DESERTIFICATION DYNAMICS AND ITS CONTROL MECHANISMS IN SEMIARID AREAS OF PAKISTAN: A CASE STUDY OF DISTRICT KARAK PAKISTAN

IFFAT TABASSUM

INSTITUTE OF GEOGRAPHY,
URBAN & REGIONAL PLANNING,
UNIVERSITY OF PESHAWAR, PAKISTAN
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DEDICATED TO:

My Parents who had the dream for my highest possible level of education,

My Husband and Children who rendered great deal of time

And to the

People of Karak

APPROVAL SHEET

This research thesis, titled "Desertification Dynamics and its Control Mechanisms in Semiarid Areas of Pakistan: A Case Study of District Karak", submitted by Ms Iffat Tabassum, under the supervision of Dr Mohammad Aslam Khan, HEC Professor, Institute of Geography, Urban and Regional Planning, University of Peshawar, KPK, (Pakistan) for the award of degree of Doctor of Philosophy in Geography is hereby approved.

External Examiner

Supervisor
(Prof. Dr. M. Aslam Khan)

Internal Examiner

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ABSTRACT

Desertification has emerged as a major environmental problem during last few decades. Due to its serious implications on food security it has attracted global recognition. Significant attention is being given to its mitigation both at government and non-governmental levels. Some of the efforts carried out by state sponsored agencies and NGOs have turned into success stories. However, it has been noticed that if the problem persists for a long time due to lack of attention then land restoration becomes ecologically and financially expensive. Therefore its earlier diagnosis and treatment can not only reduce the cost but is also beneficial for human welfare.

Pakistan has substantial land susceptible to desertification due to geographical factors such as topography and aridity and social issues like rapid population growth and socio-economic changes. The pressure on land often leads to its un-sustainable land use leading to desertification. Millions of poor farm households and their livelihoods in arid and semiarid areas of the country are prone to risks and uncertainties associated with desertification and land degradation.

Inhabitants of the areas affected by desertification try to adapt to changing environment and cope with emerging problems within their own limited knowledge and capacity. Some of the adaptation strategies like social values and norms are built in the traditions of the society. In addition, farmers try to learn from their experiences. Their efforts need to be supported as much as possible. Technology transfer and extension on conservation practices and selection of suitable and better adopted plant varieties and livestock breeds could be of substantial help in that direction. Further, financial assistance through farm credits could also help poor farmers to invest in their lands for improving its productivity.

The present study of Karak district of Khyber Pakhtunkhwa has been undertaken to portray a case study in Pakistan in an area prone to and affected by desertification. It would provide an insight not only into the causes of desertification in a semiarid area but also into workable alternatives adapted locally for the sustainable management of land resources. It would also help in policy formulation and provide guidelines for decision-making to combat desertification.

Data regarding physical parameters in this study were obtained using modern tools like remote sensing and GIS for mapping the area affected or at risk from desertification. The data on social parameters were collected through household surveys and focused group discussions that were analyzed following its processing with SPSS.

Results obtained from this study reveal declining land productivity (both crops and rangeland), crop failure, and increased cost of agriculture, pointing a finger towards increasing desertification and land degradation. Both natural and anthropogenic factors are responsible for increase in desertification. Among natural factors enhanced aridity (water scarcity) as well as erosion of soil by wind and water are prominent. In terms of anthropogenic factors, over exploitation of resources, whether through cutting of vegetation, cultivation of farmland or livestock grazing is the main culprit.

In order to reduce their dependence on land many people have migrated to earn income from nonfarm sources. However, while providing extra income, migration has also resulted in dearth of farm labor, often leading to abandonment of cultivated land opening them to erosion and desertification. Nevertheless remittances from migrants have also helped in certain cases to enhance investment in land for increasing productivity through increase of farm inputs. Finally, this study noted that the practice of traditional values for the control of desertification, which had declined with time are now being revived to control the overexploitation of resources, a good sign for future desertification control in the area.

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CHAPTER – 1

INTRODUCTION

This chapter has been divided into three parts. The first part explains the importance and magnitude of the problem in global and national perspective and discusses the main causes of the problem. The second part introduces the study area in the context of the desertification problem. The next part discusses the research methodology including the sampling and data collection methods as well as analytical techniques used.

1.1 BACKGROUND

Desertification has emerged as the most threatening environmental issue for at least the last six decades that has hindered the development of arid and semi-arid regions (Verstraete, et al., 2011; Verstraete, et al., 2008; Whitehead, et al., 1988; UNCOD, 1977). It characterizes a local challenge as it affects the productivity of the land which is the basis for sustenance and development of the local farmers and rural communities. Desertification also has global consequences because of its impact on world food security, biodiversity loss, and quality of environment (Thomas, 2008; Mannava, et al., 2007; MEA, 2005; Eswaran, 2001).

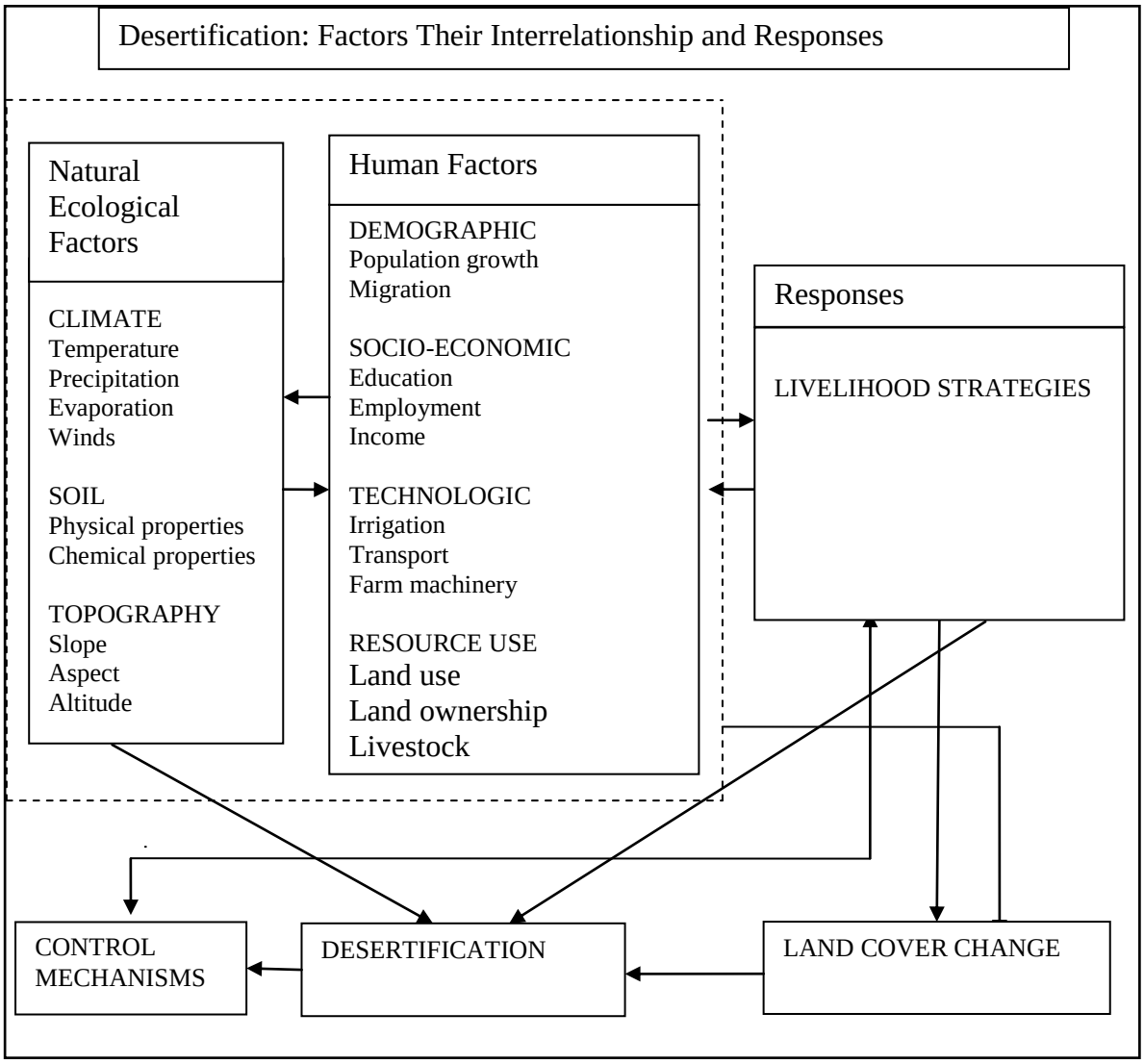
Since the introduction of the term "Desertification", in late 40s it has been debated widely in scientific and political circles (Akhtar-Schuster, et al., 2011; Herrmann and Hutchinson, 2005; Verstraete, 1986; Glantz and Orlovsky, 1983). The most authoritative and broadly referred definition today is the one given by United Nations Convention to Combat Desertification (UN, 1994). It states that desertification is "land degradation in arid, semiarid and dry sub humid areas resulting from various factors, including climatic variations and human activities" (UN, 1994). It can also be defined as a set of processes which causes reduction in biological potential of land which ultimately leads to desert like condition. However, this definition leaves room for interpretation, resulting in ambiguities (Vogt, 2011).

1.1.1 The Process of Desertification

Desertification and land degradation results from very complex processes that can be the consequence of both natural and anthropogenic factors (Santini, et al., 2010; UNCOD, 1977)

(Fig. 1.1). However these can be accelerated by a number of ecological processes (DeFries, et al., 2010) including depletion of soil nutrient, salinization, agrochemical pollution, soil erosion and loss of vegetation (Zhang, et al., 2007). Risk tremendously increases when desertification processes synergise with climate change and new drivers are added to enhance the intensity of deterioration in already degraded areas (Hillel and Rosenzweig, 2010; Abraham and Villalba, 2008; Wang, 2006; Hillel and Rosenzweig, 2002; Pickup, 1998). It is difficult to attribute a single factor to desertification due to complexity of the process. Apart from natural factors such as climate (CGIAR, 2009) i.e. rainfall and temperature variability (Chikozho, 2010), population pressure (Danfeng, 2006), the role of human activities like over grazing, incompatible land use (Seeger and Ries, 2008) and extensive fuel-wood/ fodder extraction are playing a major role in enhancing land degradation and desertification. These activities are considered as immediate and radical causes (Bewket, 2002) and often referred as chronic disturbances (Singh, 1998).

Fig 1.1: Desertification Dynamics: Factors Their Interrelationship and Responses



The risk of soil degradation and desertification is normally high in dry lands (arid and semiarid) than any other region as the high potential risk of soil erosion exist all the year round because during the dry season the intensive wind processes occur in a highly rigorous way and during the rainy season the fluvial processes are in action in a similar way. The variability of precipitation and thus the fragility of ecosystem are both high in these areas.

1.1.2 The Challenge of Desertification

Combating desertification and land degradation is probably one of the most important challenges facing humankind in the years to come (Abraham and Villalba, 2008; IFAP, 2006). Recognizing the seriousness of the problem at global level, UNEP coordinated the

efforts of the nations of the world to frame the United Nations Convention on Desertification (UNCCD) to combat this problem and to rehabilitate the land. It was opened for signature in 1994. Pakistan signed the Convention in 1994 and ratified in 1997, thus becoming a party to it. According to the Millennium Ecosystem Assessment (MEA, 2005), "desertification is potentially the most threatening ecosystem change impacting livelihoods of the poor. Persistent reduction of ecosystem services as a result of desertification links degradation to loss of human well being" (MEA, 2005). The gravity of the problem has also made it a major area of financing by the Global Environment Facility (GEF).

