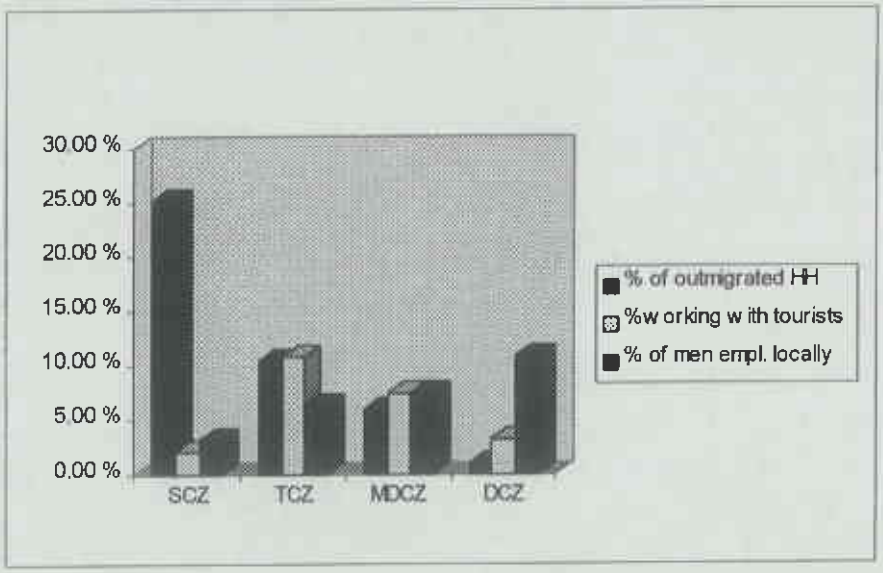
dependence on the outside resources. Similarly in Ginnyal, there is a traditional local institutional management system but it has started degrading.

3.7 Human Resource Input in Farming System

3.7.1 Labour Availability

In a subsistence farming system, humans contribute a major input in the form of labour. This labour is not only the adult labour, children also play also an important role in fulfilling the labour demands of different farming activities (Ellis, 1993), which are labour intensive. They are also forced to work in the face of labour shortage, resulting from considerable number of males working outside. Apart from those who temporarily go out for seasonal jobs, these outside workers also include males permanently employed outside. This permanent outside employment is a kind of circulation migration, because these rural migrants after retirement get back to their villages (Devia, 1996).

Figure 3.5 Pattern of employment and migration in different PAEZ



Study reveals, that percentage of men employed outside is not a function of AEZ, access to the market and family size. There is also no trend in seasonal migration with respect to AEZ, but percentage of men employed locally showed increasing trend with increasing cropping intensity. Percentage of men working with the tourists is the highest in TCZ, but there are no significant variations among the zones. The variable, which seems to depend on the agroclimatic conditions, is the percentage of outmigrated households, which increases with the increasing altitude and decreasing cropping intensity ($p=0.11$).

Table 3.7 Labour availability in different AEZ under practise

AEZ under practice	Reported labour availability (%)	Calculated labour availability (%)	Summer sex ratio
SCZ	100	50	66.9
TCZ	98	100	61.5
MDCZ	73	70	77.98
DCZ	70	56	37.26

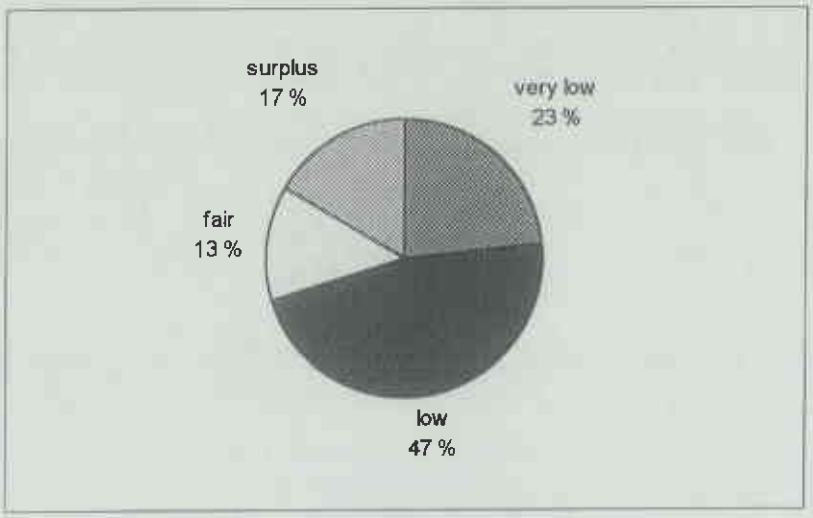
The reported labour availability does not depend on SSR, family size and composition and area of cultivated land but shows decreasing trend with increasing cropping intensity as well as with increasing access to the market, with exception of Rizvia. Whereas the calculated labour availability (Index of labour availability) is directly proportional to the family size and SSR. Calculated labour availability refers to all present adult (above 13 years of age) males and females. Low productive, complex farming systems, are characterised by a situation of labour underemployment (Siddiqui, 1995), i.e. labour is not used efficiently because of manual operation of all the activities, that is why if the farm size increases, the labour requirement is naturally augmented, that logic is underpinned by calculated labour availability.

According to the calculated labour availability (Appendix I), 23% of the villages Kharfak, Yugu, Dasunit Shiger, Mangu Shiger, Tisardoko, Shigerthang, Harkhorbarapaen), have been found to have acute labour shortage (Fig. 3.6). In Kharfak, despite extremely small family size, villagers are optimally utilising their resources, most probably due to community labour input. It was assessed by the percentage of fulfilment of household consumption requirements (fodder, fuel, FYM and food) from the local production. Despite large family size, Yugu stands under this category, due to large number of men working outside. The order of the activities in terms of labour distribution is cultivated land, livestock farming and forest management. Although they can potentially produce three times large amount of fuel from their forest but may be due to short labour input, this resource is being underutilised.

In Tisardoko, there exists an original labour shortage because of higher proportion of labour demanding farm components. Dasunit Shiger has the lowest SSR of all the villages because almost 85% of the men are working outside in summer. Similarly in Mangu Shiger, 50% of the men are not present in summer. There exists higher market dependency for procuring food which is probably due to higher cash income, despite large area under cultivation and the largest number of livestock per household. In Shigerthang, labour shortage is provoked by the combination of very large land and livestock holding, coupled with small family size. In Harkhorbara Paen, the main reason for labour shortage is extremely high area (47 kanals per household) of fruit trees. All of the three villages bear original labour shortage, it means that

shortage of labour is not created just by outside employment, and even if all the village men would be available to work, still these villages would experience labour shortage. This group, excluding Tisardoko and Shigerthang is proposed to incorporate some appropriate labour saving technology, after adaptive research. In Tisardoko and Shigerthang, incorporation of labour saving technology is not feasible due to their topography.

Figure 3.6 Percentage of villages verses labour availability



Note: very low - less than 40%, low - 40% to 80%, fair - 80% to 100%, surplus - more than 100% of the required labour

17% of the villages (Sondasgon, Birchung Keris, Hatchi, Karimpa Olding and Chondu Thalley) have been found to have surplus labour. All of them have small land holding. A very small proportion of men is absent during the peak season, therefore SSR is quite high. Livestock holding is medium in all these villages. Sondasgon and Chondu Thaley have large family size.

3.2 Difference between Reported and Calculated Labour Availability

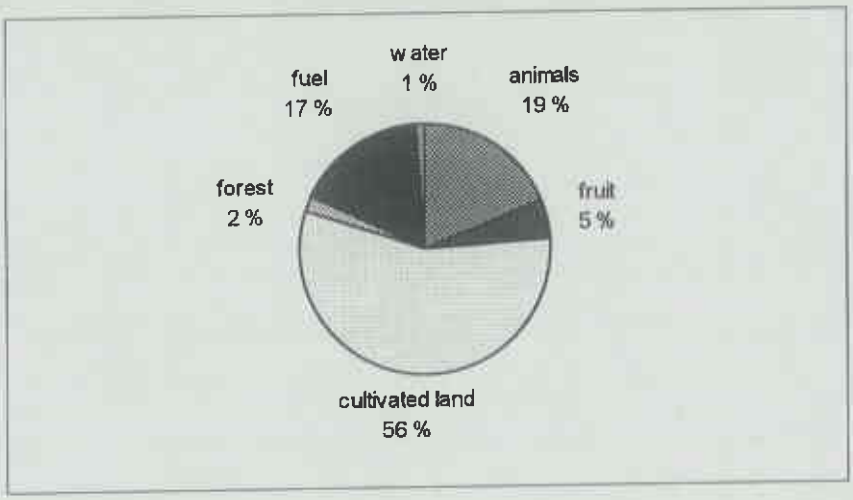
13.79% of the villages report labour availability equal to the potential (calculated) labour availability, whereas 24% of the villages report less labour than calculated and 62% of the villages report higher labour availability than calculated labour availability. It is evident that those villages, that report less labour availability, are underutilising (underemploying) their potential available labour. In the third case, it can be interpreted as either some of their production activity is being mismanaged (i.e. the resource base is present but production is not optimum), or they have strong local system of management, that makes it possible to overcome the problem of labour shortage. Other justifications may be overburden of work on women or higher labour availability being attributed to young children (under 13 years).

It has also been found that in the face of presence of schools (significant with girl schools: $p=0.076$), the reported labour availability is lower than that of the calculated one. On the other hand, the villages having machines, responded higher labour availability than the calculated one. It implies that the facilities of girls education affect labour availability negatively and availability of machines can reduce labour requirements.

3.7.3 Labour Distribution

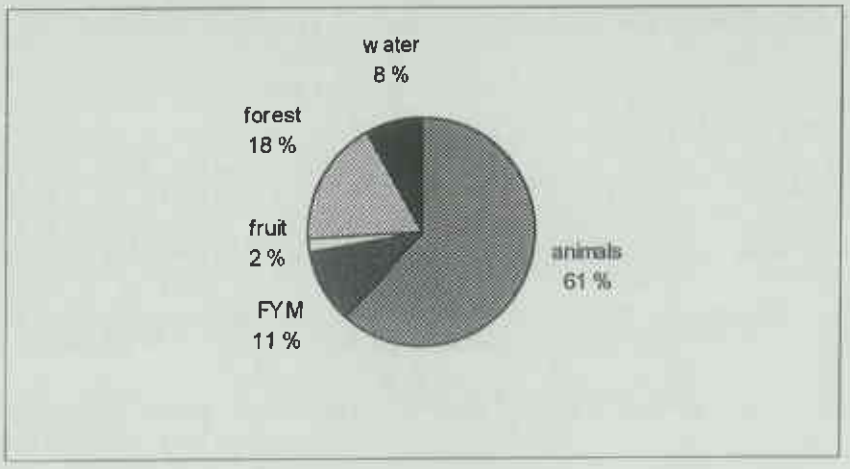
Land cultivation is most labour demanding activity, followed by livestock, whereas forest management requires least labour during summer. The variations among the distribution (requirement) of labour to different seasonal activities are exhibited in Figures 3.7 and 3.8. As being comparatively more important farm activity, fruit management requires comparatively high labour input in the MDCZ.

Figure 3.7 Proportional labour required for different activities in summer



In average, in all the villages, livestock management is the most labour demanding activity during winter. In winter, water fetching occupies comparatively high proportion of labour in SCZ (see chapter 3.5).

Figure 3.8 Proportional labour required for different activities in winter



The regression analysis shows, that the proportional labour required for different farm activities is not dependent on the proportion of land allocated to them, except fruit. Rather it depends on the total area under forest, fruit and cultivated land and is very weakly dependent on the total number of the livestock.

Table 3.8 Proportional labour requirements by different farm activities

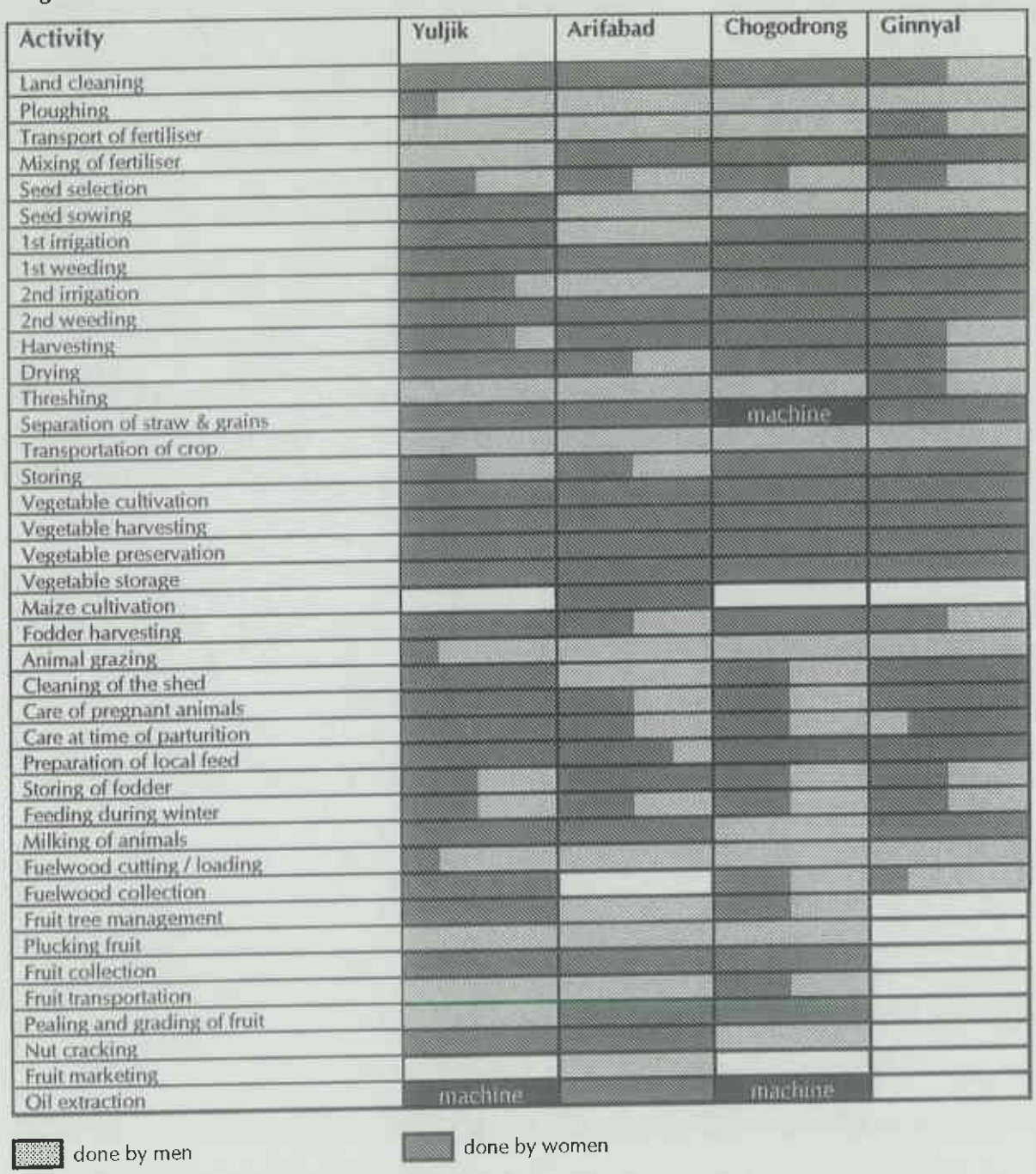
Season	Cropping zones	animals (%)	cult/FYM (%)	forest (%)	fruit (%)	F+F (%)	water (%)
Summer	SCZ	18.9	62.3	0.6	0.9	16.2	11.0
	TCZ	25.0	40.9	0.4	2.3	30.8	0.5
	MDCZ	15.8	60.9	3.0	8.8	10.9	0.5
	DCZ	14.9	60.4	0.5	15.0	22.2	0.4
	average	18.5	56.7	19.0	5.0	17.5	0.5
Winter	SCZ	53.0	11.8	12.2	0.3	0.00	22.6
	TCZ	73.3	13.4	6.2	1.0	0.00	6.1
	MDCZ	55.9	10.6	24.9	3.7	0.00	4.9
	DCZ	68.6	10.6	16.2	0.5	0.00	3.9
	average	60.9	11.3	18.0	23.0	0.00	7.5

3.2.4 Gender Division of Labour

In all the four zones, indoor household activities like, cooking, cleaning and washing are women specific. In this region, farm work can generally be described as gender sequential (Whitehead in Ellis, 1993), because women and men do not have separate piece of land, rather perform different activities on the same land. Some of the activities are performed jointly, whereas others are specifically divided between men and women and their labour cannot be substituted. For instance women are fully responsible for vegetable cultivation, fruit collection,

weeding and separation of straw and grain, men transport grains and fertiliser, plough the fields and take control over the marketing of farm products. Division of other activities (Figure 3.9) varies among the villages, depending upon local conditions and traditions.

Figure 3.9 Gender division of labour

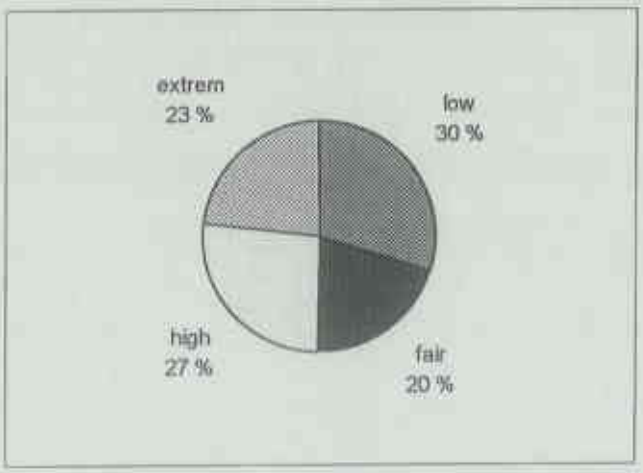


3.5 Women Workload

The result of regression analysis shows, that the number of men involved in off farm activities, considerably affects (R-Sq. = 73.7%) SSR and consequently labour burden of women. The SSR ranges from 11.5 to 122, with the mean of 68.1. All the off farm activities (permanent

outside employment, seasonal employment, working with tourist and also studying outside the village), except local employment, significantly affect women workload. It is obvious that outmigration is the major factor which alters the sex balance, also found by Devia (1996).

Figure 3.10 Relative women workload



Note: low - less than 0.83, fair - 0.83-1.2, high - 1.2-1.64, extreme - more than 1.64

In 30% of the villages, women labour input is lower or the same as that of men, but in the remaining 70% of the villages the workload of women exceeds that of men. There is extreme burden of work on women in 23% of the villages (Fig 3.10), where their labour input is more than double than that of men. The highest workload on women (6.3 times higher than men) has been found in Risarsixa. Women are working long hours not only during the peak season, as often perceived, but also remain equally busy during winter, because when crop cultivation and harvesting is completed, they take care of animals, which have been brought back from the pastures. Moreover in the villages without prompt winter water supply, they have to go daily for fetching water.

Except one to three months in every zone when women have to work for even 16 hours per day, there is not a tangible difference in their workload during the peak season and the rest of the year. For instance April, September and October in DCZ, May in MDCZ, March in TCZ, and May and September in SCZ are the months when more women labour is required. Qualitative analysis of information received from the seasonal calendars of activities shows, that the labour input given to indoor activities declines during the peak farm season.

4. RESOURCE UTILISATION

4.1 Farm Components and Their Management

4.1.1 Comparisons of Land Holding

Though the human population in Baltistan (11 person per square kilometre), is comparatively very low in contrast to the other parts of Pakistan but a very small land holding is an effect of topography.

Total private land holding varies from 4.9 to 539.2 kanals per household with 50% of the villages having less than 28 kanals per household.

36.67% of the villages, have more than 20 kanals of cultivated land per household, whereas 10% of the villages have up to 5 kanals, and in rest of the villages, land holding varies from 5 to 20 kanals per household.

4.1.2 Land Use Variations

The total land per household does not vary significantly with respect to the agroecological zones (the same results with potential and real under practice), but they affect the land allocated to crop cultivation. The highest land under cultivation has been found in SCZ ($p=0.002$). It seems to be an outcome of higher access to land. There are no significant differences in land allocated to forest, fruit and pasture with respect to AEZ but among the all four zones, largest area is allocated to these farm components in the MDCZ. It is perhaps due to less access to common resources, and comparatively high access to the market and relative importance of the farm components.

Table 4.1 Area allocated to various farm components in different PAEZ

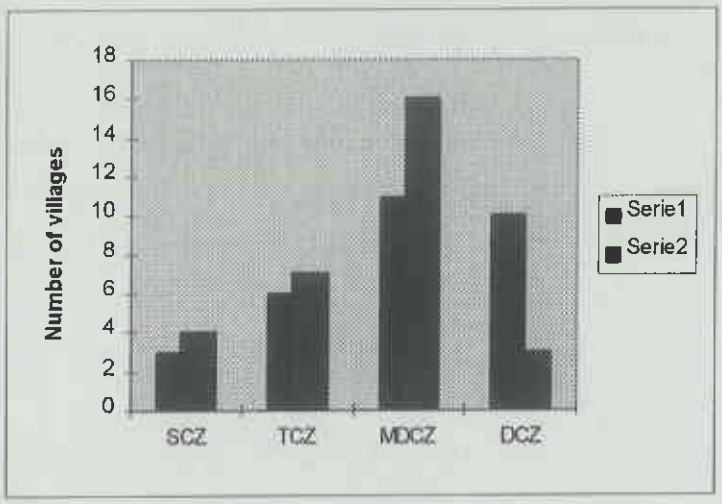
PAEZ	Cultivated land/HH	Forest/HH	Fruit/HH	Pasture/HH	Total land/HH
SCZ	34.26	12.86	0.019	10.4	57.57
TCZ	8.96	3.16	0.969	6.86	19.95
MCZ	19.75	31.7	5.33	35.5	92.34
DCZ	13.88	16.72	2.83	4.47	37.02

4.1.3 Cropping Intensity

Basically farming systems are shaped by agroecological factors, varying among the different zones. Cropping intensity is minimum in SCZ, due to the longest winter (Table 4.2), e.g. in Ginnyal, during some years (1996), even wheat does not ripe. Even to exploit the minimum cropping intensity potential, spreading of mud on the fields in the end of winter for rapid

melting of snow is very necessary practice. However, some of the villages under study, in practice do not exploit the agroclimatic potential optimally. One village has shifted from MDCZ to TCZ, six from DCZ to MDCZ and one village shifted from DCZ to SCZ. In total, 26.7 % of the villages are not practising their actual potential of cropping intensity, implying that they underutilise their potential of biophysical resources. The factors leading to this situation are in fact many and complicated. It is predicated, that they include land alienation due to improved access to the market (market dependency), degradation of local institutional management system, more involvement in off-farm activities (higher SSR), trend in crop production (a lower trend declines the CIF) and water shortage in some of the villages (Kwardo). The last constrained has also been identified by Mulk (1992) in Chitral.

Figure 4.1 Distribution of villages among AEZ



Series 1 = No. of villages potentially lying in corresponding zones
Series 2 = No. of villages actually practising the crop intensity

Table 4.2 Length of cultivation period in different PAEZ

Agroecological zones	From	To	Length (months)
SCZ	15th May	1st September	4 to 4,5
TCZ	1st April	31st September	6
MDCZ	1st March	15th October	7 to 7,5
DCZ	1st February	31st October	9

4.1.4 Crop Cultivation

Activities of crop cultivation and harvesting are distributed specifically and sequentially among both the genders (Fig. 3.9). In majority of the villages, activities like ploughing, hoeing, threshing and transportation of grains, are done manually with the help of drought animals, mainly cattle. In SCZ, horses are also used for this purpose. It was reported in Yuljik, that local

plough is laborious, does not break clots and cannot plough deep in the soil to bring the nutrients on the surface of ground. Modification of the plough design was suggested during workshop. Irrigation is gravity fed in all the villages and is not gender specific. To reduce water loses during irrigation, fields are divided into smaller parts by making artificial ridges in them. Some practices are not friendly to the fragile conditions of the soil. For instance flood irrigation causes leaching of nutrients, in turn increasing water demand. Conversely delayed irrigation of crop fields retards crop growth and its yield. Subsequent irrigation after urea application results in volatilisation of urea. The method of deep ploughing after broad casting drives the seeds deep into the ground and reduces their rate of germination.

In whole of the region, cereal crops are harvested with roots. After harvesting all the crops, animals are left free on the fields to graze on agricultural wastes, which devoides the land of being enriched by the organic matter. Though animals add their manure to the soil but its organic contents decompose under sun radiation.

In both the lower zones, in those villages, where hydro-electricity is generated, electric grinding machines are available, for example in Arifabad and Yuljik, however in the upper two zones, almost all the villages use water mills, as in Chogodrong and Ginnyal. Water milling is highly time consuming and labour demanding task. In Ginnyal, water mills are situated on the river bank at large distance from the village.

4.1.4.1 Crop Diversity

In DCZ, wheat is the major crop followed by maize as a second crop, for human consumption. In MDCZ, wheat and barley both are major crops and are cultivated as first crop. However wheat is the only crop whereas barley being early maturing crop is followed by some minor crop as a second crop. Some farmers have started cultivating maize after harvesting wheat and barley, for animal consumption. In TCZ, barley is the major crop and wheat is also cultivated on some proportion of land. Buckwheat and sorghum or millet are the second crops. In SCZ, barley is the major crop together with some wheat cultivation. Some people also grow sour buckwheat.

Index of crop diversity ranges from 1.09 to 3.37 with the mean of 1.89. Although the village (Rizvia) having highest access to the market, deviates from this finding, the rest of the villages show an increasing crop diversity with increasing access to the market. Crop diversity is partially positively affected by crop intensity factor. The reason for high crop diversity with increased access to the market, is the cultivation of HYV, together with indigenous crops.

Table 4.3 Crop distribution

Agroecological zones		Area under different crop groups				Crop Intensity Factor
		Major crops (%)	Minor crops (%)	Potatoes (%)	Vegetable (%)	
Potential AEZ	SCZ	87	2	9	2	1.00
	TCZ	64	24	3	10	1.43
	MDCZ	65	20	10	5	1.24
	DCZ	75	10	4	10	1.46
AEZ under practice	SCZ	89	1	7	3	1.00
	TCZ	65	22	5	8	1.40
	MDCZ	67	17	7	8	1.36
	DCZ	81	10	5	5	1.60

From the qualitative analysis of the four case studies, in different agroecological zones, it has been found that the diversity of indigenous crop genetic material has decreased in the villages nearest to the market as in Arifabad. Similarly a highest trend of importing HYV of both grains and vegetables, is found in Arifabad, whereas no trend of importing HYV is found in Ginnyal. It has been reported that in those villages with higher indigenous crop cultivation, seed selection for cultivation is distributed between both men and women, whereas seed grading is done only by women and the best seeds are sold in the market, in Yuljik and Chogodrong. A very small number of farmers purchase grain seeds from the market. There exists a traditional system of exchanging wheat seeds among the villages. In SCZ 100% of the seeds are produced locally, whereas the smallest proportion (74%) of the seeds is produced locally in MDCZ.

A number of local vegetable varieties are cultivated for household consumption because of their taste and short shelf life. HYV of vegetables are cultivated for market due to long shelf life (Table 4.4).

Table 4.4 Vegetable diversity

Autochtonous vegetables	*Peas, turnip, white carrot, potatoes, spinach, tomatoes, onion, salad, fraws beans, cucumber, pumpkin*
Allochtonous vegetables	*Turnip, cauliflower, cabbage, reddish, red carrot, Capsicum (bell pepper), bringal, fenugreekum, lady finger, kidney beans, lentil, bitter gourd, garlic, ginger*

4.1.4.2 Area Allocated for Subsistence Production

As most of the farms are meant for subsistence production, most of the land is used for production of household consumption goods. The largest area is allocated for subsistence

production in SCZ, major reason seems to be its inaccessibility to the market, the second largest area is allocated in DCZ, due to comparatively low access to the market because of large distances. In MDCZ the least land is allocated for subsistence production due to an increasing trend to cultivate for the market. For example Harkhorbara Paen, Yugu, and Khurshidabad, regardless of their slow access to the market, have been found to allocate largest area for market production. Their farms are gradually being transformed into the semi-commercial farms, by adopting intensive methods (chemical fertiliser, pesticides and imported seeds), as evident from percentage of area allocated for the market production, and another reason may be their comparatively large land holding per household.

The area allocated for subsistence production, seems to be readily a function of access to the market as compared to the cropping intensity. There is a very weak evidence of reduction in area for subsistence production with increasing CIF.

Table 4.5 Percentage of cultivated land allocated for subsistence production

PAEZ	Area allocated for subsistence production (%)
SCZ	98.8
TCZ	94.7
MDCZ	89.0
DCZ	96.7

4.1.4.3 Fruit Production

In fact there is no such fenced fruit orchards in any of the study area, fruit trees are informally planted either in the courtyard of the houses or in and around the crop fields. The highest land is allocated to the fruit crop in MDCZ (Table 4.1), whereas the lowest land is allocated in SCZ, where very few fruit trees are grown because fruit does not ripe due to short summer season. Therefore the highest proportion of fruit production is marketed from MDCZ. However it was found that poor management of the fruit trees results in low yield in all lower three zones. Different regions are popular for peculiar varieties of the fruits, for instance Kharmang, Olding and Shiger valleys for the varieties of apricot, and Kachura, Pari, Hashoopi and Skardu are famous for apples. The best quality grapes are found in the valleys of Rondu, Kwardo and Komra. Walnut, pears, peaches, almond, cherries, plums and mulberries are other important fruit.

The highest diversity of good quality fruit exists in MDCZ. In Arifabad, twenty best varieties of apricot, seven varieties of apple, five of mulberry, two of grapes and cherry each, three of

almond, and four of walnut are found. Most of the apricot varieties in DCZ, are of poor quality and their by-products are mainly used for livestock. Some grapes and few walnut trees are also found there. The fruit diversity descends in order from Yuljik, Chogodrong to Ginnyal.

Both in DCZ and MDCZ, FYM is added to the fruit orchard. In Arifabad, it was found, that the production of the old trees starts declining, therefore their replacement is very important. Old trees are vigorously and methodically loped off for firewood and timber. In almost all the villages, leaves and poor quality or low graded spoilt fruit are fed to the animals, in form of molasses. The kernels of apricot and nuts of walnut and almonds have multiple uses. The nuts are either consumed during winter or they are milled to extract oil and their cover is used as fuel. In Sirmik valley, apricot varieties are of poor quality. Both apricot and nuts are bitter in taste and are not suitable for human consumption.

4.1.4.4 Source of Irrigation Water and Its Distribution

With few exceptions, the source of irrigation water is glacier in whole of the region. The details of management are described with the reference of four case studies.

In Arifabad, glacier melt water flows down by gravity forces into the stream from the major nullah and provides water to all the villages on its way. In the higher part of the valley bottom, it joints with many small natural water springs. Cloudy weather accrues severe water shortage in the nullah. This gap of water shortage is filled through the spring water supply for the purpose of irrigation. Rapid snow melting during intense sunshine days causes floods in the nullah, brings stones and mud and leaves behind big ditches on the upstream. High water flow erodes land on the sides of the nullah. Water shortage results due to seepage from the ditches. Due to the influx of aeolian soil, the water holding capacity of the soil has reduced and irrigation demand has increased, if it is not fulfilled then half of the seeds do not germinate. If weather is sunny then crops demand water every three days. A tank has been built to store water from the spring to prevent its wastage. It supplies drinking water to the villages through pipes. It has also mitigated the problem of water shortage. During winter, pipes are frozen and water supply is stopped even for drinking. Due to increased propensity of floods more soil and stones accumulate in the water tank that has to be frequently cleaned. Maintenance and rehabilitation of water channels is a collective responsibility. Due to the increased availability of water, area under cultivated land has increased. People are now developing the wastelands, that was previously used for livestock grazing. Within the village, the distribution of irrigation water is well managed. The villagers have regular property rights, as for cultivated land. There also exist rules for irrigating upper or lower fields. There is a system of "bari", nobody can use water from other's bari until and unless he gets permission from him. Cultivated land has priority for irrigation.

The main source of irrigation as well as drinking water in Yuljik, is Sirmik nullah, which dividing into smaller streams supplies water to the different villages. Since last one decade, floods have increased in the nullah, having eroded a lot of cultivated land. The system of management of water distribution within the village is same as in Arifabad.

The main source of water in Chogodrong is Mugas nullah, three main cools divert water to the village. In the month of June, due to rapid snow melting, muddy water flows down which is considered good for the crop fields. Water distribution in Chogodrong, is controlled by a group of three influential persons. In the absence of water shortage, bari system is applied to only one cool, however these three persons control the opening and closing of the cools.

In Ginnyal, bari system has been established to control water shortage. The person who has more land, has rights to get more water. Water borrowing system also persists in the village. Bari person controls the amount of water and is responsible for the maintenance of the cool. To alleviate water shortage, a tank has been built in the village, water conservation practices (mainly socio-technical) have been adopted for water utilisation. Cool is usually damaged due to floods during rainy season (June and August) and due to avalanches (heavy snow in December), bringing trees and mud. Rehabilitation work is done by both the genders from all the households.

From the inter-village study, 6.7% of the total villages, have been found to have acute irrigation water shortage, 23% bear water shortage throughout the year, and in 20% of the total villages, water shortage is a problem during early spring.

It is profoundly noticed that the villagers need to know the merits and demerits of irrigation water application because where it is abundantly available, excessive amount is applied and where it is short, crop growth is affected.

4.1.4.5 Use of Fertiliser

Farm yard manure (FYM) is one of the major livestock output, that subsistence communities yield from livestock for agriculture. Trend in prioritisation of crops for applying organic fertiliser is common. Greater proportion of FYM is added to wheat and millet fields in Arifabad, and to barley crop in Yuljik. In Arifabad, chemical fertiliser is added to maize and vegetables, whereas only to vegetables in Yuljik. No chemical fertiliser is supplemented in SCZ. Night soil is added to the fields of vegetables in Ginnyal.

The four case studies exhibit that the traditional practice of FYM preparation is being abandoned by almost half of the population both in Arifabad and Yuljik, though in very near past FYM was considered to be an important nutrient supplement to the soil. Similarly the quality of FYM has deteriorated, as the surrounding area under vegetation, which previously

used to be a part of FYM, has been included in the premises of airport in Arifabad, and due to less care given to the collection of night soil in Yuljik. In Yuljik, a great hesitation is found among the children and the males to transport it to the crop fields, and alienation among the young generation from the farm activities, has been reported by the villagers.