Due to connectional difficulties (Vogt, et al., 2011), even after 14 years of the establishment of the United Nations Convention to Combat Desertification (UNCCD), no accurate estimate of the extent of desertification (Reynolds, et al., 2011) and severity of the problem exists. Since the past several years a general consensus has emerged, among scientists and the signatories to the UNCCD, that a comprehensive desertification monitoring and assessment programme is greatly needed if the members of the UNCCD are to have the reliable information they need to implement the Convention and to monitor the effectiveness of their activities (Grainger, 2009b).

The lack of a clear definition and methodologies to measure the causes and consequences of desertification resulted in largely diverging and possibly exaggerated estimates of its extent (Vogt, et al., 2011). This also slows down efforts to integrate knowledge for promoting the sustainable development of dry lands (Verstraete, et al., 2011).

According to different global assessment reports 30-43% of the world land is suffering from some kind of land degradation. Human induced land degradation has more implications. According to FAO, (FAO fact file 1997) cited in Jie, C, (2002) its rate is highest in Asia followed by Africa. Asia is also the leading continent in terms of population affected, where the problems of natural resource management are considerable (Vernooy, 2008) partially because of geographical factors but more importantly due to insufficient resources and political intervention in resource utilization and management. Within Asian continent, land degradation is the most serious problem in south Asia where 43% of the agricultural land is affected by one or other form of land degradation. Amongst the countries of the region, Iran is the worst affected (94%) followed by Bangladesh (75%) and Pakistan (61%), (Zia and Arshad, 2006).

Arid and semiarid regions of the world are supporting approximately 2 billion people that are at highest risk of desertification (UNCCD, 2006). Posing formidable challenges for sustainable development, these areas deserve special attention of the scientists and researchers. It is particularly important because despite multifarious problems, there is great potential to improve the livelihoods of the local inhabitants in these areas (IFAP, 2006). Realigning soil and water conservation policy is crucial in addressing land degradation: this is pre-requisite for achieving sustainable land management and improving livelihood. Among countries like Pakistan, the problem of land degradation and desertification in arid and semi-arid areas is very intricate, where assessment of landscape changes is a very complicated process due to the nature of spatial and temporal characteristics (Abdul Ghafar, 1997) and where information about both physical and social aspects of such problem is not readily available.

1.1.3 Desertification in Pakistan

Pakistan is predominantly an arid and semiarid country with land spread over 68 million hectares and the annual rain fall less than 300 mm. The land here is being degraded at a very high rate (Ahmad and Kazmi, 2003; GoP, 2011) and appears to be one of the worst problem (Zia and Arshad, 2006).

Productivity and household incomes in dry lands of the country are low and about a third of Pakistanis still live in poverty. Indeed, poverty in Pakistan increased during the 1990s. This relatively poor performance is due to a various factors, with land degradation and desertification at the top of the list. It has played a significant role through its impact on the productive capacity of ecosystems. Population growth and existing poverty has led to an over-exploitation of resources (cutting of trees, removal of vegetation, over-grazing etc (GoP, 2005), resulting in reduced productivity of land, food insecurity and further poverty.

Land degradation and desertification is the result of both natural and social factors including land use/land cover change (Bajracharya, et al., 2010) and rapid population growth. The later is exerting immense pressure on the natural resources (GoP & IUCN, 2002). Deforestation (Adnan and Hölscher, 2010), soil erosion, side effect of unsustainable irrigation practices such as, water-logging, sodicity and salinity unhealthy land use and management practices

resulting in negative nutrient balance, and depletion of soil fertility are the main causes of land degradation and desertification (GoP, 2011).

Each year about 5000 ha of land in rain-fed areas is irreversibly affected by soil erosion due to insufficient vegetative cover to protect the soil (GoP, 2002). Over the years about 40% of the irrigated crop land in Pakistan, which account for around 90% of the total agricultural production, has come under water-logging and salinity (Khan, 1999), though part of it has been reclaimed. Further 68% of rangeland used for animal grazing and related activities is also degraded to a certain extent (GoP, 2011, Ahmad and Kazmi, 2003). Over 30 million people in Pakistan live in these dry lands where their livelihood depend heavily on the rangeland resource base in form of food for human being, fodder for livestock, fuel for cooking and heating and other non timber products for house sustenance and income generation. The livelihood of the poor farming communities in the entire region is subject to risks and uncertainties due to desertification.

In Pakistan in general and in Khyber Pukhtoonkhwa (KPK)[1] province in particular, the problem of land degradation has caught some attention of research organizations and individual researchers in the past few decades and considerable work has been initiated in this field in recent years. Ministry of Environment with the help of United Nations Development Programme, for example, developed a multiphase project in 2002 named "Sustainable Land Management to combat desertification in Pakistan". Main aim of the project is to provide sustained environment for the removal of barriers against Sustainable Land Management (SLM) in Pakistan. It has worked in two phases. Five districts from Pakistan were selected for detailed study. From Khyber Pukhtoonkhwa, Lakki Marwat district was selected which lies on south western boundary of study area (see map 4).

The main focus of various studies conducted in Pakistan has been physical aspect of desertification although social aspect is as important in combating desertification as the physical aspect (GoP, 2004). This study has been initiated to cover both the physical and social aspects of desertification in Karak district to conduct an in-depth research at micro level for investigating the problems and issues in sustainable land management for their amicable solution.

[1] The North West Frontier Province (NWFP) was created in1901 and in 2010 it was renamed as Khyber Pakhtunkhwa Province.

1.2 SIGNIFICANCE OF THE STUDY

Like other semiarid areas of the world district Karak is highly vulnerable to frequent droughts and climatic variability. In addition, pressure on land resources is heavy due to over grazing and to produce more from the fragile land. The ensuing stress on the land has led to severe damage to soil through reduced nutrient, erosion and depletion of natural vegetation cover and water diminution. The loss of natural perennial vegetation, which can be used to assess the early onset of desertification (Plataforma, 2009) has not only resulted in shortage of food and feed for cattle, but irreversible damage to the biodiversity of the region. This depletion is also leading to disastrous consequences like declining land productivity or desertification.

The situation demands monitoring of the problem at micro level with the help of modern tools of remote sensing and GIS in combination with analytical socio-economic study to comprehend the problem in depth and work towards its solution. Hopefully it would provide an insight not only into the uses and users of these resources but also provide workable alternatives for the sustainable management of the land resources, and provide guideline for policy formulation and decision-making. The study is also likely to open avenue for future research in the area of land degradation in dry areas.

1.3 PROFILE OF THE STUDY AREA

1.3.1 Location and Physical Setting

The study area, district Karak, is located in southern part of Khyber Pukhtoonkhwa province of Pakistan.

Generally the area is hilly and has a moderate relief. Climatically, the district is classified as semiarid. Hence less than a quarter land of the total area of the district is cultivated (predominantly rain-fed). Merely 2.1% area of the district is under some kind of forest, which is lowest in the province (GoP, 2001).

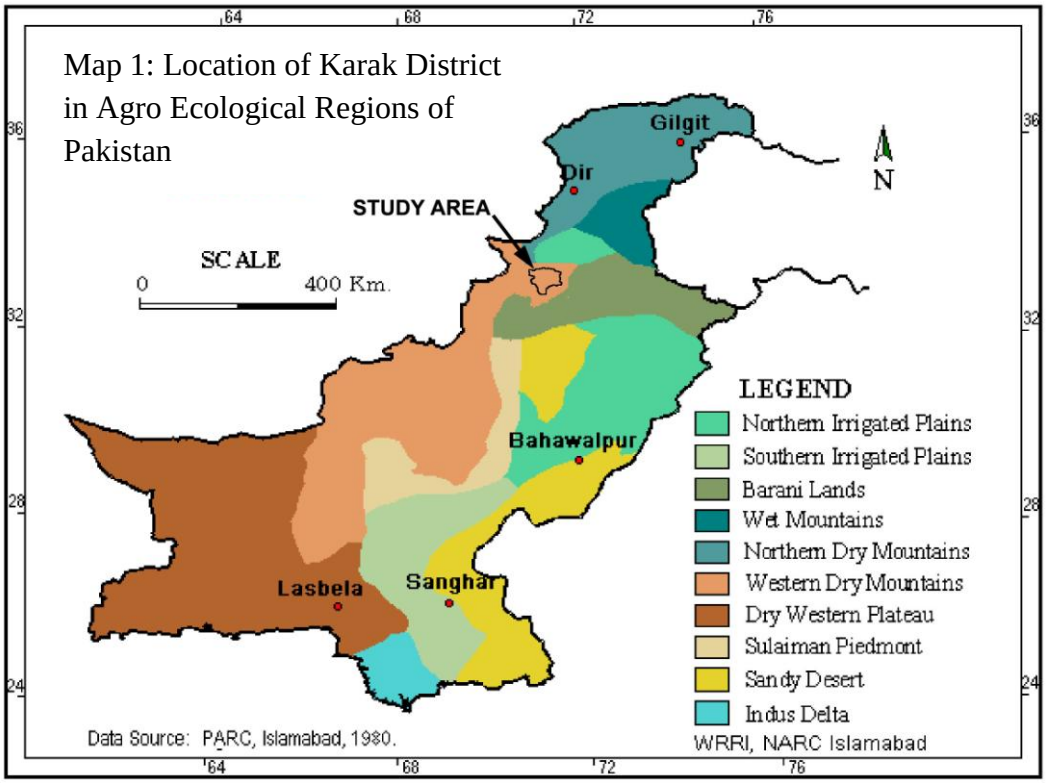
Rangeland is the most wide spread land use in the study area, and is used in variety of ways by those having no other alternatives (Iffat, 2005; 2007). Economically the area is lagging behind when compared with other districts of the province. As there is no big industry or any

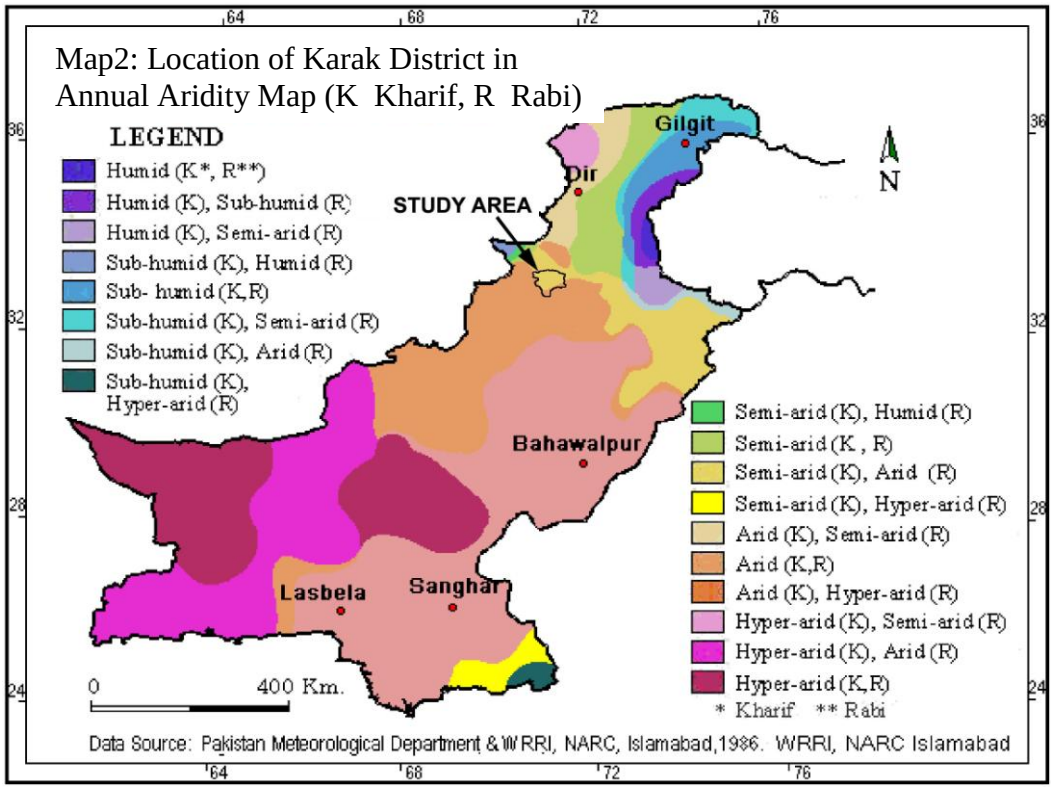
other income generating activities, therefore, most of the educated or skilled males have migrated to other areas of the country or abroad in search of jobs.

1.3.2 Agro-Ecological Setting of the District

Agro-ecological zones are defined as resource mapping unit in term of climatic conditions, land form, soil and land cover, with a specific range of potentials and constraints for land use (FAO, 1996). Karak is located in western dry mountains where summers are wetter and winters are dry or arid. Therefore based on the two major geo-ecological basis (relief and climate) it is included in semiarid mountain region of Pakistan (map1&2).

Map 1 & 2: Location of Karak District in Geo-ecological Regions of Pakistan





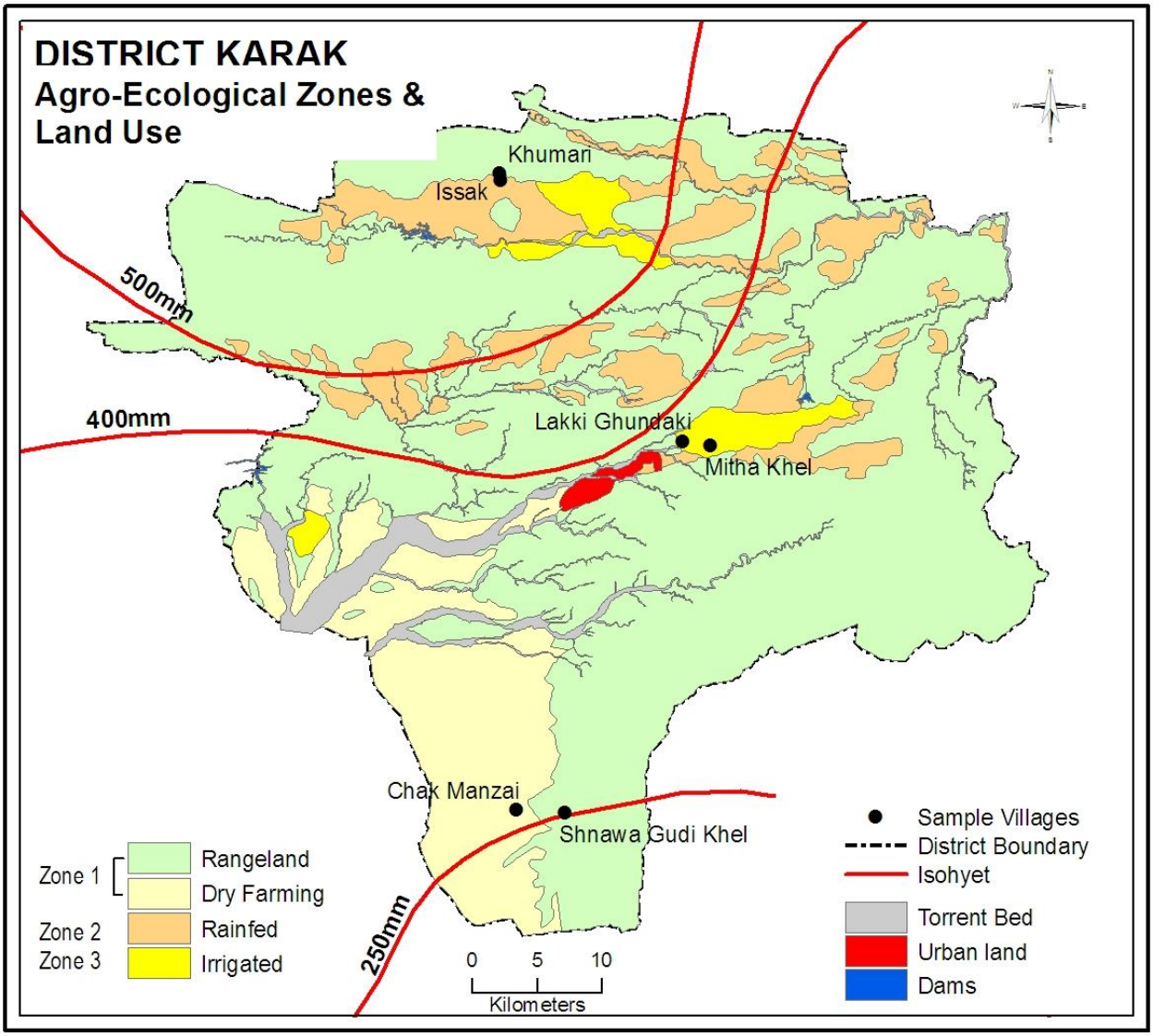
Source: Abdul Ghafar (2004).

According to annual aridity map of Pakistan (map 2) major part of the district is situated in semiarid zone. However, rainfall distribution shows some variations in Karak as shown by

map 4. The North western part of the district receives relatively higher rainfall (more than 500mm) while the Southern part is dry and hot representing arid type of climate (less than 250mm rainfall). The remaining major areas receive rainfall between 250- 500mm.

For present study the district has been divided in three agro-ecological zones based on the altitude, rainfall, land use and dominant crops (see map 3). These zones are rangeland, dry farming zone, and agricultural zone (irrigate & rain fed). Detailed description of these zones is presented in the following section.

Map 3: Agro Ecological Zones, Land use and Location of Sample Villages



1.3.2.1 Rangeland and Dry Farming Zone (Zone 1)

Rangeland, generally dry rugged hills and mountains, occupy most of the district. In this zone agriculture is almost impossible but it is extensively utilized by local people for fodder/ fire wood extraction and livestock grazing.

Dry farming zone is mainly located in south western part of the district with typical characteristics of dry region. In this zone agriculture is practiced, however, due to physical constraints (primarily climate and soil) land productivity is very low. Topographically most of this zone is covered by flat plain with sandy loamy and sandy soil. Climatic conditions are not favorable for agricultural activities as rainfall in the region is low and highly variable. Temperature during summer remains quite high increasing the evapo-transpiration rate significantly. Water is the most important limiting factor in the agricultural development of the area. Most of the fields are cropped only once a year and land remain fallow for rest of the time. Wheat, pulses, millet and barley are the common crops. However, rainfall variability and water scarcity has resulted into abandoning of land and decreased crop production. Land holdings are large but most of the land remains abandoned, used for animal grazing. Livestock rearing is a common practice; however, productivity is very low due to limited forage availability. Main crops cultivated in this region are pulses and millet and to lesser extent wheat. The local people in this zone are heavily dependent on rangeland for their sustenance.

On abandoned land (*banjer land)*, not cultivated for long time, scattered trees of Ziziphus jujube (*bair*) Acacia Arabica and hard Grasses mostly Saccharum (*kana)*, can be seen as the most common type of natural vegetation. These trees and other natural vegetations are used for fuel wood as well as forage.

Lawaghar, the largest torrent of the district, originates from Surghar mountain range (located on the eastern boundary of this zone which separate Karak from Mianwali district) and passes through the southern plains. The dry bed and banks of the torrent provide best habitat for natural vegetation and variety of birds in this zone.

1.3.2.2 Rain-fed Agricultural Zone (Zone 2)

North western part of the district consists of Khattak Range and mountains extending from Kohat and Hangu districts. These mountains receive relatively higher amount of rainfall due to which agriculture is predominantly rain-fed. Most of the rainfall is received in summer months (July and August). High rainfall variability, besides other problems, has also increased the need for irrigation particularly in winters. Currently rain water stored during summer season is the only source of irrigation. Recently Small Dam Corporation has constructed a dam on Teri Toi, named Sherki dam for irrigation purpose. It is hoped that agriculture in this region will become more beneficial in coming years. Teri Toi, the only perennial stream of the district is also located in this zone. Teri valley is narrow but fertile valley. Groundnuts, wheat and oil seeds (sorghum) are common crops of the area.

In past these mountains were thickly forested and still this area has the highest vegetation cover in the district. Previously local people of the region were mainly involved in forest related activities and livestock rearing, but during last few decades the excessive tree cutting has resulted into loss of vegetative cover. Scarcity of forage has also resulted in the decreased number of livestock. In the past seasonal migration between hills and plains was a common practice in this region. One or two persons from each household along with their livestock would move to the hills in summer and would come down in early winter. They would have also brought fuel wood and hay for the winter use. Camels were normally kept for bringing fuel wood and other rangeland products. This practice is now very weak and a lesser number of people are involved. These people work as paid herders who take the livestock of the richer families on payment.

1.3.2.3 Irrigated Agricultural Zone (Zone 3)

The north eastern and upper central part of the district has the most moderate type of climate. Temperature remains low as compared to the rest of the district even in summer season. Agriculture in this zone is mostly dependent on irrigation due to lower amount of annual rainfall (around 400mm). Moderate summer temperature reduces the evaporation rate and hence increasing water availability for small scale irrigation, which has always been a common practice in this region. The most common way of irrigation is well. Besides, rain water harvesting is also practiced by constructing local bunds in the water channels. Stored

water is then distributed to all fields through community based organized system. In this region two small dams have been constructed in recent past, providing irrigation water on limited scale.

This region was once known for growing best quality wheat. Currently groundnut has become the major cash crop, while production of all other crops (including wheat) has decreased. Onions chilies and some seasonal vegetables are also grown along with oil seeds (sorghum) and fodder in this region.

This zone also has hilly terrain with average altitude of 400 to 600 meters. Shinghar, once thickly forested, (entire belt has now been cleared) is the highest peak of this zone. The bed rock of the area is composed of gypsum and many salt mines are also located in the region. The soil is shallow and mainly gravely loam in this region. Salt range extending from west is exposed at many locations. Because the area is underlined by gypsum and salt rock in the north, the over extraction of ground water has given way to the saline water that now cannot be utilized for irrigation purposes. In many villages soil salinity has caused great problems and agricultural activities have diminished. This will aggravate the problem of land degradation further which can lead to desertification.

Research Questions and Hypothesis

The main research questions for the study were that 1) why the land related resources in district Karak have degraded during last three decades? 2) What land cover changes have occurred and why? 3) What are the major consequences of these changes on social as well physical environment? 4) How the people are adjusting to land related problems? Special attention was given to evaluate the perception of local community to these problems and to find out the strategies that have been adopted to cope with these problems.

On the basis of the above research questions, following hypothesis was tested. Higher dependency on land and its over exploitation due to population growth and changes in social set-up (monetization of rural economy, activities towards raising standard of living), particularly changes in agriculture and livestock husbandry has contributed significantly towards the problem of land degradation.

The research had the following objectives:

1 To find out land related problems and the major causes of desertification in Karak.
2 To explore and evaluate the local strategies adopted for combating desertification.
3 To create agro-ecological map of district Karak on the basis of land cover/ land use and investigate the desertification problem there in.