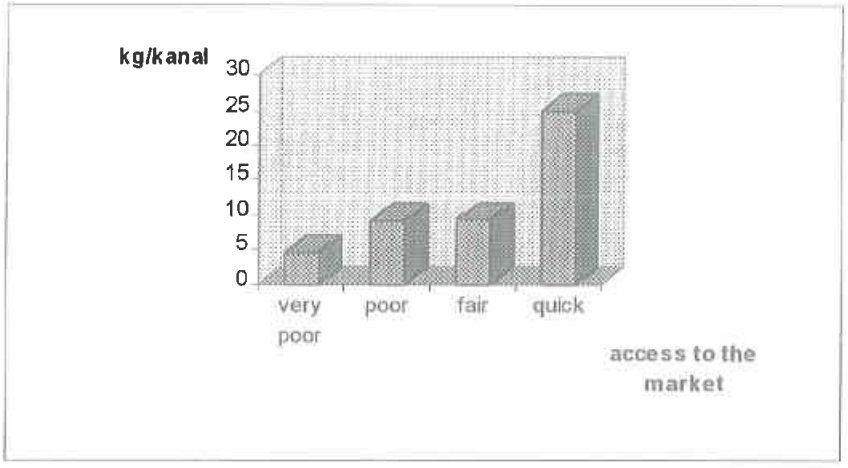
Table 4.6 Amount of fertiliser per kanal of cultivated land

PAEZ	FYM (monds)	Chemical (kg)
SCZ	10.40	0.00
TCZ	46.67	8.33
MDCZ	38.18	11.79
DCZ	50.00	6.90

In most of the valleys, where land holding is small and the output is not competent as compared to the input, a rapid switch to the chemical fertiliser took place. However due to sudden increase in prices, these semi-subsistence farmers could not maintain the required soil demand of fertiliser. Therefore they are gradually reverting back to their original track e.g. in Sirmik valley. Nonetheless they need skills and improved technology for compost preparation and transportation. The villagers are also sceptical about the use and impacts of chemical fertiliser. Nevertheless there exist good examples of proper preparation of FYM, and its adequate mixing with chemical fertiliser to get feasible economic as well as environmental results e.g. in many villages of Wazirabad and Gulapur in Shiger valley. However it is favoured by large land holding and high production in these villages.

The highest amount of FYM is added in DCZ, and the highest amount of chemical fertiliser is supplemented in MDCZ. However no significant differences have been found in addition of FYM or chemical fertiliser to the crop fields, with respect to PAEZ.

Figure 4.2 Use of chemical fertiliser verses access to the market



In view of majority of the villagers, 30 monds of FYM is an optimal quantity to sustain soil fertility. 26.7% of the total villages are adding less than this amount to their crop fields. Three of these villages lie in the SCZ, and five of them in the MDCZ.

The amount of chemical fertiliser added to one kanal of land, does not seem to have a strong affiliation with factors like percentage of land cultivated for vegetables, potato and maize and presence of VPPS, institutional support and the quantity of FYM. However it gives an impression of its comparatively greater dependence on access to the market ($p = 0.17$)

4.1.4.6 Control of Pests and Diseases

In 66.67% of the total villages, the incidence of diseases among the crops and fruit, has shown an increasing trend. Heavy losses among fruit crops due to insect attack, are reported from the villages that do not practice any control measures. In only 16.67% of the total villages, pest and diseases have been satisfactorily controlled, whereas 10% of the total villages report no problem. In many of the villages, smut and rust in different crops especially in wheat, has become a major problem. Previously, the attack of pests and diseases, in most of the villages, was kept under economic threshold by the cultivation of tobacco and some other medicinal plants on the field margins and by the addition of artemizia, natural flora that acts as insect repellent, to the FYM. In almost all the villages, a regular weeding is managed by women. Despite high labour demand, this traditional practice is believed to be the best method to control weeds. It is a kind of traditional IPDM practice, because while weeding women also mechanically control the insects in the crop fields. In Ginnyal as well as in Chogodrong, the persistent use of traditional practices to control pests, still keeps their damaging effect under economic threshold. Whereas in those villages, that are abandoning these traditional practices, the damaging effect is exceeding the economic threshold level. It is also provoked by the replacement of traditional crop varieties by HYV and due to the reduction in indigenous crop diversity. It is compatible with Bhati et al. (1992) in Himachal Pradesh, India. It necessitates that introduced varieties should be tested to assess their environmental adaptability. The major reason for increased pest and diseases among fruit crops, was also found to be the adoption of imported varieties. The fruit of local cherry during the year of 1995, was destroyed due to a disease called "crown gall", transmitted by the infected seedlings of imported cherry. Recently in Arifabad, the use of insecticides and pesticides, has been started but most of the villagers are unaware of the precise method of their application. It manifests the absence of proper extension services. In Yuljik, pesticides are not available in the local market. In almost all the four villages, charms are obtained from "ulama" and it is strongly believed that pests and diseases are controlled.

4.1.4.7 Trend in Crop Production

In 40% of the total villages, the productivity of cultivated land is reported to have increasing trend. In 33.33% of the total villages, it is declining, whereas in the rest of the villages, it is maintained. The productivity depends on how efficiently cultivated land is used. For instance in those villages, where only 43% of total land is under cultivation, farmers are managing to keep its productivity high. In contrast prevalence of decreasing trend in crop production in the villages where larger proportion (68%) of land is cultivated, shows that farmers do not manage their land properly, when proportion of area under cultivation is larger. Trend in crop production is weakly dependent on the presence of resource person i.e. VPPS in the village. However 80% of the villages, where crop production has a declining trend, do not have any VPPS, whereas in 66.7% of the villages with increasing trend in crop production, VPPS is present. It necessitates that the extensive utilisation of improved skills of VPPS is required to enhance crop production. It has been found that the increasing trend in crop production considerably depends on institutional development.

Fruit production is found to increase in 20% of the villages, whereas 43.33% of the villages have declining trend. The increase in production was attributed to increase in the area under fruit and control of pests and diseases.

4.1.5 Land Utilisation and Land Degradation

The index of land utilisation ranges from 0.107 to 1, with an average of 0.77. It does not seem to be the function of agroecological zones.

The index of land degradation ranges from 0 to 0.88 and does not show any correspondence with AEZ. In 13.33% of the total villages, more than 25% of the land has been degraded, whereas in 30% of the villages, there is no land degradation. Area under degraded land does not correspond to the percentage of animals taken to the pasture, index of labour, fodder, and fuel availability and area under private pasture and forest. However it seems to depend on the management of alpine forests, i.e. in those villages, where alpine forests are maintained, the Index of land degradation is lower (0.03) and higher (0.13) where alpine forests are declining.

Land degradation increases with the declining access to the market, implying higher dependence of remote villages on the natural resources, leading to higher pressure and consequently their deterioration. As a risk aversion strategy, where there is high propensity of land degradation, farmers do not develop more land but where there is less propensity, the Index of land utilisation is high. It has been also found that with the lower SSR, there is an increase in land degradation. It has been estimated that the highest land degradation (31%) has taken place in the villages with poor social development. However 12% of the total land has

degraded in socially developed villages (Table 3.3), whereas in the villages with medium social development least (6%) land degradation has taken place. The result of land degradation in highly socially developed villages reflects that the social development needs to be defined in a direction that does not provoke land alienation.

Study of the four villages implies that one of the causes of degradation is topographic location of the inhabitation, for instance in Arifabad area of cultivated land is being degraded due to water logging, whereas in Yuljik and Chogodrong due to land slides and floods and in Ginnyal, avalanches are the major causes. Villagers explained that though the incidence of floods and landslides has increased since past three to four decades, they had always been present as natural phenomena. The reasoning is well documented by Pirazizy (1993), who attributes them as a part of geomorphological cycles. Among effects of land degradation, abandonce of land fallowing is prominent in Arifabad and Chogodrong. In Chogodrong, due to land shortage, the villages have to rehabilitate the degraded land every three years.

4.1.6 Local Food Production and Marketing

4.1.6.1 Fulfilment of Food Requirements from Local Production

More or less, in all the villages, local cereal production cannot meet year round grain requirements of the villagers. Therefore they are compelled to purchase wheat grains or wheat flour from the market.

The result of ANOVA showed that there is no clear correspondence between the percentage of food requirements fulfilled from local production and AEZ. In individual zones i.e. in SCZ, TCZ, MDCZ and DCZ, it is 58.3%, 68.8%, 64.1% and 58.5% of the total food requirement respectively. It is not the function of area allocated to the household commodities, family size, CIF and distribution of the area under major, and minor crops, potatoes and vegetables. Moreover, it does not depend on the access to the market. However there exists a weak ($r = -0.38$) negative correlation between the percentage of food requirements fulfilled from local production and the percentage of area under cultivation.

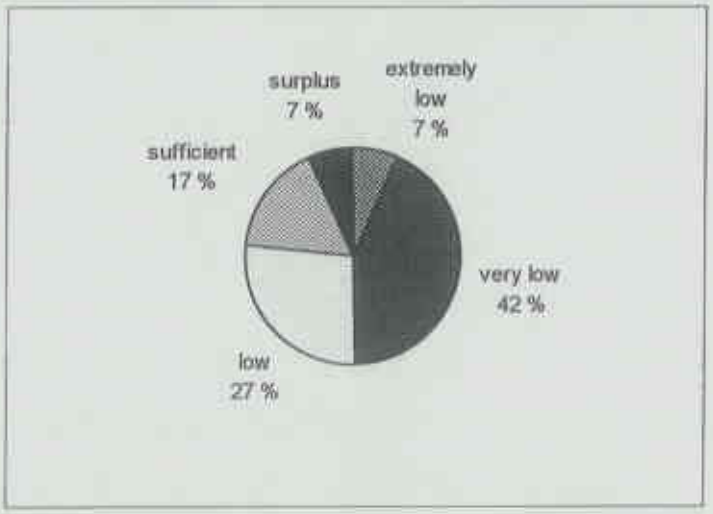
After finding absence of any significant relation of the above mentioned factors with the percentage of food requirements fulfilled from local production, for the convenience of comparison all the villages were divided into five groups, regardless of their respective AEZ. They were formed on the basis of potential to fulfil the percentage of food requirements, if 100 % of the area is allocated for subsistence production, to analyse the effect of different variables. These groups and their associated parameters are given in Table 4.7. Figure 4.3 illustrates that 76% of the total villages have local food insecurity.

Table 4.7 Local food production and marketing

Groups	Cultivated land /HH (kanals)	Potential to fulfil food requirements (%)	Actual fulfilment of food requirements (%)	Food sold in the market (%)	Area under market commodities (%)
1	22	31.6	30	1.56	5.5
2	13.67	50	50	0.79	1.62
3	15.99	79.7	71	9.34	11.88
4	23.7	98.6	91	7.58	7.6
5	22.29	115.2	80	35.21	30.75

The potential to fulfil the food requirements from local production does not depend on the AEZ and access to the market. Factors, that seem to influence it include the maintenance of crop diseases, increased trend in crop production, cultivated land per household and the area under fruit trees, though their effect is not very significant. The highest potential to fulfil household food requirement (80%), from local production exists in those villages, where trend in production is increasing.

Figure 4.3 Percentage of villages with varying potential to fulfil household food requirements



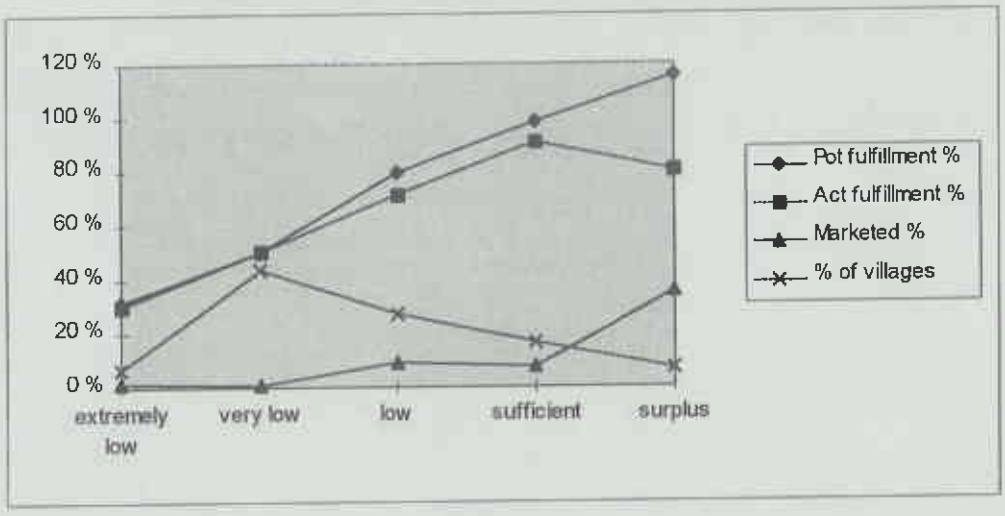
Note: extremely low - less than 35%, very low - 35%-60%, low - 60%-95%, sufficient - 95%-105%, surplus - more than 105%

4.1.6.2 Production for the Market

Highest percentage (35%) of food is sold in the market, by the villages coming from the fifth group. Highest percentage of food for household consumption is brought from the market by the first group and the least quantity is brought by group four that is self sufficient in food and sells 7,6% of food in the market. This group has the largest cultivated land per household.

The percentage of food sold in the market increases with the escalating access to the market, except Rizvia. For instance the villages with fair access to the market, sell 10% of their produce, whereas in very poor access area, only 2% of the total produce is marketed. This finding correspond to that of Mulk (1992) in Chitral, where farming systems are moving towards commercialisation with increased accessibility. The case study of four villages exhibits that the highest amount of crops are marketed from Arifabad, and almost no crop is sold in the market from Ginnyal. Here the access to the market refers access to the town market, not to the local market. Similarly the aspects of barter economy have not been considered. There are no significant differences among the cropping zones with regard to the percentage of food sold in the market, though there has been found a decreasing trend of percentage of food sent to the market with the decreasing cropping intensity. Although the trend of marketing seems to increase with the increasing institutional and physical development, it is not significant.

Figure 4.4 Local food production and marketing



The potential to fulfil household food requirements and the percentage of food sent to the market, seem interrelated (Fig. 4.4). With the increasing area allocated to the production of vegetables both potential to fulfil household food requirements from local production and the percentage of food sent to the market increase. The percentage of food sent to the market also increases with the reduced area allocated to the major crops. It implies that the villages intended to produce for the market, should produce more vegetables. Agroclimatically, the region has the privilege to produce off-seasonal vegetables, which have higher demand in the down country market. Adoption of this strategy has potential to generate local cash income which can provide food security in terms of increased purchasing power to import required food from the market. Fisher (1995) also explains, that market strategy can give more food security.

However more commercialisation of the farms must be accompanied by applied research and the adoption of appropriate technology, otherwise the environmental degradation, provoked by the adoption of blueprint technology can even exaggerate the problem of local food insecurity.

4.1.6.3 Sustainable Local Food Production

Factors which were considered to assess the level of local food self sufficiency, include land cultivated per person, crop intensity factor, area under major crops as well as under the vegetables, AEZ (potential and under practice), and indices of land utilisation, and fodder, fuel and labour availability.

The comparison of different parameters assigned as above, declared group five as the most efficient group of the villages as far as their human as well as physical resource input and output (production) are concerned. For not only they can fulfil their household food demands but also can actively produce surplus for the market to generate farm income. Furthermore they entail a 70% of land under utilisation. It implies that they can enhance their potential for marketing their products by developing more land.

The suggestion for a general model for sustainable local food security, is quite difficult because of high variations among the needs and the practices of the communities to fulfil them. Nevertheless it can be attempted considering specific cases and comparing their needs in the broader perspective of their productive (physical and human) resources and socio-cultural conditions.

First group was found to be the most unsustainable with reference to the local food self sufficiency but the two villages, Mangu Shiger and Karimpa Olding, in the same group bear larger social differences. Mangu Shiger has scarcity of labour to work on the farm and underutilises the land resources, that is why is more dependent on the market to fulfil food requirements. Their society is more prosperous because of large off-farm income from precious stone mining. In contrast the second village (Karimpa Olding) has scarce land capital and bears large labour surplus.

What can be a reasonable proposal in case of Mangu Shiger, a rich society, alienated from the farm, having switched the fulfilment of all its needs and desires from subsistence production to the market in the course of time. This is a worst case of underutilising a highly productive resource. There can be two alternatives either they should rent or sell their land resources to the interested groups; the resources should be given in the hands of those who can manage them optimally (Ellis, 1993), and completely depend on market or take initiative to mechanise their agriculture. The second village (Karimpa Olding) can be suggested to send its surplus or unemployed labour to the market to generate cash income for acquiring food security. They also

need to exploit local potential economic alternatives, for instance semi-commercial fruit production that can generate local employment and income (Islam, 1990). They do not have private forests and only depend on fetching, but they have potential to generate energy through the implementation of microhydal projects. They can then fairly abandon the importation of fuel from the market and save cash for purchasing food.

The second group has 40% land that can be developed for production, the labour availability is quite sufficient, if their skills and technology are upgraded. 30% of the villages can move from lower to higher cropping intensity, provided that they overcome the constraints that hamper to exploit their optimal agroclimatic potential. They have the lowest average land and livestock per household. They need to convert some of their cultivated land to vegetable production, because of having the lowest area under vegetables.

50% of the villages in third group, are involved in marketing some of their products and in turn are importing a great proportion of food from the market. This is a good example of social adjustment, which is not in contradiction with the sustainable production till the environment friendly technologies are practised. The other 50% of the villages in this group are just bringing from the market to overcome local food shortage and are not selling anything.