1.4 RESEARCH METHODOLOGY

1.4.1 Sources of Data

Both primary and secondary data were collected and used in the study. Secondary data were collected from various published and un-published reports, journals, books etc. while primary data were collected from the field through various tools and instruments used in social sciences as follows:

Several visits were made to different governmental and non-governmental offices, which are involved in activities related to land resources in the district and data were collected from these departments. In some cases secondary data were not available in the processed format so it was first processed and then analyzed. Important organizations from where the data were obtained for this research were Revenue Office Karak, Population Census Organization, Agriculture Development Board, Soil Survey of Pakistan, Soil and Water Conservation Organization Karak, Livestock Directorate, Irrigation Department, and Small Dams Corporation etc. Project reports related to Farm Forestry, Barani area Development and Sarhad Rural Support Program etc. were also obtained and used where required.

Primary data, as mentioned earlier were obtained through field work, which was conducted for a period of three months from January 2010 to March 2010. An enumerator, belonging to the local area was employed for assistance in data collection. He was trained for a couple of days to make him familiar with the instrument and the major concepts. To ensure the thorough understanding of the enumerator and check the validity of the questionnaire, the pre-testing survey was conducted by both the researcher and the enumerator together. 10 to 20 questionnaires were filled and at least one focus group discussion was held in each selected zone (The process of zone selection has been described below in the Sample Design). Questionnaire was modified in the light of focus group discussion and additional

questions were added after pilot survey as needed. All the interviews, discussions and questionnaire surveys were conducted in Pashto, the local language and then translated in English.

1.4.2 Sample Design

Multi stage stratified random sampling method was adopted for collection of primary data. In the first stage, Karak, the selected district, was divided into three zones on the basis of ecological characteristics (purposive sampling). One *Patwar* circle, was selected from each zone based on major land uses – one with the predominance of dry farming along with rangeland activities, another where agriculture was predominantly rain-fed while a third where irrigated agriculture was most common (purposive sampling). In the second stage, two *mouzas* (revenue villages) were selected purposively from each *Patwar* Circle for detailed survey (see map 4). In the third stage, selection of households was carried out for collection of detailed information. Overall 465 households were selected randomly from the *mouzas* as given in table 1.1.

Table 1.1: Karak District: Characteristics of Sample Villages

Name of union council/ P.C	Name of village/Mouza	Total Area (Acers)	Total population	Total households	Sampled households	%
Shnawa Gudi Khel	Shanawa	61187	25091	2090	230	
	Chak Manzai	1808	2261	196	25	
	Total	62995	27352	2286	255	11.15
Mitha Khel	Mitha Khel	4543	6472	612	80	
	Lucky Ghundaki	3316	2884	283	35	
	Total.	7859	9356	895	115	12.84
Issak Khumari	Khumari	2856	2905	314	50	
	Issak	2984	1727	239	45	
	Total.	5840	4632	553	95	17.17

Source: GoP, 2001

Detailed household information were collected from these randomly selected four hundred and sixty five households including 255, 115 and 95 households in Shnawa Gudi Khel, Mitha Khel and Issak Khumari *Patwar* circles respectively. In Issak Khumari households were scattered therefore higher number of households were selected for the representation of

entire area. Selected randomly, the survey covered households of different characteristics such as small and large land holders, rich and poor, educated and non-educated, and households with different herd size.

1.4.3 Tools and Instruments for Primary Data Collection

For collection of primary data different tools were used in field. These included

- Administration of Questionnaires
- Interviews
- Focused group discussions

Questionnaires were designed for households and total community (Attached as annexure 1 and 2). General information was collected from all the *mouza*/villages of the three selected *Patwar* circles, through semi structured questionnaire and interview method. It contained questions about the natural resources, major economic activities, facilities and services available, land use, land tenure status and trends etc. Questions were included to probe the major issues related to land degradation and adopted coping mechanisms. Perception of the dwellers regarding the role of government and NGOs in creating awareness through seminars, workshops or training was also asked. Details of the projects in the area initiated for combating desertification were recorded too. Focused group discussion and group interviews were conducted with key persons of the respective *mouzas,* like *Maliks*, the elders, leaders of the community and local level community organization heads.

Plate 1: Discussion with key informers in the village Mitha Khel (January 2010).

Required household data were gathered through self administered questionnaires, which were filled by interviewing heads of the households. Qualitative research methodology was adopted, which is ideal to look into perceptions of a target audience and provides a greater depth of information on the relevance of the subject (Tschopp, et al., 2010).

The questionnaire had four parts comprising of information about 1) socio-economic and demographic characteristics, 2) agricultural practices, Livestock characteristics, plantation and status of rangeland, its utilization and management 3). The changes noticed in land related resources during last 30 years and the coping mechanisms. 4) Questions were also included related to general perceptions on land resource degradation, its causes, indicators and coping strategies. The questionnaires included both open-ended and close-ended questions. The open-ended questions were included to give the respondents an opportunity for self-expression and to share their views, experiences and opinions regarding the problem.

Meetings with the representatives of the line agencies, relevant departments/offices and NGOs were also held to discuss the problem and their line of action for mitigation of the problems and promotion of sustainable development. Where needed and applicable, observation, interviews and focused group discussions were carried out with women of the area.

1.4.4 Analytical Techniques

Two types of analytical techniques, mapping and household data handling, were used in this study as follows

1.4.4.1 1 - Mapping (with Remote Sensing and GIS)

The main sources of data for mapping were topographical maps of Survey of Pakistan, Satellite imageries (Landsat TM and SPOT), map of Soil Survey of Pakistan and map of Pakistan Meteorological Department. Base map was created from topographic sheets which included district boundary, drainage, roads, settlements and relief data-layers. SPOT pan (2.5m) of 2006 and Landsat TM (15m) of 2010 were also used to update the base map for recently constructed small dams and new roads as well as verification of cultural features.

The existing land cover map was created through classification of Landsat TM (15m) 2010. For change detection of vegetation cover Landsat TM of 1992 (30m), Landsat TM of 1999 (30) and Landsat TM of 2010 (30m) were used. SPOT images were obtained from Space and Upper Atmospheric Research Organization of Pakistan (SUPARCO) while Landsat images were downloaded from Earth Explorer–USGS website (http://edcsns17.cr.usgs.gov/NewEarthExplorer/). A map showing agro-ecological zones and land use (2007) was prepared based on a map of Soil Survey of Pakistan. Isohyet map showing rainfall distribution was created from a map of Pakistan Meteorological Department. ArcGIS and ERDAS Imagine software were used to carry out the mapping work.

1.4.4.2 2 - Questionnaire Data Handling (with SPSS)

The primary data obtained from household survey were processed with the help of computer software SPSS16 (Statistical Packages for Social Sciences). Spread sheet was developed based on Questionnaire in MS Access which was imported into SPSS later on. Variables were first coded and data were entered into the computer and then tabulated. Statistical techniques for measuring central tendencies and measures of variability were applied. Cross tabulation was also carried out where needed for preparing analytical tables. Finally, the processed data were synthesized in the form of maps, tables, diagrams and analytical information.

1.5 STRUCTURE OF THE THESIS

The thesis consists of three parts – Introduction; data presentation and analysis, discussion and conclusion. The introductory part is covered in first three chapters, which give the back ground of the problem and methodology, the general overview and literature review, and description of the study area. Part two covering four chapters (4, 5, 6 &7) contains data collected from field and presented in form of tables and graphs and discussions. Main findings of the study are highlighted in the last or concluding chapter.

CHAPTER – 2

LITERATURE REVIEW

This chapter deals with the explanation of the problem in the context of dry areas. It is divided into three sections. The first section gives the general overview of the problem in the context of man-environment and resource relationship. It specifically deals with the problems related to land resources - their management, utilization, and sustainability in dry environment. The second part is the systematic review of literature and the work carried out so far on the problem of desertification in global, regional and local perspective. The findings of the chapter are summed up in the concluding section

2.1 OVERVIEW

Human being, since their very origin have been utilizing natural resources such as land, water, vegetation, air and many more to support their life. These natural resources whether renewable or non- renewable provide goods and services, which form the basis for economic development and maintain the quality of ecosystems. Their environmental services include maintenance of the quality of the atmosphere, climate, operation of the hydrological cycle including flood controls and drinking water supply, waste assimilation, recycling of nutrients, generation of soils, pollination of crops, provision of food from the sea, and the maintenance of a vast genetic library (Berkes, 1993). These services are essential for the survival of life and smooth functioning of the life support system. The quantity and quality of these resources determine the current and future status of the life support system. All basic natural resources, including land, and its productive potential are naturally limited (Lubchenco, 1998).

The world's population is expected to continue expanding well into the next century, with much of this population growth occurring in developing countries. Supplying sufficient food to its rapidly growing population is one of the most important tasks of the future for majority of the developing countries located in semi-arid and arid areas of the world (Walker, 1984). An inevitable consequence of the population expansion will be the demand for new cropland for commercial and subsistence agriculture. How much additional forest and other land needs to be converted to agriculture will depend to some extent on how well the productivity of

existing arable land is maintained or even enhanced. However, current evidence suggests that much existing as well as potentially productive agricultural land in developing countries is being lost through the processes of land degradation (Edward, et al., 1997). It has become more difficult to maintain prosperity and quality of life (UNFPA, 1991; RS and NAS, 1992) in the wake of present population growth scenario that is resulting in measurable shortages of fertile land, water, and fossil energy in many regions of the world (World Watch Institute, 1992; World Resource Institute, 1994; and 1998). High per capita consumption levels of these resources, especially in the developed world are also putting pressure on natural resources.

The geographical distribution of natural resources is obviously an important factor in influencing any region's potential for development. Some areas have disadvantages of limited natural resources. Amongst these are arid and semiarid plain and mountainous areas especially 'dry areas'. Although the ecological parameters used in this context vary slightly from one authority to another, it is generally accepted that close to half of the global land (41%) is occupied by dry land (MEA, 2005). Natural balance in these areas, considered as the marginal zones of the inhabited world, is the controlling system, which restricts man's economic activities (Barth, 1977). These are the areas with highest poverty rates, where the natural resource situation is so poor that there are only few resources that can be mobilized and put into functional context (Kuhnen, 1992). In dry lands, more people depend on ecosystem services for their basic needs than in any other ecosystem (MEA, 2005). They are also prone to higher risk in terms of natural resource degradation and disasters due to their geo-ecological condition. Communities in these areas normally consist of highly vulnerable population with minimum capacity to respond to both fast on-set disasters like floods as well as slow on-set disasters like droughts and desertification. Their vulnerability has many dimensions, not only in terms of high concentration of low income families but also evident in the lack of access to basic needs and voices in decision making processes. Higher risk and increased vulnerability often leads to disastrous consequences in these areas.

While dry land covers wide variety of environments, they are all characterized by climatic extremes and uncertainty. Shortage of water is the key production constraint, further compounded by rapid population growth, extremes of temperatures, poor soils and crop diseases and pests. The predominant arable farming system in these areas is usually cereals-based, but often also includes a strong ruminant of livestock component. With the emergence

of environmental issues like desertification, global warming and other environmental hazards it was noticed that the productivity of the nature in these areas is limited. The natural resources such as water, soil, and vegetation are facing unprecedented threats in these regions.

Climatic variation is partly responsible for declining resource productivity, but by far the greatest dangers emanate from human activities (Jiggins, 1994) particularly the natural vegetation in semiarid regions. An adequate cover of natural vegetation is essential for the protection of watershed and prevention of soil loss especially in these areas. The depletion of natural vegetation not only result in shortage of fodder, but also cause irreversible damage to the biodiversity, which may leads towards species extinction as well as desertification. Although there is always limited biodiversity in dry areas and only few species can withstand the harsh climatic conditions. However, the continued presence of these key species and more importantly the preservation of their interaction are more crucial to safeguard these ecosystems (Diaz, 2001) against desertification.