The improved crop cultivation practices like intercropping, green manuring, crop rotation, and adoption of appropriate farming practices, e.g. agroforestry comprising of tree species, that yield more fruit or food for human consumption, are required in all three first groups. For this purpose a great deal of government institutional support is required to give incentives in the form of credit, (transport subsidies) and to transfer improved technology to the farmers, regarding all these practices. Women, especially in SCZ and DCZ, need improved techniques to cultivate vegetables e.g. seed cultivation and transplanting, to practically increase the area under cultivation. Participatory research programmes, focused on horticulture and agroforestry, are required to be designed and implemented by development agencies. The rich genetic resources of indigenous fruit varieties can support the establishment of farmer gene bank associations, to develop local gene market per se its potential. Apart from improved technologies, aspects of social upgradation are also important. The groups number one, two and five require the incorporation of family planning programmes because of their large family size.

A high positive relation ($p=0.1$) has been found in the increased trend of crop production and that of control of crop diseases, with the percentage of potential to fulfil the household food requirement from the local production. Therefore a major emphasis in this sector should be asserted as a priority. A strict control on the introduction of improved or HYV, needs to be exercised to keep the disease and pest attack under economic threshold level. In TCZ and SCZ,

the performance and adaptability of early maturing and frost resistant crop varieties can be tested through applied research, for their further extension.

4.1.7 Forest Resource Use

4.1.7.1 Forest Management

A high diversity of local forest tree species is found in Arifabad and Chogodrong. Since two decades a high trend of afforestation of fast growing tree species, prevails in lower two zones as response of increased need for fuelwood. In Yuljik, 5,000 kanals of land have been planted along the river bank. This plantation was protected from floods by the construction of 200 feet long dam on cost share basis with AKRSP. A recent trend of afforestation has started in Chogodrong.

In the lower two zones, the management of the local forests gives an impression, that people are well aware of the fact that stable production from their local forest can ensure fodder for their animals, fuel for household consumption, and timber for building construction. For example in Arifabad, they have established a sustainable system of utilising their trees for fuel purposes through an appropriate method of harvesting wood for fuel use and of preserving and planting seedlings for reforestation. Local forest area in Arifabad is degrading due to water logging, alkalinity and salinity, though the drainage channels have been constructed to control it.

In Arifabad as well as in Yuljik, tree line demarcates individual forest area, whereas in Chogodrong, individual forest area is demarcated by stones. In Arifabad, no conflicts arise on the use of trees or on new plantations, because it is well managed by the village confraternity. In Yuljik, due to very small land holding, land is under great pressure of ownership, any vacant piece of land that has no clear rights, is appropriated by planting trees. Conflicts arise when one farmer's tree shadows other farmer's crop field.

In all these three zones, fodder shortage during early spring and the fodder requirement fodder for animals remaining in the villages during summer, is fulfilled from these trees. In Arifabad, people do not go for fetching fuelwood. In both lower zones, albeit increased local forest area, fuel requirements (magnified six times due to large family size and trend towards nuclear families), are not fulfilled completely, and woodfuel or kerosene oil is purchased from the market.

In general, as forests are traditionally used as grazing grounds, regeneration of trees as well as their growth is inhibited (Sharif, 1995). In majority of the villages including these three villages, where the forest trees have been planted in and around the crop fields, their irrigation takes

place automatically together with the irrigation of cultivated land. Some people add FYM to the forest. In Baltistan, infestation of diseases on forest trees is not a problem. In late autumn trees are protected from animals by wrapping their stems with thick cloth, jute or by coating with animal dung.

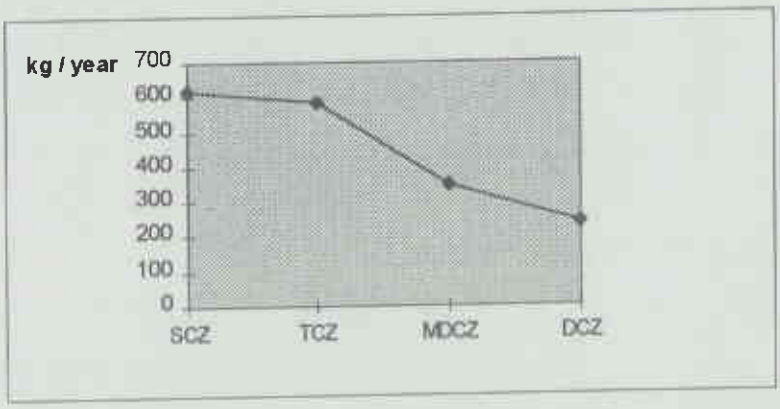
In Ginnyal, there are no such self planted and well managed private forests, except some bushes or woody small trees in the private pastures, including some trees of willow as well.

4.1.7.2 Fuel Requirement and Fuel Availability

The fuel requirement during past was mainly fulfilled from the surrounding vegetation and the wood collected from the higher mountains but due to the reduction in the surrounding vegetation (excessive cutting, uncontrolled livestock grazing), increased energy requirement cannot be merely fulfilled from fuelwood collection. As a response of increased demand of fuelwood, afforestation is resulting in the competition for land (very small land holding) between crops and forest trees. It is evident in some of the villages of proper Khaplu, where more trend of marketing of timber is resulting in inappropriate land use practices.

There occurs a differential trend of fuel requirements among different AEZ ($p=0.092$), ascending from DCZ to SCZ, with large difference between the lower two and the upper two zones.

Figure 4.5 Annual fuel requirement per household



The responded fuel requirements do not seem to depend on any other factors, for instance family size and area under private forest, except the agroecological zones, implying that it is mainly affected by the climate. In SCZ, due to extremely cold weather, the demand of fuelwood is very high, also found by IUCN (1996).

The differences of the reported fuel availability among different zones, are not significant. However the villages in SCZ, fulfil 100% of their requirements from their own resources (private

or common), in MDCZ, 82% of the requirements can be fulfilled locally, the rest of the fuel is purchased from the market. There is a trend to purchase fuel from the market, in all other zones except SCZ. The highest amount of fuel (53%) is purchased from the market in the village with highest access to the market. Whereas the villages having fair access to the market (30% of total), purchase 15% and those with the least access, buy only 6% of the total fuel requirement. However the attempt to calculate the actual availability of fuelwood from the forest and the surrounding vegetation, gave quite varying results.

Table 4.8 Fuel requirement and fuel availability

PAEZ	Fuel requirement / HH (kg)	Reported fuel availability (%)
SCZ	616.7	100
TCZ	584.3	93
MDCZ	348.9	82
DCZ	239.5	95

4.1.7.3 Fuel Resource Utilisation

The total potential of fuel availability from private and common resources, was calculated (Appendix VI) to assess their level of overexploitation or underutilisation and to further present suggestions for their sustainable use.

33.33% of the total villages have potential to produce excessive amount of fuel from their private forests but it does not imply that all of them are utilising this potential. It has been found that 40% of them are underutilising this resource, and rather fulfil their energy requirements from the market.

23% of the total villages have severe actual or potential fuel shortage (more than 70%) but only one village imports fuel from the market, rest of the villages report 100% local fuel self-sufficiency. It is clear, that they are exerting excessive pressure on their other possible fuel resources including rangelands, alpine forests, fruit trees and animal dung as in Hushe valley (IUCN, 1996) or do not utilise their forests sustainably. These villages invariably belong to all the zones. Therefore there is no difference in the calculated fuel availability with regard to the agroecological zones. It implies that the sustainable or unsustainable use of fuelwood resources or the availability or unavailability of fuelwood is not the function of the agroecological zones.

In the face of no significant correlation of fuel availability with the agroecological zones, the findings of this resource use cannot be straightforwardly described. However in order to analyse the pattern of fuel resource utilisation among the villages, certain groups have been formed on the basis of their level of dependency on different sources of fuel.

The villages having greatest potential to produce fuelwood have largest area under forest (37.3 kanal/household), whereas those having lowest potential and exerting highest pressure on other fuelwood resources, have the smallest area (2.2 kanal / household) under forest.

Table 4.9 Groups of villages with different potential of fuel self sufficiency

Groups	Annual fuel requirement/hh (kg)	Forest/hh (kanal)	Index of fuel availability (%)	Reported fuel availability (%)
1	493.6	2.23	37.8	100
2	283	2.3	58.8	62
3	298	7.02	148.3	100
4	350	18.1	466.2	98
5	336.7	37.29	906.2	74

First group comprises 40% of the villages, that cannot fulfil their needs sustainably but at the same time are excessively exploiting the common and private fuel resources, including even the fruit trees. It is also plausible because of their labour availability, which is 78%. This is an alarming situation from environment point of view, because it affects indigenous fruit varieties and natural vegetation.

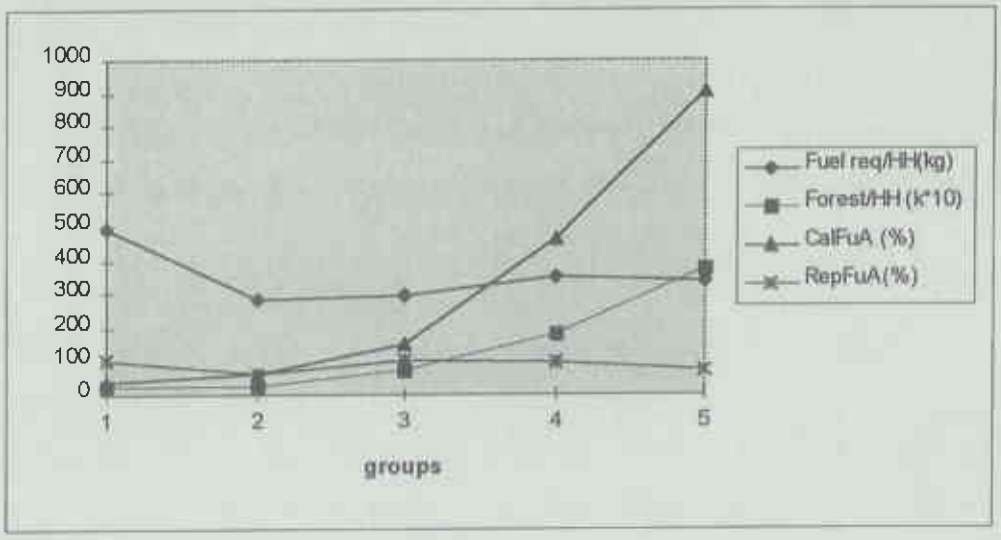
Second group consists of a cluster of 16.7% of the total villages that are unable to fulfil their needs from their private forests but at the same time are aware of conservation of their natural resources, even though they have surplus labour to fetch fuel from the common resources. However it cannot be clearly demonstrated if they have already degraded their fuel resources. They are diverting to the market for fuel importation. Although their access to the town market is not quick but the fuel is available in the local market.

Both third and fourth groups consist of the villages that can fulfil their needs from their resources, either from common resources in case of third category (16.6% of the villages) or from the private resource; category 4 (16.6%). In the case of former, though according to the calculation, which has the flexibility of limited fetching, it is acceptable. Nonetheless their common resources mainly alpine forests (albeit government protection) are rapidly degrading. The villages lying in the fourth category, have been regarded as the most sustainable, as far as their fuel consumption is concerned. The 100% fulfilment of the fuel requirements of group 4, from their private resources is supported by the fact that all of them have smallest family size, thereby have comparatively low fuel requirements.

The fifth group comprises those villages (10%), which despite having higher potential (Index of fuel availability ranges from 2.3 to 21.9), purchase fuel from the market. The identified constraint that more readily seems to restrain optimal exploitation of their potential, is low

labour availability (40% in average), which gives rise to the poor management of this resource and consequently less production. It can be explicated that in these villages, linkage between the household and the forest is weak with regard to labour and management input and fuel output from the forest.

Figure 4.6 Groups of villages with different potential of fuel self sufficiency



The second group has the lowest index of land utilisation (57%; 11 kanals of uncultivated land per household), and they have a potential for land development. Land development projects accompanied by the construction of new water channels or the extension of existing water channels would help overcoming the problem of fodder shortage and releasing the pressure on natural pastures and forests (IUCN, 1996). They can substitute their importation from the market by afforestation. It is also feasible due to the highest labour availability. Some similar suggestions stand valid for the first group, but as the index of labour availability is comparatively lower, they need institutional technical support to evolve improved land use systems, that can use labour more efficiently, for instance agroforestry programmes. It is emphasised to be coupled with efficient household fuel use technologies, that require lot of research for their establishment, because the rate of adoption of fuel conservation technologies in most of the rural areas is very low (Barnes, 1994). Government is required to consider this problem of highest pressure on the rangelands exerted by all the villages similar to those of the first group, and launch some conservation programmes after their identification. Local communities require financial support and technology incentives for developing water channels. Therefore in this case if the resource is seriously concerned, three departments NAPWD, Department of forest and rangeland management and AKRSP are required to coordinate and help the communities to come out of this destitute situation of helplessness.

In general, Katpana represents a model village, where private forest resources are used both for subsistence as well as commercial production. The villagers not only fulfil the household fuel requirement but also are benefited from this local income generating activity by selling the surplus production in the market.

Similarly, the villages of fifth group by virtue of having highest potential can establish commercial forestry enterprises in their villages. Additionally they have an extra advantage of lying in the highest access to the town market. However the establishment of commercial forestry enterprises would take approximately 10 years period of time, is labour demanding and requires high level of professional expertise. Nonetheless the technical support is available free of cost from AKRSP. This activity is prerequisite for the rehabilitation of degraded land and for environmental conservation. As these villages have quick access to the market and are constrained by labour shortage, the severity of the problem can be alleviated through the adoption of bio-gas cylinders especially for cooking because women workload would reduce and their surplus labour could be substituted to the intended activity, and it is rather a healthy step for the conservation of environment. Additionally, they will get cash income to purchase cheaper energy source (bio-gas) from the market. It would help to control the air pollution produced by the smoke in the house, positively impacting women health. Environmental problems and effects on human health due to the use of traditional stoves, have been identified by Hommes (1995), in Northern Areas of Pakistan.

The third group fulfils fuel needs mainly from fetching but it cannot be recommended to continue because their natural forests and rangelands are under great pressure. Excessive exploitation is provoking the increased propensity of flood and landslides. They should not rely on this resource as a long term source, rather search for other alternatives. Their afforestation potential is very low, so improved land use practices are indispensably required in this group also because of low ability to fulfil household food requirements from local production.

4.1.8 Animal Husbandry

Livestock production in this region, occupies a considerable status, as subsistence farmers are dependent on it not only for the FYM and drought power, but also for their household milk, meat and wool requirements. Insufficient cash economy and improper local livestock markets, force them to fulfil their animal protein needs from their own farm.

4.1.8.1 Livestock Management

In this subsistence economy, private pastures are one of the major source for livestock fodder production. Private pastures usually occur together with the private forest in all the zones. The

irrigation of the pastures takes place simultaneously with the forest irrigation. Areas, where private pastures yield considerable production of grasses, and majority of the animals are taken to the alpine pastures, grasses are harvested for winter use. In most of the villages, private pastures, called "uls" have been developed to overcome fodder shortage. Fodder from the crop fields, and grasses harvested from the field boundaries or from the private pastures, are preserved in the fields and stored for winter use.

The time for transferring the animals to and from the summer pastures varies from village to village, depending mainly upon the beginning and closing time of crop cultivation period. During last one decade, delayed animal transfer to the summer pastures, due to prolonged rainfall and further their earlier transfer back to the villages, has aggravated the fodder shortage in the villages.

On the pastures, milking of goats and cows is done collectively, milk by-products are made and transferred to the villages. In the past, people used to bring fresh milk but now they have become reluctant to transport it to the village. A general impression obtained in this study is that due to the improved communication, people have started thinking most of their traditional practices to be more time and labour demanding and want to have more leisure time. It was just one generation ago, when all these practices were part and parcel of their normal routine.

Three kinds of systems can be identified for the management of livestock on the summer pastures.

a) Collective livestock management, a group of people takes all the herd and stays on the summer pastures permanently e.g. in Chogodrong.

b) This responsibility revolves round the adult males of the whole village. After every two weeks another group replaces previous group, e.g. in Arifabad.

c) The private services of one villager are hired, who takes all the herd e.g. in Yuljik. It is a recent evolution.

A system of barter economy exists for compensating the group in the first case. In the second case no one is rewarded because every household performs its job. In the third case shepherd is remunerated either in form of value or in the form of kind, by the individual households.

With few exceptions, in none of the villages livestock grazing practices ensure management of the common pastures, rather takes into account better livestock feeding, and communal responsibility.

In both the upper zones, livestock rearing is a very important component of the farming system, partly because of small land holding as in Chogodrong and partly because of minimum cropping intensity as in Ginnyal. In both these zones, livestock are kept on the pastures for most of the year, facilitated by rapid access to the pastures.

In those villages that have uls, animals are left free for grazing on uls after harvesting grasses from there, while bringing them back to the villages. After reaching the village, they are left free on crop residues. By this time all animals have gained maximum live body weight.

However from now onward, they start losing body weight, and this is the time i.e. early winter, when most of the energy gained, is spent on fetching food and diseases attack on these debilitated animals. Enterotoxeamia is common among sheep, while pleuropneumonia attack all animals. Nutrition deficiency associated diseases like mange are commonly found among goats and cows. Foot and Mouth Disease affect both the health and the production of small as well as large animals. Slaughtering is considered as the best strategy to save cash spent on treatment of sick animals. Prevention and control of diseases through vaccination is only practised in those villages, where the resource person (LSS) is active and has considerably motivated the villagers to adopt that programme e.g. in Arifabad. 67% of the villages, where the trend of livestock diseases has increased, do not have LSS. However LSS is functional in 77% of the villages, where incidence of livestock diseases has reduced. In some of the villages, through the strict prohibition to import animals from outside, incidence of diseases is kept low, e.g. in Ginnyal.

During severe cold, animals are kept in poorly managed dark sheds without proper ventilation, constructed in the basement of the house. Animals are fed unchopped hay mostly on the ground, with partial free grazing during the day time.

Breeding of livestock is performed traditionally. For the breeding of cattle, and zomo (local bovine species), one or two bulls and yaks are tended in each village, through collective management. At some places, yaks are borrowed from neighbouring villages during breeding season. The breeding of large animals takes place on the summer pastures, and that of goats during the months of September and October. Sheep breeding is time indifferent.

However, high inbreeding among indigenous breeds has resulted in the poor quality of gene performance, necessitating the need for genetic uplift. The rate of adoption of breed improvement programmes is very low. Improved programmes concerned with the livestock production cannot be propagated on the community level until and unless the economic value of livestock is up-graded through designing more lucrative livestock enterprises and through the establishment of livestock market, for which government institutional support is crucially important.

4.1.8.2 Herd Size and Composition

There is a decreasing trend in the number of livestock per household, with the increasing cropping intensity (Table 4.10). It corresponds to our finding of higher dependency of livestock on cultivated land in lower two zones, that forces the farmers to keep comparatively smaller

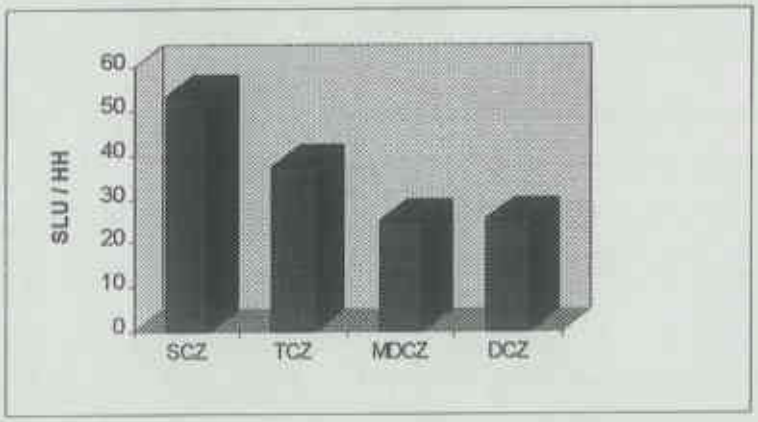
herds to mitigate competition between food and fodder production. The highest number of livestock per household has been recorded in SCZ ($p=0.046$). It reflects that livestock is an important component of farming system in SCZ, which is probably due to lower opportunity to harvest crops, minimum CIF, higher access to common resources and less labour demanded by this activity.

Table 4.10 Livestock holding per household and herd composition

Agroecological zones	Average LS no. per HH	Herd composition		
		sheep (%)	goat (%)	cattle (%)
SCZ	53.0	52.2	29.8	18.0
TCZ	37.2	48.6	32.0	19.4
MDCZ	24.6	33.2	39.4	27.3
DCZ	25.3	32.4	43.8	23.9

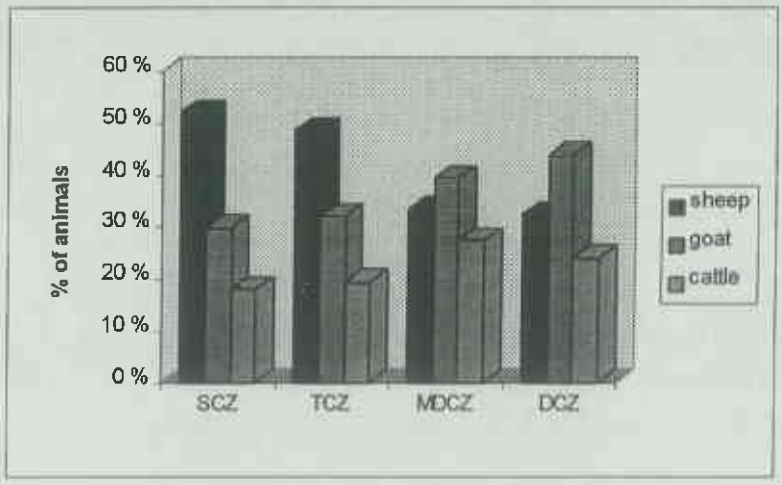
Herd size and herd composition do not show their correspondence with family size, implying that households do not adjust their animal herd size according to their requirements of animal products. However it also does not depend on any other land use practice, except cultivated land, which positively (R-Sq. = 26.4%) affects herd size.

Figure 4.7 Number of small livestock units per household



Sheep make the largest proportion of animal herds in higher altitudes ($p=0.048$), whereas cattle constitute relatively high proportion of herd in MDCZ as compared to other zones. It can be explicated, that the strategy of composing the livestock herds, consisting of comparatively large number of cattle and less number of sheep, has been adopted in the lower two zones in the wake of degradation of collective livestock management system. Adoption of this strategy is facilitated by the comparative advantage of the feeding habits of these animals. However the ambiguous results pertaining to the number of goats found in different AEZ cannot be satisfactorily explained.

Figure 4.8 Herd composition



4.1.8.3 Livestock Production

In both the villages of upper two zones, villagers claim that production from animals is very high. However marketing of the surplus is underprivileged due to poor access to the town market, absence of local market for livestock products and cultural values of these products. Nonetheless some of the farmers from SCZ, rear sheep and goat herds for the market and bring them to the town before the onset of winter, the cash earned from their sale is spent on purchasing the food items form the market. Traditional processing of wool and hair from the animals is a major household activity in both the upper zones. Livestock has potential for being promoted on commercial scale in both these zones.

The production of the livestock mainly depends on its management, which in turn reflects the extent of dependence of household on this component. Empirical analysis from the household study clearly reflects that the overall animal production is dependent on their management in great relation to the desired element of production. For instance the highest milk yield (9204 kg/cattle) in Chogodrong shows the best management in relation to milk production. As their grazing pastures are not at long distance from the village, milk of these animals is regularly collected and transferred to the village, whereas comparatively lower yield of milk obtained in Ginnyal, does not reflect low productivity of animals but is related to the frequency of milk transportation from the higher mountains. Farmers reported that large proportion of milk is converted to butter and ghee (milk by-products) and then transported to the village. It is evident, that in Ginnyal, ghee and butter are more important household consumption goods, therefore fresh milk is not transported to the village. The second highest productivity of milk in Yuljik is privileged mainly due to the better feeding management of the animals, especially during winter. The highest meat and wool yield is reported in Ginnyal. The lowest livestock production

the market to purchase these items due to its highest accessibility. It can also be predicated that it is an effect of poor feeding management i.e. lack of adequate stall feeding during winter.

Table 4.11 Annual livestock production

Village	Milk/cattle (kg)	Meat/ animal* (kg)	Wool/sheep (kg)	Animals slaughtered / HH	Animals marketed / HH
Yuljik	3980	34.42	0.76	2.69	1.56
Arifabad	1632	28.03	1.02	2.37	0.26
Chogodrong	9204	31.75	0.74	3.67	0.90
Ginnyal	3063	58.91	1.83	5.05	6.76

* slaughtered animal

The number of animals slaughtered annually to fulfil household meat requirements significantly ($p = 0.00$) depends on access to the market, and on the number of sheep and cattle per household (R-Sq. = 41%). The former affects it negatively, whereas the latter is positively related. The highest number of animals per household per year are slaughtered in Ginnyal (Table 4.11). Like common feature of the upper mountains (Sharma and Jodha, 1992), the farming system in SCZ represents a livestock dominant system. There prevails a strong linkage between the livestock and the market.

A considerably large number of animals marketed from Ginnyal , which is affected mainly by the number of the goat and cattle, reflects higher dependence of the villagers on animals for generating cash income. This statement is also substantiated by the number of SLU being the only factor (R-Sq. = 85.6%), which affects their income from the farm.

4.1.8.4 FYM Utilisation

Index of FYM utilisation was derived by dividing the total potential FYM production by the actual amount added to the cultivated land (Appendix VI). It has been found, that FYM is being least efficiently utilised in the SCZ, i.e. only 43% of its total potential production, whereas it is most efficiently utilised in the MDCZ (113%). However the differences among different zones are not significant.

Regression analyses of the effect of cultivated land and small livestock unit per household on the Index of FYM utilisation (R-Sq. = 40%), reveals that its efficiency is a direct proportionate of the land per household but inverse proportionate of the SLU per household. It implies that households having large number of SLU either keep them on pastures for more than 6 months or

the stocking of large number of SLU is not the reflection of their need for FYM, rather it is for some other purposes or an indirect indicator of traditional social concepts. [2]

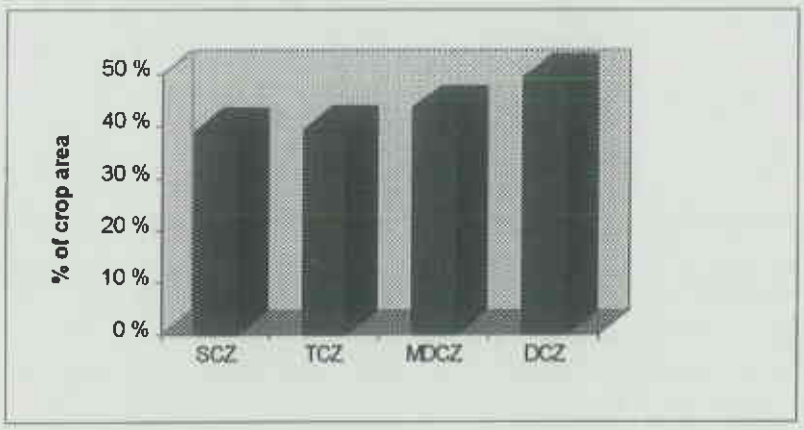
13% of the total villages have very high Index of FYM utilisation (higher than 2), meaning that they are adding more than calculated potential production. It can only be extrapolated that either they keep their animals in the pasture for short period, most probably due to less labour availability during summer, or they collect FYM from the pasture because it is mainly done by women. Another reason can be the higher quantity of mud added to compost.

40% of the total villages are utilising less than 50% of their potential amount of FYM. Due to very high access to the market, in one village (Rizvia) it is being replaced by chemical fertiliser, despite taking small number of animals to the pastures during summer. In 50% of these villages, less than 50% of men are present during winter. Skildrung in TCZ albeit having smallest land holding, has least Index of FYM utilisation, partly because of less value given to the cultivated land and partly because of free livestock grazing for most of the year due to easy access to the alpine pastures. Second reasoning also stands true for Ginnyal, where land holding per household is large. 33% of the total villages, seem to utilise it efficiently because they add equal amount of FYM as they can potentially produce.

4.1.8 5 Fodder Availability

The highest proportion of cultivated land (49%) is allocated to the production of fodder in the DCZ, and it has been found gradually decreasing with the increasing altitude. It can be clearly established that in the lower altitudes, there exists higher dependency of livestock on agricultural land, whereas in the higher altitudes, it is more dependent on the alpine pastures or common resources.

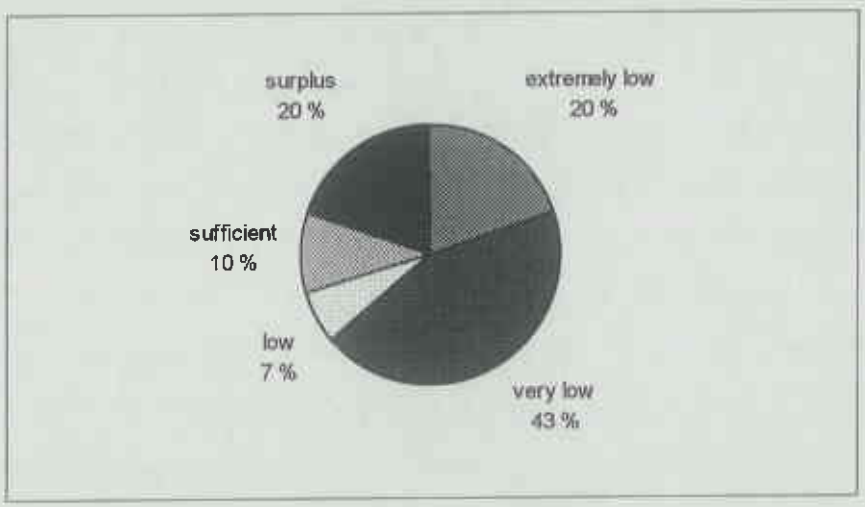
Figure 4.9 Percentage of cultivated land allocated for fodder production



[2] livestock is usually considered as a traditional status symbol of the communities

Almost all the villages with few exceptions, allocate some proportion of their cultivated land primarily for fodder production (Table 2.3). From case study of the four villages, it can be extrapolated that in some villages, the trend of livestock fodder cultivation is increasing, mainly because of a partial switch from subsistence grain production to grain importation from the market. However grain importation from the market is influenced by two factors considerably, the cash income and taste and preference of the people, as in Yuljik. However the amount of fodder produced from cultivated land is an extremely small proportion of total animal feed requirements (Roohi, 1995). This deficiency is fulfilled by traditional supplementation of leaves form forest and fruit trees and crop residues. This strategy can hardly fulfil the maintenance requirements of the animals because of low quality nutrition. The total potential production form all these sources was calculated (Appendix VII) and it was found that extreme shortage of fodder prevails in 20% of the villages. Only 10% of the villages are able to fulfil fodder requirement of their animals, whereas 20% of the villages have surplus fodder.

Figure 4.10 Percentage of villages and fodder availability



Note: Extremely low - less than 30%, very low - 30%-70%, low - 70%-95%, sufficient - 95%-110%, surplus - more than 110%

The strong positive relation (R-sq. =99.1%) between total land/SLU and the index of fodder availability, implies that the availability of fodder is a function of land allocated to one small livestock unit. Keeping this result under consideration, some suggestions about the herd size are recommended for the sustainable use of fodder resources.

Empirical analysis also shows that the fodder availability is not the function of any other land use activity except area under forest and pastures. The dependency on the former is only 10%, whereas later bears responsibility of 70% of the fluctuations in fodder availability.

4.1.8.6 Adjustment of Herd Size

These suggestions are based on the calculation of optimal number of SLU in relation to the fodder availability (Appendix VIII). 10% of the villages have potential to keep only 35% of the present total SLU with respect to their fodder availability. In general 73% of the villages need to reduce their herd size. Nevertheless it cannot be concluded that they are overstocking their herds in absolute terms, rather in relative terms of fodder shortage. There are only 10% of the total villages, that have wisely formed their livestock herd. 16.67% of the villages, have excessive amount of fodder and have potential to increase their herd size. However instead of expanding their number of livestock, they are suggested to intensify livestock farming for semi-commercial and commercial purposes.

According to our data analysis, 7 SLU/person is found to be the optimum number which when multiplied with the household size, gives optimum number of SLU, that can fulfil livestock oriented needs of the household, for instance most important in this case is FYM, milk, wool, meat, skins and drought power to work on land. This number also corresponds to the index of fodder availability. Though the quantitative calculation of these products is beyond the capacity of this research, but some realistic approximations have been established to justify this constant.

Table 4.12 Optimum number of SLU and optimum land holding per household

Cropping zones	Optimum no. SLU/ HH	Optimum total land / SLU	Optimum total land/ HH	Actual total land / HH
SCZ	70.67	0.5322	37.61	57.57
TCZ	73.93	0.4396	32.50	19.95
MDCZ	60.60	0.4617	27.98	92.34
DCZ	60.68	0.3295	20.65	37.02

The comparison of different parameters given in the table 4.12, supports that in SCZ, MDCZ and DCZ, 7 SLU/person is a sustainable number in contrast to their present farming practices. Whereas in TCZ, the recommended number of SLU exceeds their private fodder production. However keeping in view their more dependence on livestock farming in the face of very small land holding, it cannot be proposed that they should reduce the number of their SLU. It is also supported by their higher dependence on the common pastures which are in frequent access

and sustain the livestock for most of the year. However they need to incorporate some improved systems of land use e.g. agroforestry, which can fulfil multiple subsistence needs of the households including fuel, fodder and food.

In both the lower zones, a potential for intensifying livestock farming, through the introduction of improved varieties of fodder, methods to preserve it for winter, and improved breeds of animals, has been identified. In the face of labour shortage, they are suggested to introduce less labour intensive methods of livestock management and give their intensified farms the status of commercial or semi-commercial farms, through the incorporation of improved milk processing techniques and developing a market for their products. It can act as an income generating activity accompanied by local food security. The need to take their animals to the alpine pastures would suppress, resulting in less pressure on the natural vegetation or improvement of the rangelands.

In case of SCZ, there is a potential to exceed the suggested number of optimum SLU. There is higher dependence on the livestock farming because of smallest CIF. Additionally, as their traditional livestock farming practices are not labour demanding, they can raise the number of their SLU to 10, otherwise it would become difficult for them to meet their requirement of FYM. However it is also important to emphasise on raising the economic value of their livestock for its better management. Therefore in such rural areas, if sheep and goat fattening or some other packages, like improved technology of manufacturing woollen and leather by-products (Roohi, 1994 b), and that of milk processing are introduced, these farmers can sustain and improve their living standard by raising their income.

4.2 Status of Common resources

Unclear property rights, improper enforcement of rules and regulations by the government, and overstocking of livestock are resulting in the mismanagement of the natural resources in almost whole of the region.