The causes of land degradation and desertification are complex and their analysis must rely on multidimensional approach (Lestrelin, 2005). The principal desertification processes are degradation of the vegetative cover, accelerated water and wind erosion, and salinization and water logging. These processes affect the three major land uses in arid and semiarid areas: irrigated agriculture, rain-fed cropping and pastoralism on rangeland. Rangeland desertification is primarily a matter of degradation of vegetative cover through over grazing and cutting of woody vegetation. Rain-fed cropland desertification is commonly expressed as increased water and wind erosion particularly due to cultivation on marginal lands. Salinization and water logging are the principal degradation processes of irrigated land due to inappropriate irrigation system. Wind erosion like water erosion, affect significant portion of range lands and can also cause damage on sandy irrigated lands (Dregne and Chou, 1992). Therefore, over grazing, incompatible land use and excessive woodcutting cannot be ignored in the process of desertification. Social factors like population pressure and mismanagement of natural resources can further increase the risk of land degradation and vulnerability of local population in fragile arid and semiarid regions.

2.2 LITERATURE REVIEW

The analysis of man-environment relationships was an important aspect of geographical research in the beginning of 20th century (early 1900s). Geographers were describing and explaining human behavior based on physical environment. Their work in its extreme form known as 'environmental determinism' became too simplistic. Reasons for human behavior were seen as a result of physical factors, where other possible explanatory variables were ignored and overlooked (Mitchell, 1991). The focal point of the research at that time was on the description and distribution of resources and phenomenon, stress was normally on what, when and where? Ignoring the investigating questions of how and why? Because of its very basic level of investigation, this type of research couldn't get enough room in scientific studies of that time.

Although environmental determinism did not remain the focus of research in early 1900s, many geographers continued their research on man-environment relationship focused on human adjustment to natural environment. Barrows (1923) in this connection recommended that geography should be defined as human ecology. He further emphasized that geographers should study this relationship with the aim of determining "the relationships between the natural environment and the distribution and activities of man", His perspective of geography as human ecology, focusing on the adjustment of man to the natural environment, actually became the conceptual foundation upon which hazard research has grown (Mitchell, 1989). Many investigators relate their inquiries to Barrows viewpoint and outlined the characteristics and trends in hazards research (cf. Burton and Kates, 1964a; White, 1973; 1974a; Mitchell, J.K., 1974a; White and Haas, 1975; Burton, Kates and White1968; Whyte, 1986). During 1960's and early 1970's the topic, enjoyed a revived interest with the emergence of concern on environmental issues, and became more fashionable with the arrival of environmental crises' (Carson, 1962; Udall, 1963; Ehrlich, 1968; Commmoner, 1972a).

Environmental problems in general and desertification in particular arise due to the complex interaction between the natural phenomenon and mismanagement of the environment by man. Desertification being a slow-onset and creeping disaster is barely noticed in its early stage, and its consequences are normally confronted at later stages when the problem's severity enhances. This is the reason that although it was historically known that soil fertility declines and vegetation deteriorates but the concept and terminology of desertification was coined in

the literature relatively recently. The concept emerged during colonial rule in West Africa out of concerns on signs of desiccation and the creeping of the Sahara desert into the Sahel (e.g. Bovill, 1921; Stebbing, 1953) but the actual term 'desertification' is credited to Aubreville (1949), who used it to describe the change of productive land into desert as a result of man's activity in the tropical forest zone of Africa (cited in Herrmann and Hutchinson, 2005).

In the last few decades scientific research on land degradation and desertification particularly in Africa and South East Asia has been focused either on physical processes affecting/ leading to land degradation such as deforestation, soil erosion, water logging and salinity or on impacts of land degradation on famine, migration and conflicts (Heinz, 1986; Kemp, 1997; Ehlers, 1982). Some work has also been conducted on mapping of degraded areas or on the use of suitable irrigation technologies (Blum, et al., 1985). Very little work has been conducted on the affected communities and innovative indigenous strategies that have been adapted by them for adjustment in response to land degradation (Reed, et al., 2007). Most of the classical studies have totally neglected the issues like indigenous knowledge, coping mechanisms and changing livelihood strategies and their effectiveness under condition of uncertainty (Nüsser, 2002). Nevertheless at least some studies show that human management of the land without leading to degradation is not only possible in a great majority of environments, but has been frequently accomplished in human history (Fazlur-Rahman, 2007). However, the same human skills are not useful and effective in all places and all times (Blaikie and Brookfield, 1987), as the problem of desertification can occur in different ecological zones like irrigated agriculture, rain-fed agriculture and rangeland and can take different forms such as water-logging and slinization , erosion, soil exhaustion, etc.. Therefore, it needs specific knowledge of response pertaining to specific environment to minimize the impacts in both short and long term.

During last few decades a dramatic change has taken place in the research paradigm and thinking of the researchers generally in agricultural development and more particularly in management and utilization of natural resources. Although it was realized in mid nineties that the role of human induced factors cannot be overlooked in the process of desertification but has been appreciated more in scientific discussions since the publication of the Bruntland Report 'Our Common Future', 1987 (the report of the World Commission on Environment and Development) which introduced the concept of sustainable development and stated, "If human needs are to be met, the Earth's natural resources must be conserved and enhanced.

Land use in agriculture and forestry must be based on a scientific assessment of land capability and the annual depletion of topsoil" (Bruntland, 1987). This became a phenomenon of global concern for all. Today in many countries, especially in the prosperous countries of the world, national priorities for environmental management are in place. Even countries of the developing world have realized the gravity of the threat and there is an increasing awareness of the need to maintain a healthy ecosystem and quality of environment.

In their publication, "The changing contexts of the desertification debate", Herrmann and Hutchinson, (2005) have examined the evolution of the desertification debate in the contexts in which this debate has taken place and how those contexts have contributed to the evolution of our understanding of the tangled processes that contribute to desertification. The development of four contexts is traced that have framed much of the debate - these are changes in our understanding of climate variability; vegetation responses to perturbation; social processes; and changes in our understanding of desertification as a political process.

2.2.1 Causes/Factors of Desertification

2.2.1.1 Natural Factors

Natural factors particularly droughts and erosion were considered as main factors responsible for the process of desertification in early years of research (in seventies) on desertification. In terms of natural cause of desertification which received attention of the researchers soil erosion remained on the top. It is wreaking ever-increasing damage upon land resources and the livelihoods that depend on them. Erosion occurs in all countries and climates, resulting in significant losses in fertile land and, its productivity. However, the impact is particularly high in semiarid countries where periods of drought are followed by brief but violent rains pounding down on bare soils (Mathieu, et al., 2007; Desprats, 2000). It has always been of great concern because of its profound impacts visible in loss of agricultural production.

Worldwide, soil erosion averages approximately 30 tons/hectare/year, or about 30-times faster than the replacement rate (Pimentel, 1993). Because of the slow rate of topsoil renewal; it takes approximately 500 years for 2.5 cm (1 inch) of topsoil to form under agricultural conditions. Approximately 3,000 years are needed for the natural reformation of topsoil to the 150 mm depth needed for satisfactory crop production (OTA, 1982; Elwell, 1985; Troeh, et

al., 1991; Pimentel, et al., 1995).

In earlier years, desertification was also associated largely with droughts. During this period most of the studies on desertification were related to theoretical aspects of droughts like its meaning, classification and effect. Uncertainty associated with the identification of drought was considered a major factor responsible for a lagged response in mitigating its impacts. Management and policy tools to improve the integration of economic and ecological aspects of drought-induced de-stocking decisions, especially by incorporating the long-term irreversible costs of erosion and desertification were stressed as in extreme cases of widespread rangeland degradation, a severe reduction of vegetation cover can change surface reflectivity, which can theoretically inhibit cloud formation and reduce precipitation. To prevent accelerated erosion, desertification and possible alteration of local climate, the management system must be able to respond (to reduced vegetative growth resulted by droughts) quickly and efficiently, so that adequate plant and litter cover remains in place (Charney, et al., 1975; Otterman, 1977).

In the late 1960s when a series of droughts began and contributed to famine conditions in several Sahelian countries, which was exacerbated by political instability and unrest, renewed attention was drawn to the concept of desertification (Herrmann and Hutchinson, 2005). The United Nations Conference on Desertification (UNCOD), held in Nairobi in 1977, was the result of an increased interest in the repercussion of the initial round of these droughts spells. It was aimed to identify the measures that might be taken to reclaim the areas that had been damaged. The conference not only launched the desertification issue into the political arena but also triggered a great deal of scientific interest as well as controversy. A heated and ongoing desertification debate raged after this conference, which is reflected in a plethora of literature and the existence of more than a hundred definitions of desertification (Glantz & Orlovsky, 1983). To simplify, standardize and reach upon a single definition the 1977 conference looked into the issue and defined desertification as, "the diminution or destruction of the biological potential of the land, which could lead ultimately to the formation of desert-like conditions" (UNCOD, 1977). This definition although seems simple but it generated endless debate about what, where and how? The only agreement about desertification by everybody was that desertification was a land degradation process.

Although it was believed that the problem of desertification has no boundaries and it can

happen almost anywhere but increasing rate of land degradation in Africa and resulting problems of food insecurity attracted many researchers towards dry areas and their resource degradation. It was felt that in arid and semiarid regions where resources are very limited, the over exploitation of already scarce resources would have devastating influence on the habitat and its inhabitants (Maydell, 1985).

Realizing this interrelationship UN convention was initiated in 1991 and the definition of desertification originally formulated by UNCOD in 1977 was modified and the new definition was given (see chapter 1 page 1 of this thesis). This also gave the conceptual understanding of the interdependence of natural capital and human made capital.

Berkes, (1993) discussed the newly introduced concepts of and made a conclusion about the existence of a fundamental interrelation between natural capital, human-made capital, and cultural capital. He further discussed that natural capital is the basis and precondition for cultural capital while the interaction between natural and cultural capital generates the human-made capital. Cultural capital will decide how we will use natural capital to 'create' human-made capital. Therefore, human-made capital is never value-neutral. Technologies that we develop are not simply tools we can put to good or bad use - they reflect our cultural values. He has stressed about the need to incorporate human resource flows with ecosystems in a synergistic manner to control the rate of resource degradation.

2.2.1.2 Anthropogenic Causes

Along with natural factors anthropogenic or social factors have also been addressed in many studies as a cause of desertification (Sher, et al., 2010; GoP, 2002; Aleem, 1980). However, attributing a single cause to desertification is not possible and cannot be generalized over the large areas. World Resources Institute (WRI, 1992; 94) has been actively involved in the diagnostic research and identified overgrazing as the most persistent cause of soil degradation in Africa and Australia (49 and 80 percent of soil degradation, respectively). In contrast to these studies grazing of large herds on the severely degraded land has been identified as the remedy to degraded land by Cliff Kuang Wed (2010), who argued that livestock might not be just the cause of desertification–they might also be the solution Box 1).

BOX 1

The Buckminster Fuller Institute announced the winner of its 2010 Challenge: Allan Savory, who has spent the last 50 years refining and evangelizing for a method of reversing desertification that he calls "holistic management." The African Center for Holistic Management International, an NGO he helped found, will take home a $100,000 grant.

The Buckminster Fuller Challenge is meant to award big, sweeping solutions to seemingly intractable problems. As the Institute's executive director, Elizabeth Thompson, tells, "We're looking for strategies that solve multiple problems at once, not just surgical implementations that don't address the root problem." Savory's work its the bill. By combating desertification in Africa, he argues that families are able to once again earn a living from the land; that in turn reduces poverty and violence. "Allan is an absolute pioneer in ecological design," says Thompson.