4.2.1 Rangelands

It consists of area under alpine pastures, sparse vegetation, woody grassland and bushes and rocks. This land is not irrigated by water channels but absorbs moisture from precipitation (rain or snow). It is used as grazing land and source of fuelwood. Apart form seasonal disturbance, rate of regeneration of most of the natural bushes and grasses in the wastelands, is being reduced due to increased pressure of fuelwood collection resulting from augmented population. Some wood species have gone endangered. For instance the population of artemizia is rapidly

declining in the wastelands due to excessive pressure generated by increased fuelwood demand, and overstocking of livestock. It has multiple uses as barbed wire around the fields, added to FYM to improve its quality, also acts as insect repellent, and it is a good land stabiliser. However excessive pressure on natural vegetation is resulting in rangeland degradation. In most of the villages wastelands have totally disappeared due to human settlement and development works especially in the suburbs of the town. Previously the community management systems were functioning optimally having rules and regulations concerned with the harvest of fuelwood and livestock grazing. These rules ensured their proper management. This local institutional management systems regulated the period during the year, number of hours per day, amount of wood that could be collected by one person and the kind of vegetation, that was allowed to harvest. Similarly duration of stay of livestock, time to transfer them to the pasture and then bring them back to the village was fixed. These rules started being violated when the local institutional management system received repercussion from changing socio-economic environment in the face of increased needs of food, fodder and energy. Its degradation was further provoked by labour shortage. Additionally, no alternative institutions are formed, that can replace the degraded traditional local management system. Degradation of local management system resulted in increased propensity of natural catastrophes. Rangelands do not have any management plan or in other words are devoid of proper institutional support except in few villages, where they are managed through some local institutional management system e.g. in Chogodrong, ensuring the revegetation and propagation of shrubs and grasses.

Alpine pastures

The assessment of the status of alpine pastures i.e., the total area of the alpine pastures and their carrying capacity is difficult to achieve. Efforts are made to calculate the area of the pasture that can carry one SLU, but it mostly depends on the vegetation cover. Similarly the interviewed villagers responded that they never take care of it, so no satisfactory results can be presented. However some extrapolations can be made considering the overstocking of SLU, and the percentage of animals taken to the pastures during summer. On the basis of these variables, it can be described, that those villages, that overstock their herd and take higher percentage of the animals to the summer pasture, exert pressure on the alpine pastures. Overstocking and denudation of common grazing resources are the major problems in mountain region of Himachal Pradesh, India (Bhati et al., 1992). Pirazizy (1993) relates increased herd size to be a basic cause of overgrazing, deforestation, soil deterioration, land degradation and consequently encroachment into the highlands. But there are certain villages, where despite overstocking, large areas of summer pastures facilitate the villagers to adopt a system of rotational grazing to

ensure better management (revegetation, biodiverstiy conservation) of the alpine pastures e.g. Chogodrong and Ginnyal.

However the findings of the case study reveal that the climatic variations result in reduction of the total period, animals are kept on the alpine pastures, further implying that pressure on the pastures is reducing. In majority of the villages, where summer pasture are highly inaccessible due to long distances and extremely poor communication, and further breakdown of the collective livestock management system has taken place, the percentage of animals taken to the pastures is reducing. Similarly, price rise of dry milk, implicates transportation of milch animals to the alpine pastures. Consequently there is an alleviation of pressure on the summer pastures. The higher pastures of Yuljik valley, Chogodrong and Ginnyal, all are linked to Deosai plain and in Yuljik, people are conscious of the excessive use of Deosai pastures by migratory pastoralists influxed from down country.

In Baltistan, it is imperative to initiate research in optimal rangeland management programmes because almost every household for sustaining their agricultural production system depends on the rangelands one way or the other. These research programmes must emphasise on the type, frequency, yield and growth of tree, shrub and grass species occurring in natural rangeland, and above all the carrying capacity of the rangelands must be evaluated to alleviate pressure on them.

4.2.2 Alpine Forest

High biodiversity both large and small natural trees, occurs in Ginnyal on mountains and on the river bank. In some villages as in Chogodrong, a high diversity of forest trees is maintained by communal restriction on forest cutting but the population of some of the woody bushes is declining.

Table 4.13 Number of villages and status of alpine forest

PAEZ	Number of villages		
	No forest	Declining	Maintained
SCZ	-	3	-
TCZ	2	2	2
MDCZ	3	6	1
DCZ	5	3	1

In some villages that had high biodiverstiy of alpine forests, their forests have completely disappeared due to excessive cutting, especially after abolishment of the feudal state system. Some valuable tree species are at danger of disappearance in the whole region. Villagers

reported that trials of seeding these species in the village have failed. Being an arid zone, the whole region of Baltistan is devoid of good alpine forests. 35.7% of the total villages do not have any alpine forests. In 50% of the total villages forest sources are diminishing. Only 14.3 % of the total villages have maintained their alpine forests through communal efforts, by promulgating rules and regulations to use them sustainably.

All the forests in Ginnyal, are protected by the government. Cutting of birch and willow is strictly prohibited, until and unless it is prone to fall. However concessionary rights of communities are resulting in overexploitation and misuse (Tahir, 1995). Illegal cutting is also very common. Previously there was greater pressure on the forest because the contractors , who used to supply fuelwood to armed forces, extracted forest trees exorbitantly (Tahir, 1995).

4.2.3 Wildlife

4.2.3.1 Wild Flora

Most of the villages reported that their alpine pastures are rich in wild herbs. It has also been documented by IUCN (1996). In the upper two zones, herbs are commonly used as traditional medicines, fruit and wild food. A higher diversity of these medicinal plants, offers a choice to treat multiple human as well as livestock ailments. They are reported to have a comparative advantage of being cheaper than allopathic medicines. In reality, villagers have no concept of their management except to exploit them for medicines and food. Livestock grazing creates permanent disturbance. The villagers complain that youngsters are no more able to identify the herbs. In fact, Deosai plane houses thousands of marvellous species of flowers, wild fruits and vegetables and medicinal plants and has an aesthetic attraction for the tourist but human intervention is affecting its endemic value. Some of the medicinal plants have a potential of marketing. Adoption of this package on the village level can provide a local income generating activity besides biodiversity conservation.

4.2.3.2 Wild Fauna

The alpine rangelands also offer diverse habitats to varieties of wild animals and birds but there exists a competition for food between wild and domestic animals. As reported in Chogodrong, there is 50% decline in the wildlife and in Yuljik more than 75% of wild animals have emigrated due to road construction.

Illegal hunting and poaching of birds and markhore is common in Yuljik, whereas in Chogodrong and Ginnyal, it is claimed to be prohibited. Government has appointed one person from each village called "rakha" for watching and reporting illegal hunting. In general improved communication has forced many wild animals to migrate from their natural habitats. Loss of

habitats has also declined their population. During the month of October, November and December availability of markhore meat on small hotels in the valley of Goal, Kharmang and Khaplu, witnesses their illegal hunting and marketing. Another threat to these animals is poaching for international smuggling.[3]

Based on the information from the villagers, it was found that in the alpine mountains of 18.5% of the villages, wild animals were never seen. Whereas in rest of all the villages their population is declining. In 7.4% of the villages, more than 75% of the population has declined over a period of only 30 years. In 26% of the villages, up to 25% of the wildlife has disappeared whereas in 29.5% of the villages, the population of the wildlife has declined by 25% to 50% of the total population, that was frequently seen on the mountains. None of the villages is directly or indirectly involved in the maintenance or management of the wildlife, it is only limited to their hunting in most of the villages. In some villages, it was responded, that hunting has been controlled since government has banned it. Whereas in other villages, it was responded, that though it has been banned, still many young boys go for hunting trips because the law of wildlife conservation is not being enforced adequately, and the wildlife conservation department has limited staff. Successful community wildlife management experiences in Gilgit [4](Minapin) reveal their potential of generating income for the communities. Such potential benefits of wildlife can be explored in the region of Baltistan.

4.2.4 Fisheries

Fish occur in almost all water bodies like rivers, streams and lakes in Baltistan. Local people identify as much as six indigenous varieties of fish, named locally as Siah, Oam, Khadak, Khata Chogho, Khaypayok and Datha. Fish has tremendous potential of an industry in Baltistan and in the whole region of Northern Areas. Commercially there is only one fish shop in the town market, that has been established by a Pathan. His annual income from this enterprise is 190,000 Rs. Local people have not adopted it as a commercial activity, except some road hotels in different valleys, where the owners throw small nets in the river and catch few fish to cook for the customers. From almost all the villages, inhabited near or on the river banks, some of the villagers explode dynamites in the river and the number of dynamites increases during the months of early and late winter because of reduced water level and increased catch size. This practice has also increased after the importation of ammunition in the region. During past, method of fishing was of very primitive type, which did not harm environment but dynamite

[3]witnessed by first author
[4]first author has personal exposure to the community wildlife management programme in Minapin

explosion besides direct killing of fish, degrades their habitats and can affect the fish diversity in the river.

46.6% of the villages have access to some water body and in 36,6% of the villages, fishing is practised. In half of these villages, dynamites are exploded in the river to catch fish. Number of the dynamites exploded every year ranges from 12 to 200. It is found that fish population is declining only in MDCZ and all of these villages report dynamite explosion in the river.

Table 4.14 Number of villages and status of fish population

PEAZ	Number of villages			
	No water source	Source present, no fish	Fishing & fish declining	Fishing & fish maintained
SCZ	1	-	-	2
TCZ	3	1	-	2
MDCZ	5	2	3	2
DCZ	7	1	-	2

None of the villagers are involved in commercial fishing, it is restrained because of wild river during summer. They are also not willing to adopt it as a commercial enterprise, but it is observed that it is mainly due to the lack of awareness and institutional support. There are many small lakes and streams where fish cultures (both indigenous as well as exogenous) can be cultivated. Fish farming can provide an economic alternative to the people of Northern areas on the grassroot level through designing new packages of sustainable community fish farming.

4.3 Impact of Economic and Socio-cultural Changes on the Natural Resources

In the very near past, in the whole region of Northern Areas of Pakistan, there existed traditional cultural practices which ensured resource conservation. However improved communication, unpatterened social and economic development packages induced by outside agencies including GOP, and enhanced local economic activities, apart from their positive impacts, have brought negative changes in the traditional pattern of life. As McNeely (1994) describes that economics converts many people from the status of ecosystem people to biosphere people, which is accompanied by the loss of cultural diversity. This loss of cultural diversity and adoption of unsuitable practices has affected the natural resource base in following ways.

a) Increased pressure on natural resources brought about by changed socio-economic needs in the face of internal and external factors.

b) Alienation from traditional management of the natural resources as documented in the case of Yuljik. Actually it represents all valleys that are linked by road, have small land holding, and have been exposed to development for example proper Khaplu, Olding and Sixa. One reason is availability of all kinds of consumption goods in the market.

c) Underutilisation of some of the resources for which access to improved knowledge and technology is unavailable. For instance, in the whole region of Baltistan, water is not explored for its tremendous amount of energy, it can potentially offer to the people of the region.

These isolated communities had limited economic needs for food, and energy, before the influx of varieties of food items and other household consumption goods in the wake of opening of Karakoram Highway. The availability of these consumption goods in the town as well as in the local market, gave rise to increased need to purchase and fulfil household requirements from the market, also found by Kassam et. al. (1993), consequently diverting and changing their behaviour to their society and their resources. Societal alienation is followed by outmigration, which is accelerated by increased mobility (also Kassam et. al., 1993), leading to farm labour shortage. It consequently brought two major changes as concluded from the case study of four villages, breakdown of local institutional management system and changes in traditional farming practices. Both these situations are found in Arifabad and Yuljik, where they are equally attributed to political and economic interventions. As McNeely (1994) remarks that development leads to dependence on external resources, social and economic gravity shifts away from the community and local institutions become marginalised politically.

Farming system has received large repercussions due to labour shortage for example effect on livestock farming, change in cropping intensity, effect on FYM preparation and trend towards monocropping. In case of changing farming systems, for instance in Arifabad, practically the length of the cultivation period has decreased. Due to less labour, urgent transfer of livestock from alpine pasture to the village hinders to harvest mature maize crop, limiting it to be used as livestock fodder. The villagers from Arifabad claim, that in the very near past, they used to harvest two mature crops. Similarly unavailability of surplus labour to take all the animals to the pastures, compels many animals to be left in the village, giving rise to the competition of labour between livestock and agriculture. In Yuljik the amount as well as the quality of local fertiliser added to the cultivated land (Table 4.15) has reduced to one half and the dependence on chemical fertiliser has increased. Similarly dependence on the market for household consumption food has increased, which has given rise to environmental problems, e.g. the importation of animals and poultry for meat purposes, has introduced many diseases in the region.

In Ginnyal, some of the land of the families, who have completely migrated from the area is cultivated by their relatives who pay them about 1,500-2,000 Rs. per year. However their workload has increased giving rise to poor land management. It is evident from the sharp reduction of the FYM added to the cultivated land and reported decreasing soil fertility. There is no change in Chogodrong because of balanced labour, optimal performance of local management system and less access to the market.

Males involvement in off-farm income generating activities has overburdened women workload on the farm giving them less time to make local handicrafts from livestock products, in turn affecting animal management and their production. In the past by virtue of joint family systems and joint kitchen culture, fuel demand was kept limited. Due to increased trend of nuclear families, energy demand has risen to a greater extent. Such changes are more pronounced in villages having better access to the town e.g. in Arifabad and Yuljik. It can be observed even in the far-off valleys because many villages have been linked by roads.

Rock blasting in the face of rapid road infrastructure construction has resulted in the loss of natural habitats of many wild animals causing their emigration and affecting their population. In areas with sluggish access, encroachment into the rangelands is degrading the environment. Uncontrolled use of rangelands above and below the channel as an outcome of degraded local institutional management system, has resulted in increased floods and landslides.

Many development packages primarily focused on equitable distribution of economic as well as social benefits proved to be highly monopolised and are characterised by unequal distribution of benefits. It has created income disparity and status imbalances in the society.

In Chogodrong no pronounced changes have been reported especially in the farming system, most probably due to their adherence to the traditional socio-economic and socio-cultural pattern of life and adjustment of social changes in a manner that does not affect them. In Ginnyal, due to persistently unprivileged internal socio-economic conditions and extremely low external interventions to improve local living standard coupled with harsh climate, many households have been forced to migrate permanently giving rise to the problems related to land absentees.

4.3.1 Indicators of Sustainability

4.3.1.1 Biophysical Indicators

From the process of ranking (chapter 1.4) of four villages to measure their level of physical and social sustainability, it was found, that none of the villages is sustainable biophysically. However Chogodrong is the least unsustainable village with respect to its bio-physical

characteristics. Arifabad was characterised as the most unsustainable village with regard to these indicators (Table 4.15).

The biophysical conditions in Yuljik are also not less deteriorated than in Arifabad. It was pointed out in the workshops carried out in both the villages that for the better management of their natural resources, rehabilitation of water channels in Yuljik, and control of floods and land erosion in Arifabad are indispensable, which require external financial support. Lack of capital, inaccessibility to credit and loans are major constraints in the management of natural resources. However unsustainability also exists in Ginnyal but with less intensity.

Table 4.15 Bio-physical indicators of sutainability

Biophysical indicators	Yuljik	Arifabad	Chogodrong	Ginnyal
Crop requirements for irrigation	o	--	o	o
Quality of irrigation water	o	--	++	o
Quantity of irrigation water	++	o	++	o
Quality of FYM	-	----	o	o
Quantity of FYM	--	++++	++	--
Labour for FYM preparation	----	---	o	o
Total cultivated land	o	+	---	o
Total degraded land	-	-	--	-
Rate of land fragmentation	-	-	-	--
Yield / kanal	++	--	o	++++
Crop diseases	o	--	o	++
Crop diversity	-	--	++	-
Area under fruit trees	++	++	+	o
Fruit diversity	+	++	o	o
Yield / tree	---	--	o	o
Fruit diseases	++	--	--	o
Area under private pastures	++	++	o	--
Time to reach alpine pastures	--	o	o	o
Duration of stay on alpine past.	o	--	o	o
Area under private forests	++	++	+	o
Alpine forests	----	o	--	--
Tree diversity in alpine forests	----	o	o	o
Wildlife population	--	o	--	--
Wildlife diversity	--	o	o	o
Diversity of medicinal plants	++	o	++	++
Surrounding vegetation	--	---	o	--
Average L/S holding	--	-	o	--
Available L/S feed	++	--	o	-
Feed quality	o	--	o	o
LS production	--	-	++	++
LS diseases	--	++	o	++
Land allocated for fodder production	++	-	++	o
Labour availability	---	--	o	++
Soil fertility	++	--	--	--
Flood propensity	---	--	---	--
Area prone to floods	---	--	---	--
Area prone to landslides	--	--	--	--
TOTAL	-27	-28	-5	-12

+ positive change - negative change o no change (see chapter 1.4.3.2)

The high level of unsustainability of bio-physical indicators in the villages of Arifabad and Yuljik, is an outcome of many internal as well external factors. In Yuljik, it is mainly due to the poor management of natural resources above the channel, for instances high deforestation and higher pressure on natural vegetation. It has been aggravated by the small land holding which accounts for the aversion from farm activities. Youth alienation is also a major factor. Improved physical infrastructure also provokes it. The case of Yuljik and Arifabad can be explained by McNeely's (1994) statement that communities that gradually become integrated into larger systems lose their institutional control over resources. However in Arifabad, the unsustainability of bio-physical conditions is also due to degraded environment, which is caused by increased floods due to the lack of protective measures to manage the resources above and below the channel. Whereas the least unsustainability of bio-physical environment in Chogodrong, is supported by the less external intervention, comparatively less accessibility and importance of local level resources for productive purposes. The stability of the bio-physical environment is extremely important for sustainable food production. Highland afforestation of Hypophae is recommended to alleviate the seriousness of the problem.