But Savory's prescription seems shockingly simple–and it's taken him 50 years of work to convince others that he's not crazy. The core of Holistic Management is simply grazing local livestock in super dense herds that mimic the grazing patterns of big-game (which have since disappeared). Those livestock in turn till the soil with their hooves and fertilize it with their dung–thus preparing the land for new vegetation in a cycle that was evolved over millions of years.

Surprisingly, that flies in the face of modern wisdom about land management–the typical response is to rest land completely, and livestock are often named as the chief culprits in desertification. "We've been ridiculed for 50 years," says Savory. But he argues that examples from around the world show that resting the land doesn't prepare it for the return of vegetation–instead, it simply remains barren, with rain simply running off soil that stays cracked and dry. "But when you range animals correctly, the land starts returning," he says. "The only thing that can do it is a heavy herbivore with a wet gut."

Apart from overgrazing and over exploitation of f natural resources like fuel-wood and other non wood products (Iffat, 2009), incompatible agricultural practices and unsustainable land use have always been considered an important cause of desertification. These are normally driven by social factors such as rapid population growth and migration; economic factors such as market prices for agricultural products; and, government policies such as land tenure, infrastructure development, tariff barriers and agricultural development strategies particularly in Asia (Asian Development Bank, 2010).

Land use and land cover change in fragile areas could also be the factor that leads to land degradation. This relationship has been studied by Zhang, et al., (2007) who examined the temporal and spatial dynamics of land use change and land degradation during 1991-2001in China. Rates of conversion of land use were calculated and distribution pattern were mapped with GIS. The results showed that land use changes have resulted in widespread environmental degradation. Six prominent land degradation processes were identified. It gave complete and an up-to-date picture of land degradation in the country, which can help in formulation of sound policies to combat land degradation. Expansion of agriculture in marginal land is the most common type of land use change.

In addition to these an interesting study was conducted by A. CERDÀ, 1997 regarding the role of agricultural practices in the process of desertification. He studied the effect of land abandonment on the rate of soil erosion in Spain. The objective of his study was to investigate the changes in erosion potential after land abandonment in semiarid environments. He selected five land uses for research: cultivated or ploughed, abandoned since 3 years with almost 5% of herbs, abandoned since 10 year better vegetation cover, and non-cultivated semi-native and native vegetation conditions. He used the rainfall simulator research on the basis that it is more rapid, more efficient, more controlled, and more adaptable than natural-rainfall research. He simulated the low frequency-high magnitude precipitation events under semiarid conditions in southeastern Spain, where rainfall is extremely unpredictable. All selected plots by him displayed a low slope gradient (less than 2°), and they had similar soil depths (20 cm) because of their development on the same geomorphological position. His findings confirmed that vegetation has a major influence on the soil erosion processes in such an environment. On the contrary, his study demonstrated that continued land abandonment reduced infiltration and increased runoff and erosion during the following years. Results further clarified that soil erosion rates are higher on the land abandoned recently as compared to land abandoned for longer time because on the later natural vegetation develops and slowdowns the rate of erosion. Recently a study conducted in Mediterranean mountain environment on the soil degradation on abandoned fields confirmed the results of the previous study. According to which high rate of soil erosion, low infiltration capacity and high runoff results due to abandonment of agricultural fields. All studied sites show the depletion of organic material and weak water storing capacity (Seeger and Ries, 2008).

Beside land use change, land tenure could also have an important repercussion on land degradation. Owner cultivators are believed to take maximum care of the land and never exploit it for short term benefits while in contrast the tenants are more interested in short term benefits. Circulatory land tenure system of high potential land was once a common practice in the mountainous areas of Pakistan. It is now no longer practiced in the area with the exception of few pockets in the Swat and Malakand division. This system has negative environmental impacts particularly on soil erosion, due to social conflict and social changes (Nafees, et al., 2009).

Warren and Agnew (1988) described that the causes of land degradation are more in society and the world economic order, than in nature. According to their discussion land users, planners and scientists are the strong component of the process. Among land users the blind spot may be because of uncertainty or distant future. They argued that poor conceptualization is the major cause of failure in planning compared to lack of facts as facts can only be collected after clear conceptualization.

In his study Edward (1997) has investigated the economic determinants of desertification and land degradation in developing countries. The main trends examined were about rural households' decisions to degrade as opposed to conserve land resources, and the expansion of frontier agricultural activity that contributes to forest and marginal land conversion. The results of his study revealed that economic factors play a critical role in determining these relationships. Poverty, imperfect capital markets and insecure land tenure reinforce the tendency towards short-term time horizons in production decisions, and may bias land use decisions against long-term land management strategies. The main reason identified is that poorer households are confined either to marginal environmental areas or only have access to resources once they are degraded. In terms of the scope for policy improvements to reduce economic constraints for effective land management, the author argues that in many developing countries policy reform will have to be complemented by investments in key infrastructural services, post-harvest marketing facilities, to increase credit and extension and basic services such as education and health care services.

Using a meta-analytical research design, Geist and Lambin (2004) analyzed different case studies (worldwide) on the causes of dry-land degradation/desertification. They aimed to determine whether the immediate causes and underlying dynamic forces fall into any pattern

and to identify mediating factors, feedback mechanisms, cross-scalar dynamics, and typical pathways of dry-land ecosystem change. The results show that desertification is the result of different combinations of proximate causes and underlying driving forces in varying geographical contexts. Nearly all of these combinations include coupled socioeconomic and biophysical factors- the concept initiated in late 1990s, that desertification is the interactions between human and climatic drivers, as well as the temporal and spatial scales of the phenomenon (Smith, et al., 2002; Reynolds, et al., 2007; Reynolds, et al., 2011).

2.2.2 Measuring the Rate and Extent of Desertification

Conceptual complexity and dynamism, and width of its extent have always made desertification a difficult process to monitor and assess (Eswaran, et al., 2001). An assessment of the global damage done by desertification through different processes was carried out by Dregne in 1992, who estimated that nearly 50% of the arid regions of the world are affected. Approximately one-quarter of the irrigated lands, half of the rain-fed cropland, and three-quarters of the rangeland have been already degraded. The dominant forms of degradation in dry areas are loss of biodiversity, deterioration of vegetative cover and degradation of soil fertility.

At global level investigation of soil degradation rate has always been a problem due to the ambiguity of the term, lingering imprecision and un-clarity about the nature of the problem and a lack of measurable criteria (Herrmann and Hutchinson, 2005). The difficulty of finding an appropriate scale for exploring the severity is another important factor. Due to different definitions and terminology, a large variation in the available statistics on the extent and rate of land degradation also exists (Eswaran, 2001). In 1991 survey of Global Assessment of the Status of Human-Induced Soil Degradation (GLASOD, 1988-1990) was completed by the United Nations Environmental Programme (UNEP) and International Soil Reference and Information Centre (ISRIC). They worked in collaboration with the Food and Agriculture Organization of the United Nations (FAO), Winand Staring Center and ITC (Oldeman, et al., 1991). This assessment resulted in a world map at an average scale of 1:10,000.000 showing the global distribution, and severity, of various types of soil degradation. This was followed by a regional survey of Soil degradation in South and Southeast Asia (ASSOD) which was the result of meeting in Bangkok of the Asia Network on Problem Soils. A recommendation was made in 1993 for the preparation of a soil degradation assessment for South and

Southeast Asia at a scale of 1:5 million, based on the GLASOD methodology (modified where deemed necessary). A new physiographic map for Asia that was compiled at a scale of 1:5 million provides information on soil degradation in South and Southeast Asia (Oldeman, et al., 1991). It describes the current status of human-induced soil degradation and at the same time increasing awareness of soil degradation problems among decision makers and the general public in this region (Vogt, 2011).

Beside the rate and extent, the geographic distribution of degraded land is poorly documented. Another problem is the documentation of the severity of degradation, which is normally judged qualitatively. Global assessments have been undertaken to measure the degradation of soils in all biomes (dry-lands, and tropical forest lands). Gretchen *C.* Daily, in 1995 analyzed different survey results undertaken to evaluate the rate and extent of land degradation and desertification world-wide. It was estimated that 2 billion ha, or 17% of Earth's vegetated land has been degraded. Of this, 38% are classified as lightly degraded (defined as exhibiting a small decline in agricultural productivity and retaining full potential for recovery); 46 % are moderately degraded (exhibiting a great reduction in agricultural productivity amenable to restoration only through considerable financial and technical investment); 15% are severely degraded (offering no agricultural utility under local management systems; reclaimable only with major international assistance); and 0.5% are extremely degraded (incapable of supporting agriculture and un reclaimable). Region wise extent of land degradation was calculated and the percent of affected area regionally estimated, which seems to be independent of ecological zone or economic status; for example the rate was highest in Europe (23%), followed by Africa (22%) and Asia (20%). Rate of degradation is lowest for Asia although it is more vulnerable to land degradation due to both physical and social factors particularly population growth.

According to Global Assessment of the status of Human Induced Land Degradation (GLASOD), 65% of the world's land resources are degraded to some extent (Oldman, et al, 1991). Degradation of cropland appears to be most extensive in Africa, affecting 65 percent of cropland compared with 51 percent in Latin America and 38 percent in Asia. Degradation of pasture is also most extensive in Africa, affecting 31 percent, compared with 20 percent in Asia. Forest land degradation is most extensive in Asia. Focusing on Asia of the 1977 million ha of dry-lands in Asia, more than half is affected by desertification (UNCCD, 1998). According to the study, the worst affected area is Central Asia (more than 60 per cent

affected by desertification) followed by South Asia (more than 50 per cent) and Northeast Asia (about 30 per cent).

Desertification is distinct from natural oscillations of vegetation productivity that occur at desert fringes. Deserts are not considered to be at risk of desertification and are excluded from assessments thereof. The total decertified dry lands area amounts to 3.6 billion ha or 70% of global dry-lands area (excluding hyper-arid regions). Out of this roughly 2.6 billion ha exhibit no soil degradation, but have reduced crop yields, livestock forage, and woody biomass for fuel and building material (Daily, 1995). In dry areas most of these resources are obtained from rangeland, which make up 88% of the dry-lands area. Of the total rangeland, 1.6% is very severely degraded, 44% are severely degraded, 28% are moderately degraded, and 27% are degraded slightly or not degraded at all. The rate of abandonment of dry-lands due to degradation and the rates of degradation seem to be accelerating, particularly in developing nations (Daily, 1995).

Some scholars have criticized the global assessments of land degradation arguing that they lack the appropriate methodologies (Lestrelin, 2007). Desertification is indeed strongly scale sensitive; measurements made at some scale may be contradicted by measurements made at another scale (Grey, 1999). Besides scale, depending on the contexts like biological, physical, monetary and cultural in which it is defined; land degradation has multiple temporal and spatial dimensions (Brookfield, 1999; Warraen, 2002).

However, introduction of remote sensing technology has made considerable contributions in this field. Desprates.F.J et.al (2000) have carried out a study to evaluate the soil vulnerability by using the remotely sensed data (SPOT) and combing different layers with the land register in data base. They concluded that by this methodology vulnerable areas can be identified at even farm level and farming techniques can be recommended for land conservation and restoration. They have developed soil vulnerability map with four degrees of severity that is very high vulnerability, high vulnerability, medium vulnerability and low vulnerability by taking the basic criteria like vegetation cover, slope gradient, slope aspect, slope curvature and drainage pattern.

2.2.3 Impacts of Desertification on Marginal Communities

The results of many studies and researches have shown that the burden of the environmental problems, including desertification falls most heavily upon the poorest communities and countries. Within these countries the people living in marginal regions are at higher risks. These marginal areas have the disadvantage of their location in semiarid and arid areas with no irrigation, highlands with low precipitation, thin soil or steep slopes and infrastructure wise less developed areas (Kuhnen, 1992). The disadvantageous groups living in these areas have less financial and technological resources to restore the degraded lands and are hence highly vulnerable to all types of disasters.

Impacts of desertification are more profound in such areas of the developing countries compared to developed countries. Ninety percent of dry-land populations live in developing countries where they experience high population growth rates and low human well being and development. The gross domestic product (GDP) in dry-land areas is 50% lower than in non-dry-land areas and dry-lands are home to 45 % of the world's hungry and 70% of its malnourished children. The infant mortality rate for all dry-lands in developing countries averages about 54 per 1,000, exceeding that for non-dry-lands by 23 % or more (ADB, 2010). Problem of desertification is closely linked to poverty in Asia which is the worst affected continent in term of number of affected persons. Here it creates economic, environmental, and social hardship for millions of poor farmers who practice subsistence agriculture in fragile environments. Although these areas are subject to periodic droughts and other desertification processes but local communities are the caretakers of fragile dry-lands. Their capacity and decisions about land management can either accelerate or reverse desertification (ADB, 2010).

Malik and Nazli (1998) argued that while knowledge and literature about poverty is expanding rapidly, a comprehensive understanding of linkage between the poverty and land degradation is lacking. They debate that Short- and long-term implications of land degradation are not very clear and the understanding of the interactions of poverty and land degradation is even less clear and limited. The study suggests that there is a serious need for research on this aspect, as literature in developing countries particularly regarding the effects of land degradation on social welfare is highly qualitative and less rigorous.

From the above discussion it is obvious that the most important factor to overcome the environmental problem like desertification is the economic imperative that drives people to degrade land, prevent restoration and encourage a continuing spiral of degradation. Economic forces are linked closely to political ones; what marginal groups living in the dry lands need is control over their economic future. When this comes, they will demand to know how to manage their land so that it is resilient.

Land degradation affects men and women differently given their differing productive roles. While stress and hardship rise for everyone as the resources closest to a community begin to disappear, women are more affected by desertification than men. They usually end up traversing longer distances for resource collection, often under harsh and unsafe conditions. Their workload grows as they struggle to collect food and fuel (FAO, 1996). They perform many essential survival tasks and have developed valuable skills and practices that complement men's knowledge. Their dependence on natural resources for the survival and sustenance of their households make them particularly vulnerable. They often lack alternative ways of earning a living and are less able to invest in sustainable land management mainly due to their subordinate socio-economic position (Iffat, 2005).

2.2.4 Mitigating Desertification

According to Winslow, among the multitude of problems in mitigation of desertification complexity lies in its definition (Winslow, 2004), its multi causal nature and selection of appropriate scale and identification of workable methodology. Effective measures against desertification (or any other environmental problem) must rest on as precise diagnosis as possible. If the problem is thought to be a drought, lasting no more than two or three years, food aid may be ample. If there has been near-complete de-vegetation, in the absence of a climatic change, the treatment is re-seeding or re-planting. If the diagnosis is that the desert is actively expanding at its margins, then some kind of holding-line might be the answer. Development of more appropriate land-use practices are essential if the problem is falling productivity because of over-grazing, improper cultivation, or misuse of irrigation water (Warren and Agnew, 1988).

Local communities and the natural resource users are always concerned about the disastrous consequences of desertification, as they are the first one who are affected and really have to

bear the losses. They always try to restore the resources according to their best knowledge. This has been studied by Reij (2005) in Central Plateau of Burkina Faso. He analyzed the circumstances on the northern part of the Central Plateau of Burkina Faso. In the early 1980s, situation was characterized by expanding cultivation on marginal lands, declining rainfall, low and declining cereal yields, disappearing and impoverishing vegetation, falling ground-water levels and strong outmigration. This crisis situation provoked two reactions. Farmers, as well as technicians working for non-governmental organizations, started to experiment in improving soil and water conservation (SWC) techniques. When these experiments proved successful, donor agencies rapidly designed SWC projects based on simple, effective techniques acceptable to farmers. A study looked at the impact of SWC investments in nine villages and identified a number of major impacts. It noted significant increases in millet and sorghum yields since the mid-1980s and found that cultivated fields treated with SWC techniques had more trees than 10–15 years ago, but it also noticed that the vegetation on most of the non-cultivated areas continued to degrade. However, improvement was also noted in greater availability of forage for livestock, increased investment in livestock by the villagers and a beginning of change in livestock management from extensive to semi-intensive methods, improved soil fertility management by farmers, locally rising ground-water tables, a decrease in outmigration and a significant reduction in rural poverty.

2.2.4.1 Desertification in Pakistan and Efforts Made to Mitigate the Problem

Pakistan is located in the arid and semiarid region of the world where more than 60% land area is occupied by mountains. Desertification is a significant problem in the country; more than three fourth of the country area has been classified as under risk of desertification, which has been active since historical times in the area. The decline of Indus civilization has been attributed to prolonged process of desertification which brought irretrievable damage to agriculture in the area (GoP, 1988a). Almost two third of the land has already been affected (GoP, 2007) by various factors of land degradation. In recent times with the modern technologies the process has been once again provoked taking heavy tolls on the economic and social life of the country particularly in dry areas.

The literature on desertification in Pakistan covers numerous aspects including causal factors, present status of desertification, key issues related to it, and success stories related to issues of desertification (GoP, 2000; UNCCD, 2006; Azhar, et al., 2006; Kahlown and Gill, 2004).

Amongst the factors contributing towards desertification in Pakistan, mismanagement of resources and population pressure is the fundamental underlying cause. Like many other developing countries, the gap between demand and supply of food, timber, and energy is increasing in the country and in many cases has been met by imports, raising the cost of living, particularly for those dependent on natural resources or poor living in fragile environment/ marginal lands in the country. The existing pressure and the expected increase in future population, therefore, calls for the improved and proper land management and sustainable resource use (Iffat, 2005).

Major immediate physical factors of the problem include deforestation inadequate reforestation activities, uncontrolled and excessive livestock grazing and browsing of fuel-wood, over and inappropriate cultivation practices in hilly and rain-fed farming areas and incorrect irrigation practices. Soil erosion is another important factor in land degradation, although it is a natural process especially in the mountains of Pakistan. However, when the land surface on the mountain slopes is left bare of protective vegetation, mainly as a result of human activities, soil erosion is accelerated. It is estimated that about 13.05 million hectares of area of the country is affected by water erosion and about 6.17 million hectare area is affected by wind erosion, although wind erosion has relatively lesser impacts but the cumulative impacts of the two are more devastating. The loss of soil results in a serious decline in fertility; this reduces the land productivity by 1.5-7.5% per year. Range productivity over most of the western Pakistan is among the lowest in the arid world. A small beginning has been made in bringing the rangelands up to their potential productivity. Much remains to be done as range management is only a young science in Asia (Dregne, 1986). More than 60% of the natural grazing areas of the country have forage production levels lower than one third of their biological potential. In majority of the soils of plains in Pakistan, the rainfall is usually low and the evapotranspiration is higher than the annual precipitation resulting in buildup of salts in the soil profile and their accumulation on the soil surface. At country level, 6.28 million ha area is affected by salinity and sodicity. The majority of salt-affected soils are saline-sodic in nature (Khan, et al., 2004). These salt affected soils are causing potential reduction in yield (Zia and Arshad, 2006). The problem of water logging has reduced due to prolonged drought and excessive mining of ground water through tube wells.

The fertility status of Pakistani soils is rapidly depleting. The data generated by the public and private organizations in the country reflect the general agreement about the general deficiency of nitrogen in soils. Same is the situation with organic matter, which is on average 0.5%. More than 90% soils are also deficient in phosphorous. Further, potassium deficiency in Pakistani soils, which was not a soil fertility problem earlier, is increasing rapidly due to the discriminate use of only nitrogenous and phosphatic fertilizers. Various public and private organizations in the country are reporting a soil potassium deficiency in the range of 20-40%. For that reason, NPK formulations for various crops have also been introduced in Pakistan. Among micronutrients, field scale deficiencies of economic significance prevail in case of zinc, boron, and iron. (Zia and Arshad, 2006).

The literature on soil erosion as a cause of desertification in Pakistan is also abundant (Ashraf, 1993; Zia, et al., 2003-04; Nasir, et al., 2006). The mountainous areas of KPK are extremely susceptible to water erosion. The sediment load is higher during the monsoon period (July to September) when rainfall is high, resulting in flash floods. Wind erosion is generally more of a problem in the drier areas of the southern parts of the province. There was a time when the majority of KPK was covered with forest and natural vegetation. However, much of that forest cover has gone and the affected areas are seriously degraded, with exposed rock visible in most of the hilly areas (GoP, 1988a). Based on its geo-ecological conditions the entire plain area should be under tropical thorn forest in theory, with dry subtropical broad-leaf forest on the drier foothills, moist and dry temperate forests on the mid-mountain areas, and sub-alpine forests at the highest elevations of vegetative cover. However, the tropical thorn forests have been destroyed mainly as a result of the conversion of land for agricultural purposes, combined with grazing and cutting of woody vegetation for fuel. The remaining types of forest have been reduced to a fraction of their original extent, mainly as a result of heavy uncontrolled grazing, tree felling and agricultural cultivation on mountain slopes (GoP, 2007). Increased demands of fuel wood, lopping of trees for commercial purposes and un-restricted livestock grazing are major human activities leading towards deforestation and de vegetation. A study of Siran project area, Hazara, KPK, shows 52% decline in the vegetation resources between 1967 and 1992. Similarly the mangrove forests of the Indus Delta has halved from 2,600 square kilometers in the late 1970s to 1,300 in the 1990s, due to the grazing by camels. Almost 50% of the original riverain forests have been degenerated beyond economic viability (Zia and Arshad, 2006).

Farooqi (2006) has classified environmental issues on the basis of agricultural capability of the land of Pakistan into two distinct classes. Nine major problems have been listed in agriculturally marginal area, based on scanned literature. These include steep slopes, inefficient irrigation system, deforestation, soil erosion, drought, surface crusting, low fertility, poor crop management practices and dry land salinity. While in second class that is areas favourable for agriculture, five main environmental problems have been identified inclusing water logging, salinity and sodicity, flooding and ponding, fertilizer imbalance and poor use efficiency and, environmental pollution due to agricultural chemicals and industrial wastes.

2.2.4.2 Policy Formulation on Desertification in Pakistan

Activities like soil and water conservation, afforestation of dry land and rehabilitation of degraded rangelands/ saline areas have been part of the various programmes of line agencies of Pakistan since independence (1947) and even during the British rule (GoP, 2000). Desertification and land degradation were considered serious issue in late sixties/early seventies. These initial projects, however, lacked perspective and participation of local community.

Earlier strategies and policy initiatives to address serious issues of land degradation and resource conservation resulted in the compilation and preparation of National Commission Report on Agriculture (1988), Forestry Sector Master Plan (1992) National Conservation Strategy (1992), Sarhad (NWFP) Conservation Strategy (1996) and National Master Agricultural Research Plan (1996). These documents have already resulted in widespread acceptance of the principles of sustainable development; broader realization of the importance of natural resources and proper land use; new ways of working between sectors; institutions and disciplines; methodologies for consulting, communities, NGOs; involvement of women and group of Pakistan policy analysis experts. Pakistan has also signed and ratified the UN Convention on Biological Diversity. A climate change impact assessment and adaptation strategies study was completed in 1998 (GoP, 2000).