4.3.1.2 Social Indicators

The analysis of social indicators shows, that both Arifabad and Yuljik are inclined to a better social status whereas in Ginnyal, high level of social unsustainability has been identified. It seems true that lack of infrastructure and inaccessibility prevent access to health and education facilities (Bayers and Sainju, 1994). The background information of these villages, support that the social sustainability or security is the function of distance from the main economic centre of the region as well as the collective initiative taken by the community and the level of awareness and exposure of the community.

Table 4.16 Social indicators of sustainability

Social indicators	Yuljik	Arifabad	Chogodrong	Ginnyal
Human health problems	--	++	-	-
Treatment availability	++	++	++	-
Mother and child health care	++	++	-	--
Cost spent of health	++	++	+	--
Life expectancy among males	-	+	o	o
Life expectancy among females	-	+	o	o
Education facilities for boys	++	-	--	--
Education facilities for girls	++	--	---	---
Rate of outmigration	-	+	+	--
TOTAL	7	8	-3	-13

As far as the indicators of local institutional management system are concerned, it has been found that a highly sustainable traditional local institutional management system prevails in Chogodrong, whereas it has been highly degraded in Ginnyal. In Chogodrong the prevalence of comparatively less harsh environment and fairly high level of local dependence appreciate the strength of this system. Apart from favourable climate, human factors, like availability of sufficient labour also keeps it intact in Chogodrong. However extremely harsh climate has already forced many families to outmigrate from Ginnyal.

Table 4.16 Indicators of sustainable Local Institutional Management System

Local inst. management systems	Yuljik	Arifabad	Chogodrong	Ginnyal
Water distribution	++	+++	++	++
Local pastures	-	--	++	+
Alpine pastures	++	--	++	+
Local forests	++	+++	++	--
Alpine pastures	-	o	++	--
TOTAL	4	2	10	0

4.4 Identification of Needs, Constraints and Potentials for Sustainable Development, through Participatory Workshops

In Arifabad the major constrains as identified during the workshop, include land degradation (soil erosion and water logging), inability to utilise the full potential of CIF, due to earlier transfer of livestock from alpine pastures, free grazing, labour shortage, labour competition among livestock, horticulture and agricultural activities, and water shortage. Such conditions have also been described by Conway et al. (1985). They affect the quality of work, and consequently the production, harvest and yield. In their understanding the problem of land degradation can be overcome through the building of safety wall around the village and a dam in the origin of the nullah. The former would control free grazing enabling the farmers to exploit full potential of the cropping season, in terms of seed production of maize for commercial purposes and surplus fodder for livestock. They would be able to utilise surplus winter labour by practising plastic tunnels for production of fresh vegetables, both for the household and for the market. They think that by the introduction of frost resistant grain varieties, they can overcome water and labour shortage and it would prolong the length of cultivation period. One such experiment is being done by one farmer, on frost resistant wheat variety. Dam construction would help controlling floods and land degradation and settlement problems but they have a fear that that the maintenance of the dam would give rise to inter village conflicts.

They identify the need of road construction to their alpine pastures, to exploit and manage resources above the channel. The resources of Gamba valley are overexploited and mismanaged

by the people of Shigerthang on the opposite side of the nullah. A road constructed to the alpine pastures would facilitate the proper management of distant rangelands and alpine pastures. Different areas of pastures can be protected and rotated to be used alternatively. All the animals can be easily transported to the pastures, this practice is now partially being abandoned due to long distance of three days. Similarly their regular transfer to the alpine pastures would help to alleviate the competition of fodder cultivation. There is a great need for highland afforestation to control floods and landslides. Alpine reforestation of adapted species would become possible. Rehabilitation of habitat would attract wildlife. Additionally wild grasses can be harvested and transported to the village for winter use. Similarly sick animals can be brought down for treatment to overcome losses during summer. Animal wastes can be brought to the village to be used as FYM. Additionally the potential of seven lakes situated in the higher mountains, for trout cultivation and tourism can be manipulated.

The major constraint is that they cannot strengthen their local management system of resources due to labour shortage. A road to the brook and a wall around the village would save labour which can help in restrengthening and implementation of rules and regulations of a local management system.

The identified local commercial enterprises include vegetable seed production, apricot dehydration, commercial potato production and manufacturing of handicrafts. The potential for development was pointed out in terms of farming system research programs, concerned with soil improvement, pests and disease control (IPM) and high yielding, disease resistant varieties and research on improved livestock breeding programmes. They suggested "Environmental impact assessment" of the intended development programmes.

Women workshop highlighted pest and disease problems of vegetables, and fungal diseases of wheat. They emphasised on the introduction of appropriate technologies to improve agricultural activities (crop and fodder harvesting), to alleviate their workload. In the sector of human resource development, they require agricultural specialist, food and fruit processing expert both among men and women and vocational training to improve local employment, and preservation of cultural practices.

It was also mentioned, that the quality of education in government schools is poor, whereas private schooling is very expensive. Lack of medicines in the medical dispensaries was also complained. There is a need to train some local woman in the area of mother and child health care and first aid post.

In Yuljik, it was identified that there is a profound aversion among the youngsters to work on land or other productive activities. This attitude of the school going children and young boys, in turn increases the workload of the remaining members of the household. So there is a need to

patternize the social development to address this problem. The curriculum of school education needs to be revised and redesigned so as to inspire and motivate the children to respect their assets and conserve their cultural as well as social practices of managing the natural resources, in a sustainable way.

Both in Yuljik and Arifabad, there is great potential of alternative agricultural practices of fish farming. In Yuljik, there is an acute need for launching village based economically attractive packages on equity basis for diverting the attention of young generation, that is extremely frustrated and remains searching off farm employment opportunities because labour on land does not return as much as they desire or require.

Due to habitat losses there is considerable reduction in the wildlife, that requires immediate action for conservation, above the channel. Land holding can be increased by the rehabilitation of irrigation channels, that were irrigating a large common area on the mountains but their utilisation was stopped because of conflicts among the villages. It can bring 2,000 kanals of land under cultivation or under forest plantation. However one channel rehabilitation requires 150,000 Rs., therefore some financial support as well as social external intervention to establish a system for their management is required. Land renovation would reduce frequency of floods, and landsliding and degradation of cultivated land. They identified that the management of surrounding wastelands (protection from grazing and fuelwood fetching), is also important. High mountain afforestation and reforestation (frost resistant forest species) campaign should be initiated, and protected from free livestock grazing. The coordination of some external agency with Tanseemi Nojawanani Yuljik Noor Bakhshia is required to take this initiative The need for cultural preservation and expansion of tourism to three lakes above the channel was also pointed out Women workshop highlighted the need for girl vocational trainings to promote handicraft manufacturing and marketing.

There is government level family planning programme, villagers want it to be more functional but they require at least two lady health visitors.

In Chogodrong, the major constraint for development is floods and landslides in the nullah (mainly due to rainfall), that are a direct result of deforestation in the alpine forests (Pirazizy, 1993). The excessive expansion of the nullah has been identified as immediate threat to the cultivated land, Sadpara lake (accumulation of sediments) and human settlement. The rehabilitation of degraded land requires tremendous amount of labour. They need a bridge on Hergaisa nullah because during the months of June and July, they are completely disconnected from Skardu due to excessive amount of water in the nullah. Among their priorities, drinking water supply to reduce women workload, medical dispensary equipped with medicines free of

charges, girl school, introduction of appropriate technologies (nut cracking machine) and local economic activities (semi commercialisation of their woollen by-products) are prominent.

In Ginnyal, they identified the need to introduce mechanised ploughing, to reduce their workload and save time. For this purpose first a road should be constructed to improve their communication with proper Gultari. They also identified the need to incorporate some male oriented enterprises to use their labour efficiently, complete water supply projects, and introduce grass cutting machines to reduce women workload.

Due to the floods during 1996, 300 goats died and many pine trees were damaged. These floods are caused by excessive deforestation and the villagers predict that if this trend continues, only within a period of 5 -10 years, all forests would disappear. Tree cutting should be completely banned to control floods and landslides , to conserve the aesthetic beauty of the area as well as the population of markhore, which have great attraction for tourists.

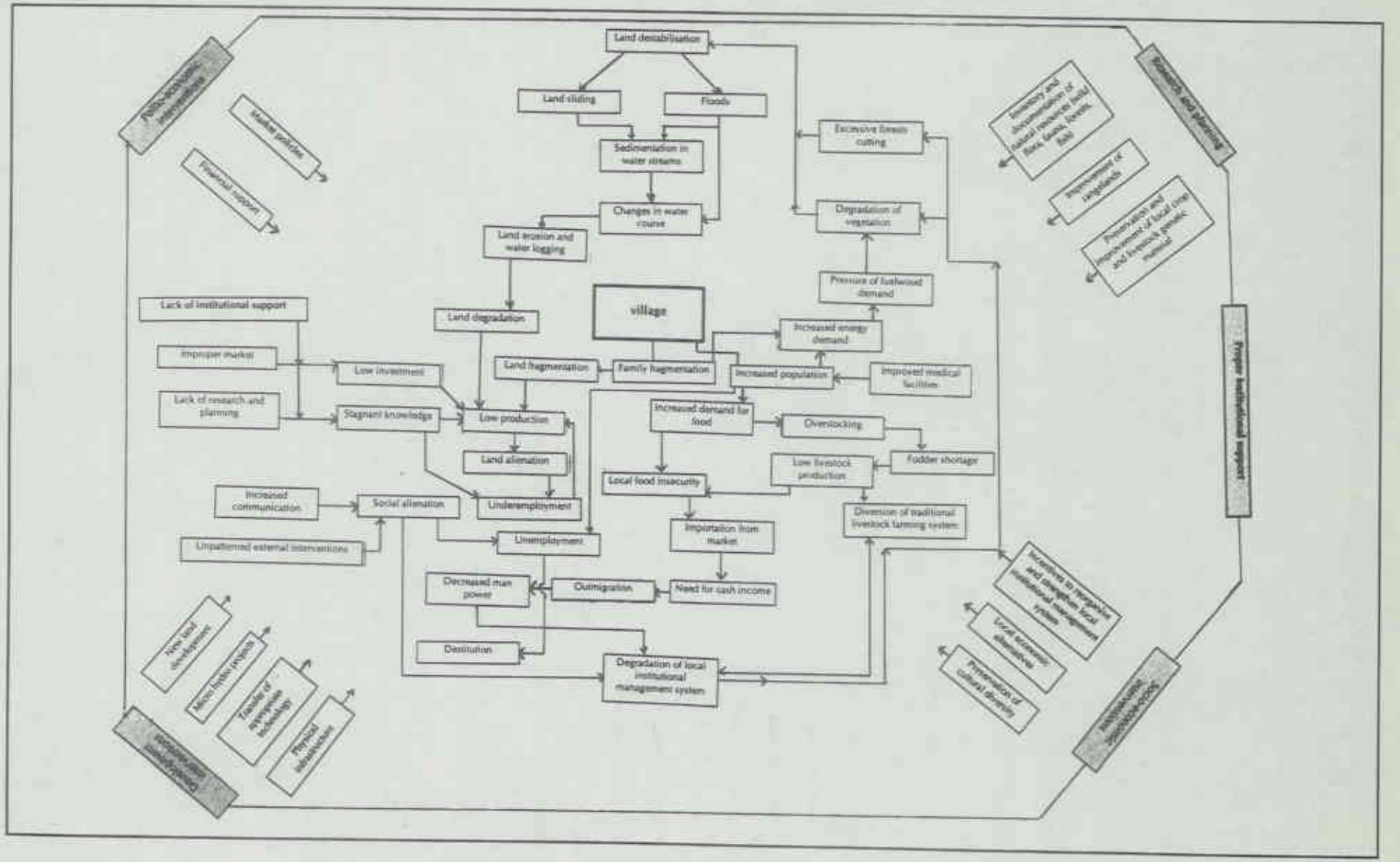
They highlighted stone mining as a potential local income generating source but for this purpose, they require external support for technology and skills development and establishment of market. This potential was also identified in Yuljik.

There is a very deep lake in the river between Ginnyal and Thaley. It has tremendous potential for hydro-power generation. A microhydal project needs to be implemented.

Both the people of Chogodrong and Ginnyal, are not satisfied with the existing medical facilities (in terms of medicines, building of the dispensary and the attitude and expertise of the dispenser) and stress upon improving its quality. There is a need to increase the funds for the medicine and to well equip the dispensary for the treatment of some major diseases. In the boys school skilled and dutiful teacher should be appointed and girls school should be established there.

The abundance of medicinal plants and herbs found on the alpine pastures of three valley except Arifabad, can be exploited to create a sustainable local income generating activity for the people, after the biochemical analysis and cultivation on commercial scale for its better management. It requires a participatory planning for research and "Environmental impact assessment" for identification, cultivation, harvesting, preservation, storage and dispatching of these medicinal plants.

Figure 4.11 A systematic illustration of causes and effects of resource mismanagement and suggestions for improvement



5 CONCLUSION AND POLICY IMPLICATIONS

The findings of this research prove that there are extreme variations among the villages coming from various AEZ, therefore application of generalisations is not rational, highly specific variables must be considered in specific communities. Socio-economic stratification vary even within the zones. Needs for development are also highly specific. For some of the cases, invariable results were obtained, when comparison was made among different AEZ e.g. outside employment, local food production, and fuel availability. In some cases, differences occurred among the zones but without any clear trend e.g. proportion of cultivated land allocated to various crops.

The average family size decreases with the increasing crop intensity factor. Similarly the lowest labour availability has been recorded in the villages with highest crop intensity factor. Majority of the communities have poor living standard. Inaccessibility, scattered human settlement, lack of funds and lack of awareness of communities are major constraints of social development. Lowest socio-economic development has taken place in SCZ, due to its highest inaccessibility. For improved physical infrastructure, community participation is very important.

Throughout the villages under study, cultivated land is highly prone to natural hazards (land slides and floods), representing the highly unfavourable mountain ecosystem. Highest land degradation has occurred in socially deprived villages. In contrast occurrence of moderate land degradation in socially developed villages, asserts that social development helps in reducing the rate of land degradation but requires to be planned adequately. There is highest pressure on the natural resources in the remote villages because land degradation has been increasing with decreasing access to the market. It has also been found that these villages have lowest trend to fulfil their requirements from the market, even though, the potential of their resources is very low.

Uncontrolled livestock grazing has been identified as one of the major constraints to exploit the optimal potential of cropping intensity of many areas. Majority of the villages, where traditional practices to prepare FYM are degrading, lie in close approximation to the market. Through the household study, it is concluded that the increased attack of pests and diseases of the crops is an outcome of crop intensification. A tangible transformation of subsistence agricultural farms into semi-commercial farms, is taking place in those villages which have

better access to the market, and have comparatively large average land holding per household. Majority of the villages have local food insecurity. However, prevalence of the highest potential to fulfil household food requirements from local production in the villages with increasing trend in crop production, shows that the proper management of crop production can provide local food security.

There is strong linkage between the livestock and the households in the SCZ. There is higher dependency of livestock on the private resources in the lower two zones as compared to the upper two zones. In general, livestock development has been neglected. Livestock production depends on better feeding management, whereas livestock diseases can be controlled through better disease management. Farm yard manure utilisation varies among the villages regardless of AEZ, depending on the land holding and SLU per household. Fuel resource utilisation varies among all the zones. Villages in SCZ have acute fuel shortage and fulfil their fuelwood requirements from fetching and forest cutting. Thereby exert high pressure on natural vegetation. In turn very small proportion of the villages, coming both from lower two zones uderutilise their potential forest production, mainly due to high labour shortage.

The local institutional management system for water works satisfactorily as compared to all other natural resource management systems. Most of them have degraded regardless of the agroecological zones. It is established, that for the sustainability of socio-economic conditions of the communities, their adherence to their socio-cultural values is very important.

Unclear constitutional status of Northern Areas of Pakistan, is one of the major cause of under-development of the region as a whole. Redefinition of the constitutional status can bring about thriving changes in the socio-economic status of the region. Government of Pakistan is required to design and implement a logical policy framework in the perspective of providing local food security. These policies to protect farmers (subsidies on fertilisers and other improved technologies), have been found successful in enhancing the food production (Conway et al., 1985). In Northern Areas of Pakistan the policies to discourage importation of food items from the down country and encourage their local production (credit, loan and marketing), would help in improving the status of natural resources. Designing and incorporation of government policies to give priority to the development of physical, social and economic status of the mountain region is imperative for the conservation of natural resources to ensure national food security. Simultaneous consideration of the social, economic, cultural and environmental complexities of the region by the researchers, planners, policy makers and implementers at the time of

introduction of development packages is crucial for sustainable achievement of desired objectives.

Integrated rural development with the participation of communities is one of the basic requirements for sustainable mountain development.

For agricultural development, improvement of local genetic material of crops as well that of livestock and introduction of improved IPDM programmes are required. Niche comparative advantages are to be identified and exploited for the promotion of commercial fruit and livestock production and marketing. Adoption and implementation of participatory farming system research methods to develop and propagate environmentally feasible technologies are very important.

The management of rangelands requires government intervention to develop rangeland management plans and make sure of enforcement of laws concerned with the community exploitation of rangeland. However designing and implementation of rangeland improvement packages (grass regeneration, protection of the areas, rotational grazing, artificial revegetation of climato-ecologically adapted grass species on the rangelands and control of free grazing) need to be undertaken with the involvement of the communities.

There is a great potential for the development of micro-hydal projects, large scale implementation of these projects with community participation would help in the improvement of natural resources and upgradation of the living standard of the communities. Local level income generating activities induced by the government to explore the potential of underutilised resources by the introduction of environment friendly technology can help to reduce the rate of outmigration and improve the socio-economic status of the communities.

Preservation of culture is also necessary for the conservation of natural resources and their sustainable utilisation.

The conservation of both environmental as well as cultural diversity, is crucial for sustainable food security and human social welfare. For manipulation of the natural resources to achieve these two objectives, integrated research activities need to be designed and carried out properly, with great consideration of mountain specificity as well as that of demographic, cultural, social, religious, economic, and political characteristics of the marginal societies for upgrading their

living standard. Problem oriented research programmes conducted by the teams of national university graduates with interdisciplinary approaches and broader perception can present practical solutions in a broad line of action keeping in view the holistic nature of the mountain production system. The research objectives need to focus on ideas and concepts that can create more suitable linkages among the components of production system. For this purpose universities of Pakistan must develop funds and policies to support research. Government should establish a regional level research support institution to streamline these activities in Northern Areas of Pakistan.

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Illustration of artificial crop fields and traditional method of ploughing

Carrying of fuelwood piles collected from the wastelands

Appendix I Labour Availability Calculation

1 man day (md) = 8 man hours (mh)
1 md = 1.2 woman man day (wmd)

I) summer

The activities considered in summer include

A Livestock
40 animals are looked after by 1 full time man labour on the pasture. 25% of the cows as 50% of the goats are taken as miking animals. 1 cow milking requires 0.48 mh/day and that of goat requires 0.38 mh/day.
a) Total md to take care of animals in the pasture = no. of animals / 40 @ 1md * 30 * 6
b) Total md for milking = (no. of cows * 0.25 * 0.48) / 8 + (no. of goats * 0.5 * 0.38) / 8

13 animals left in the village require 3 mh/day of 1 man labour
c) Total md = no. of animals / 13 * 3 * 180 / 8
d) Total men day for livestock management during summer = a + b + c

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B Forest Management
a) 10 mh per kanal of forest area are required for the whole summer
b) total md= 10/8 * area under forest

C Fruit tree management
20 trees from one kanal of land yield fruit
a) one tree requires 12 mh for the whole summer (tree pest management, thinning, picking of fruit, collection, transportation, cleaning, grading, pealing off the fruit, nut cracking, dehydration and lastly storing it for marketing
b) md per kanal =20 *12/8
c) total md =b * total area under fruit trees

D Cultivated land
All the calculations have been made keeping in view the gender division of labour.
Wheat has been taken as standard and the factor of deviation of labour required for other crops has been simply ignored.
For one kanal of cultivated land:
a) Transportation of fertilisers =16 mh
b) Ploughing =6mh
c) Levelling of land =2mh
d) Sowing =.5mh
e) Irrigation =5mh
f) Weeding =26.6mh
g) Harvesting =26.6mh
h) Pilling =29.3mh
I) Threshing =48mh
j) Separation of straw from the grains =40mh
k) Storage =34.66mh
l) Milling =40 mh
m) total md for one crop per kanal = (a + b + c + d + e + f + g + h + I + j + k + l) / 8 = 34.33
n) Total md = m * crop intensity factor

E Fetching water
a) Village no. 4, 5, 7, 10, 11, 13, 14, 17, 18, 24, 27 require 0.5 wh/day
total md = (0.5 / 1.2)/8 * 180 = 9.4

b) Village no. 20, 25, 26 require 1 wh/day

total md = (1 / 1.2) / 8 * 180 = 18.75

c) Village no. 21 requires 1.2 wh/day
total md = (1.5 / 1.2) / 8 * 180 = 28.13

The rest of the village have water pipelines for drinking water supply.

F Fodder collection
For those villages where practiced it is assumed that 100% of the total women go 50 times for the collection of grasses either from the wasteland or harvest grasses from the field boundaries.
a) total md = (50 * total women population) / 1.2

G Fuel collection
This case has been treated similar to the Fodder collection.
a) total md = (50 * total women population) / 1.2

H) Total labour required during summer = A + B + C + D + E + F + G

I) Total md available during summer = (total women population * 180/1.2) + (population of men present in summer *180).

Index of labour availability in summer = I / H

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ii) winter

A Livestock
Categories were made according to the no. of the animals per HH in each village as given,
1) No. of animals per HH below 10 = 1 mh /day
a) total md = 1 * 180 / 8 * no. of HH in this category
2) No of animals between 10 and 20 = 1.8 mh / day
b) total md = 1.8 * 180 / 8 * no. of HH in this category
3) No. of animals between 20 and 30 = 2.4 mh / day
c) total md = 2.4 * 180 / 8 * no of HH in this category
4) No. of animals between 30 and 40 = 2.8 mh / day
d) total men days = 2.8 * 180 / 8 * no. of HH in this category
5) No. of animals above 40 = 3.2 mh / day
e) total md = 3.2 * 180 / 8 * no of HH in this category
f) total md for the whole village = a + b + c + d + e

B Forest management:
a) 18mh per kanal for the whole winter
b) total md = 18 / 8 * total forest area

C Fruit tree management
a) 8mh per kanal for the whole winter
b) total md = 8 / 8 * area under fruit trees in kanals
The time allocated for fruit and forest tree management includes time for irrigation, wrapping of the stems, tree pruning, replanting seedlings, unwrapping, fencing the area, and pest management

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D Preparation of FYM:
a) dumping of one mond of the manure altogether requires 7 minutes (0.117mh)
b) total men days = 0.117 * monds per household * no. of households

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E Water Fetching
a) Villages no.4, 5, 7, 10, 11, 13, 14, 17, 18, require 0.5 wh / day
total md =(0.5 / 1.2) * 180 / 8
b) Village no. 27 requires 0.8 wh / day

total md = (0.8 / 1.2) * 180 / 8
c) Village no. 20 requires 1 wh / day
total md = (1 / 1.2) * 180 / 8
d) Village no. 24 requires 1.5 wh / day
total md = (1.5 / 1.2) * 180 / 8
e) Villages no.21, 25, 26 require 2.5 wh / day
total mds = (2.5 / 1.2) * 180 / 8

F) Total labour required during winter = A + B + C + D + E

G) Total labour available in winter = (total women population * 180 / 1.2) + (total men present in winter * 180)

H) Index of labour availability in winter = G / F

Appendix II Crop Groups

All the crops that are cultivated on land were divided into four groups for the calculation of proportion of cultivated land under these groups.

Major crops	Minor crops	Potatoes	Other vegetables
wheat, barley and maize	buckwheat, millet and sorghum		carrot, onion, tomato, turnip, cauliflower, spinach etc.

Area under each of these crop groups was divided by "Sum of all the crop areas" , which exeeds the total cultivated land because of crop intensity factor higher than one.

Appendix III Area Allocated for Fodder Production

Millet, sorghum, turnip, maize and alfa alfa.have been taken as primary fodder crops. Wheat, barley and buckwheat were taken as secondary fodder crops. Area under these crops was divided by different coefficients according to the proportion of the yields of food for human and fodder for animals and their relative importance. Potatoes, beans and other vegetables were taken tertiary fodder crops because bean husks and residues from other vegetables is fed to the animals

Crop	Grain yield (monds)	Straw yield (monds)
Wheat	5	25
Barley	4	10
Buckwheat	3	5

As responded by the farmers, wheat grain and straw weight ratio was taken as 1:5. However keeping in view the value given by the farmers to both these products, land ratio was taken as 1:1. Area allocated to other crops was also calculated in the same way.

Crop	Grain and straw weight ratio	Food and fodder land ratio
Wheat	1 : 5	1 : 1
Barley	1 : 2.5	1 : 0.5
Buckwheat	1 : 1.67	1 : 0.334

Crop	Percentage of area allocated for food production	Percentage of area allocated for fodder production
Wheat	50	50
Barley	71.4	28.6
Buckwheat	75	25
Potatoes	95	5
Beans	80	20
Other vegetable	95	5

Percentage of area allocated for fodder production
Area allocated for fodder production / Sum of all crop areas

Appendix IV Crop Intensity Factor and Crop diversity

Crop intensity factor was calculated by dividing the sum of all the crop areas by total cultivated land
Crop diversity was calculated by modifying the basic formula $1 / \Sigma (n/N)^2$ (Deshmuk, 1994) to $1/ \Sigma (a/A)^2$ -

n = no. of individuals of a species, N = total number of the individuals of all the species present in a specific area.

a = area under one crop group, A = total area under all the crop groups

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Appendix V Fuel Availability Calculation

Total potential amount of fuel

a) there are 30 forest tree / kannal
b) branches are lopped off from 10 trees
c) 1 tree yields 2,5 monds per year
d) fuel produced form 1 kanal of forest = a * b * c
e) total amount of fuel from the forest = d * area under forest
f) all the adult women from the village go for fetching the woodfuel 50 times per year and in one round bring one mond of woodpile
g) total amount obtained form fetching = 50 * total population of women
h) Total amount of available fuel e + g
I) percentage of fuel requirements which can be fulfilled from private forest = e / total requirements
j) percentage of fuel requirements which can be fulfilled by "sustainable " fetching (which does not exceed 50 times) = h / total requirements
k) percentage of fuel requirement which are fulfilled in unsustainable way, either extra pressure on highland vegetation, cutting of fruit trees or overexploitation of private forest

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Appendix IV Potential Production of FYM Calculation

FYM has been taken as a combination of following components:

A) Animal waste

a) Animal wastes are collected for 6 months
b) the quantity of animal dung from 1 SLU is taken to be 0.5 kg per day
c) amount of added mud = b * 2
d) 0.25 of feed wastes are added
e) (a + b + c) * 180 = Amount of FYM for 1 SLU (kg)
f) e / 40 amount of FYM for 1 SLU in monds

g) Total amount of FYM obtained form animal by 1 household = g * total number of SLU/ HH

B) Human wastes

a) 0.1 kg of wastes per person per day
b) amount of added mud = a * 2
c) total amount of FYM per household per day = (a + b) * family size
d) total annual amount = c * 365 /40 (monds)

C) Kitchen wastes

a) 0.25 kg / day
b) amount per year = a * 365 /40 (regardless of the family size)

Total production of FYM per household = A + B + C

Appendix VII Fodder Availability Calculation

I) Amount of available fodder for six months of winter

a) total yield of wheat straw = 25 monds / kanal * area under wheat
b) total yield of buckwheat straw = 5 monds / kanal *area under buckwheat
c) total yield of barley straw = 10 monds / kanal * area under barley
d) total yield of maize stalks = 6 monds / kanal * area under maize
e) total yield of sorghum and millet hay = 6 monds / kanal * area under millet + sorghum
f) total yield of turnip = (0.25 monds / kanal of dried turnip fruit +1.5mond / kanal of dry leaves) * area under turnip
g) total yield of dried potato leaves = 2 monds / kanal * area under potato
h) total yield of dry leaves from other vegetable = 1.5 monds / kanal * area under vegetable
j) total yield of alfa alfa hay = 7.5 monds / kanal * area under alfa alfa
k) total yield of dry leaves from the forest = 2 monds / tree * 30 * area under forest
l) total yield of dry leaves from the fruit trees = 1.5 monds / tree * 30 * area of fruit trees
Total amount of available fodder = a + b + c + d + e + f + g + h + j + k +l

ii) Fodder required for six months of winter

Total fodder required = No of SLU * 3 * 180

SLU were formed on the basis of the fodder requirement of sheep, goat and cattle and one sheep was taken as one SLU and goat and cattle were given the relative number of SLU in comparison of their fodder requirement with that of sheep.

1 sheep = 1 SLU which requires 3 kg of fodder on the stall / day
1 goat = 1.3 LU which requires 4 kg of fodder on the stall / day
1 cow = 10 SLU require 30 kg of fodder on the stall /day

Appendix VIII Optimum Number of SLU Related to Fodder Availability

The calculation of optimum number of SLU was based on regression equation

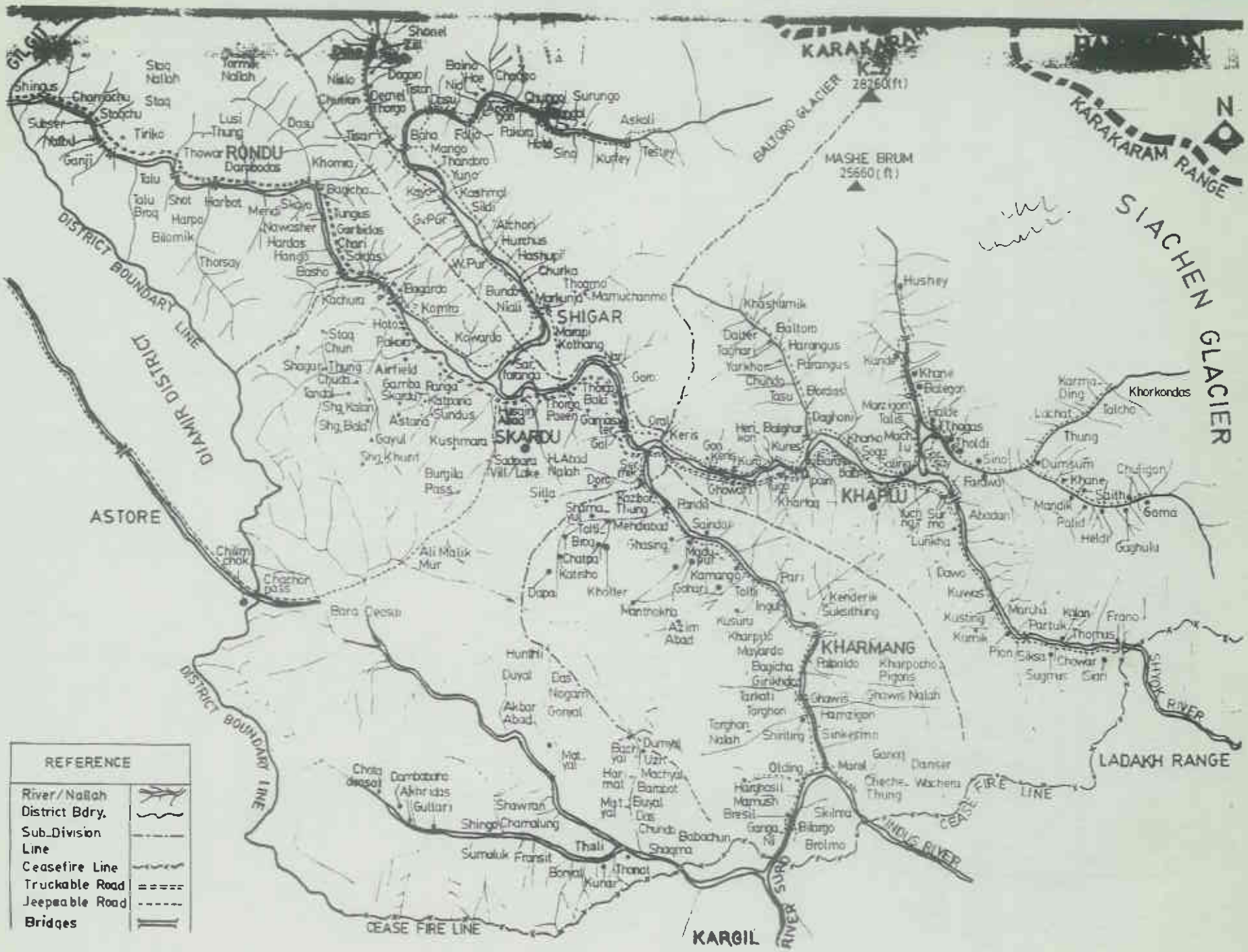
Index of fodder availability = 0.0691 + 2.22 Total land / SLU (R- sq. 99,1 %)

This equation shows that if total land per small livestock unit is increased by one kanal, the index of fodder availability increases by 220%, or in other words, to increase fodder availability, by 1%, total land per SLU has to be increased by 1/220 or .00455 kanals

a) fodder shortage = (1 - index of fodder availability) * 100
b) How much total land per SLU has to be increased = a * 0.00455
c) optimal area per SLU = b + Total land per SLU
d) optimal number of SLU = Total land / c
e) percentage of present herd which can be kept sustainably = d / SLU

Appendix IX List of Villages with Corresponding Agroecological Zones

No.	Village	PAEZ
1	Askerigon	MDCZ
2	Chachungpa	MDCZ
3	Zagonpa	MDCZ
4	Ticho	TCZ
5	Khurshidabad	DCZ
6	Kharfak	DCZ
7	Yugu	MDCZ
8	Rizvia	MDCZ
9	Dasunit Shiger	MDCZ
10	Tissardoko	MDCZ
11	Risar Sixa	MDCZ
12	Mangu Shiger	MDCZ
13	Biankapaya Gamba	DCZ
14	Tandalbrokgrong	DCZ
15	Taluyulpa Rondu	DCZ
16	Zandapa Chunda	TCZ
17	Sondasgon	DCZ
18	Arifabad	DCZ
19	Birchung Keris	DCZ
20	Katpana	DCZ
21	Shigerthang	SCZ
22	Harkhorebara Paen	MDCZ
23	Hatchi	MDCZ
24	Chogrolprol Soq	SCZ
25	Skildrung	TCZ
26	Ginnyal	SCZ
27	Skinderabad	DCZ
28	Yirkhor Thaley	TCZ
29	Karimpa Olding	TCZ
30	Chondu Thaley	TCZ



Appendix X Map of Baltistan