In Pakistan, the concern for environmental management with broad perspective on national scale was effectively marked after the United Nations Conference on the Human Environment in Stockholm (June 1972). Some very important developmental projects like

Warsak, Mangla and Tarbela dams and initiation of Karakuram highway were carried out without any environmental impact assessment in that time. Nevertheless the emergence and expansion of environmental problems particularly those related to desertification such as water-logging and salinity and soil erosion did receive government attention. Some remedial measures, though not in systematic and tangible manners, were undertaken to address the problems of water logging and salinity (SCARP). Many departments like soil survey of Pakistan, soil conservation departments and Pakistan Forest Research Institute were established in this period. Besides, large scale family planning and rural development programms also received some attention. All these were related in one way or other to human environment or resource conservation. However, these still were isolated actions and need for sustainable resource utilization and management was not realized. After the Stockholm conference the attitude of both people and government of Pakistan changed and many research articles in news papers and journal were addressing the environmental issues. The real breakthrough in this regard was a meeting of experts concerned with different aspects of environment convinced by the Ministry of Presidential Affairs in November 1972. A major outcome of this meeting was the formulation of committee on human environment, which submitted its report in April 1973 making number of recommendations for both short term curative and long term preventive measures.

In 1975 a new Environment and Urban Affairs Division was created within the Ministry of Housing, works and Urban Development and all environmental matters were shifted to it. The enactment of Pakistan Environmental Protection Ordinance in 1983 showed the higher level of awareness of the government regarding environmental issues. The new legislation created a powerful National Environmental Council which was chaired by the head of the state. Pakistan Environmental Protection Agency was also created by the same ordinance to prepare the national environmental policy and framing of the national environmental quality standards for protection of natural environment in the country (GoP, 1988 a; GoP, 2000).

As an outcome of the increased debate on environment, a closer focus on the conservation of natural resources was placed in the wake of its rapid depletion. In Pakistan, with the collaboration of IUCN, a strategy was formulated to identify and plan measures required for conserving natural resources. The strategy, known as National Conservation Strategy (NCS), was formulated in 1992 with a well focused plan of action identifying fourteen core areas across all sectors of the economy.

Later on provincial governments were asked to prepare provincial conservation strategies. In Khyber Pakhtoonkhwa, the government with collaboration of IUCN Sarhad Provincial Conservation Strategy was launched in 1996.

Recognizing the goals and objectives of the National Conservation Strategy, national environmental action plan and other existing environment related policies, actions and strategies were formulated to provide broad guidelines to Federal government, Provincial Governments, Federally Administered Tribal and Northern area and local governments for addressing environmental issues and ensuring effective management of natural resources, National environmental policy was developed in 2005. In its article under the agriculture and livestock sector special attention has been paid on the problem of desertification. National environmental policy aims to develop strategies and programs to tackle desertification in line with the national action plan to combat desertification and drought. Additionally it established National Desertification Control Fund.

Various programmes and projects related to desertification such as on salinity control and reclamation and soil conservation have addressed the problem in Pakistan particularly by NESPAK (see Annex 5). One example of such study refers to dug wells in many parts of district Karak that became non operational due to high amount of salts in water and extraction of marginal water. This resulted into build-up of salts in the soil once used for high value cash crops. To evaluate the degree and extent of the problem and develop management and reclamation packages, a study, Evaluation, Reclamation and Management of Saline-Sodic Soils in Kohat Division, was initiated and executed under the Research Component of National Drainage Programme during 2001- 2004 (GoP, 2004).

In its first phase the preliminary survey was conducted to analyze the present status of problem the area. The survey report stated that Karak District, which is located in the salt zone, is suffering from multiple problems regarding soil and agricultural productivity due to its geo-climatic conditions. As a result of prolonged drought the water table lowered and the root zone soil profile salinity increased due to high evaporation rate and limited leaching. It was found that the main source of salinity is saline water used for irrigation. Therefore, the reclamation of soil in the area on permanent basis was not possible. All efforts were therefore focused on scientific management of the soil to obtain reasonable economic crop yields.

Further it was recommended that application of NKP fertilizers along with organic manure was essential. The survey results indicated that the farmers needed a lot of motivation, training and education regarding the saline agriculture system and it was hoped that good results could be achieved as majority of the farmers in the area were owner cultivator who had great interest in project activities and were very co-operative. The survey report further stated that soil of the area was deficient in organic matter. After many experimental exercises the project report made many valuable and workable recommendations. These included cultivation of salt tolerant crops like sugar beet, cotton along with the traditional crops of wheat, ground nuts and millet in highly saline areas like Tarkh Kohi village of the district.

Soil and land conservation authority has been established in many parts of the country including the study area. The main goal of the project is to protect the environment through natural resource management particularly water and soil conservation. This organization has taken many preventive measures like check dames, dikes, and water bunds as well as plantation in many parts of the district has been made.

Plate 2: Protective *Bund* in Ghundi Mir Khan Khel (Photograph from M.Yasin SWCO Karak)

Plate 3: Check Dam Karak (Photograph from M.Yasin SWCO Karak)

2.2.5 Local Adaptation and Control Mechanisms

Sustainable use of the natural environment is conventionally interpreted as a result of the successful or un-successful adaptation of the human-being to the natural environment (Tröger, 2002). Since ancient times local population have often adopted strategies and mechanisms based on their indigenous knowledge and experience in these fragile areas for sustainable resource use (Ehlers, 1996; 97; MacDond, 1998). These coping strategies and measures were very much in harmony with nature in the past but due to increased risk to natural resources and higher vulnerability of the local communities the coping mechanisms might need reconsideration in terms of interrelationships between people, natural resources and environment at micro level – a subject that is being explored in this research.

The best prevention against desertification and land degradation in dry area is maintaining vegetative cover to protect soil from erosion. Properly maintained vegetation cover also prevents the ecosystem services during drought episodes (MEA, 2005) essential for human wellbeing (Khan, et al., 2010). Dry-land environments are fragile. Their vegetative cover is sparse; when removed through overgrazing or excessive tillage, exposed soils quickly erode and lose fertility, and the surface sealed soils cause water to be lost as runoff. Sustainable solutions that preserve and enhance soil cover and organic matter such as mixed crop-tree-livestock systems, water harvesting and conservation, and the judicious use of manure and inorganic fertilizers at economically-optimal rates are showing success in many countries.

Often these investments reduce rather smallholder's risk (Winslow, 2004). Most of the land/resource users are concerned about their land and they adapt various indigenous methods to minimize the risks of land degradation and desertification in their limited capacity. However, traditional and local institutions have often been neglected or even discouraged by government agencies that seek to introduce modern policies and practices from the developed world (Iffat, 2005). Poor farmer's households may be able to overcome such constraints if they have access to credit, but usually such access is denied because of their low level of investment collateral (Edward, 1997). In this respect they require institutional and technological capacity and financial capital, which can prevent desertification.

Literature shows (Shetto, 1999; Reij, 1996) that The conventional approach to soil conservation in developing countries has been to encourage adaption by farmers of improved farming systems and crop production techniques and 'packages' that have been designed specifically for hilly and marginal lands. In these areas often liberal subsidies are made available to farmers to spur adoption. Although development in marginal land farming systems and soil conservation techniques are very important, more elementary are economic considerations such as food, security, land, labor and capital limitation, tenure problems and risk perceptions which will determine farmers' willingness to adopt these techniques (Edward, 1997). He further argued that provision of subsidies does not necessarily improve adoption of these techniques; rather farmers often go back to former practices once the subsidies eventually end. .

China has a long history of desertification and many efforts have been made in there to control the problem. Large area of the country has been impacted by different levels of desertification (Zhang, 2007) due to various factors both natural and social (Tang, 2008). Zhang after overview of land desertification issues and activities in the people's republic of China, briefly states the major causes of desertification followed by a detailed account of the achievements and mechanism adapted for combating desertification by Chinese government. Successful preventive and curative methods including fixation techniques for mobile sand dunes, aero seeding over shifting sand dunes, narrow strip planting, straw checkerboard networks, windbreaks and shelterbelts of grass, shrub and trees for farmland protection and agro-forestry for ecosystem have been highlighted. Mechanisms adapted for combating desertification including legislation and institutions, integrated planning and management approaches and commitment of China's National Action Programme have been discussed in

another study by FAO (FAO, n.d).

Many studies (Chidumayo, 1989b; Lugo, 1992; Kaoneka and Solberg, 1994 and Mbegu, 1996) have been conducted, after the Sahel drought spell, in Africa on rehabilitation of degraded land[2]. They refer to steps that were taken to rehabilitate the degraded land and various curative and preventive measures adopted by affected communities. These traditional erosion control practices, such as mulching or management of pasture or long-term fallow, no longer keep pace with the increasing pressure on the land. Therefore, improved conservation methods have been developed and advised by researchers which include the stabilization of the soil by stone lines, terraces, vegetation strips, agro-forestry and soil and water conservation measures. However, soil and water conservation (SWC) measures need to be adapted to particular soil and landscape characteristics such as soil texture or terrain and, also, to the socio-economic conditions of the population. In the variable landscape of Sahel detailed knowledge about the spatial distribution of potential intervention areas was considered essential for extension approaches to be sustainable. In this respect, the NiSOTER (Niger SOil and TERrain) database has been applied to evaluate and indicate potential intervention areas suitable for specific SWC techniques. As an example, the selection of suitable terrain for ridge cultivation has been presented and discussed by Graef et al, (2001). Results indicate that in general, the methodology presented is applicable not only to the dry Sahelian landscape in Niger but also to other climatically different regions worldwide. The NiSOTER database is suitable for SWC planning at different scales for various terrain and landscapes. However, parameters such as rural infrastructure as well as socio-economic and ecological aspects have to be considered on different time scales as well. Sustainable techniques adopted need to be short-term oriented, economically viable and in accordance with the local agro-ecological and social environment, but they have to include, simultaneously, long-term sustainability aspects (Graef, et al., 2001).

[2] See Dominic Blay, Edouard Bonkoungou, S.A.O. Chamshama and Ben Chikamai. (2004). Special Programme For Developing Countries (Iufro-Spdc) Rehabilitation of Degraded Lands In Sub-Saharan Africa: Lessons Learned from Selected Case Studies. (Eds). Peter Wood and Atse M. Yapi By Forestry Research Network for Sub-Saharan Africa (Fornessa) International Union of Forest Research Organizations, for further details on rehabilitation efforts and success stories.

2.3 CONCLUSION

The literature review in this chapter indicates that the inherent fragility of dry-land and increasing threats of desertification can only be overcome with knowledge, planning, political will and investment. Desertification being one of the important issues has been addressed in all parts of the world including Pakistan but the main emphasis is usually on the assessment of the effects or the causes responsible. There is a need to investigate more on the success stories to combat desertification particularly the indigenous strategies that have been adopted to combat the problem. It is for the same reason that this study has been undertaken to investigate how the indigenous communities have adopted their lives to respond to the problem of desertification.

CHAPTER – 3

ENVIRONMENTAL CHARACTERISTICS OF THE KARAK DISTRICT

Analysis of geo-ecological parameters that are causally related to soil erosion is the prerequisite for the study of desertification and land degradation. These parameters include topography, geology, soil, natural vegetation cover, climate (rainfall, temperature and winds) and hydrology. In case of present study beside these, socio-economic factors like population characteristics, type and intensity of land use, land management mechanisms, other related characteristics of land (land holding, tenure, and ownership) and livestock etc are also essential. Therefore, an integrated approach has been adopted in this study and detailed account of both physical and social environment of the study area is presented in this chapter.

This chapter gives a detailed introduction of the study area regarding the environmental settings and land use characteristics. It is divided into two sections after giving the location; the physical environment including relief, climate, vegetation, drainage, soil characteristics and geology etc are discussed in detail. Second portion deals with Land use and land management system of the area, the social environment of the area elaborating important socio-economic characteristics are also presented in the same section.

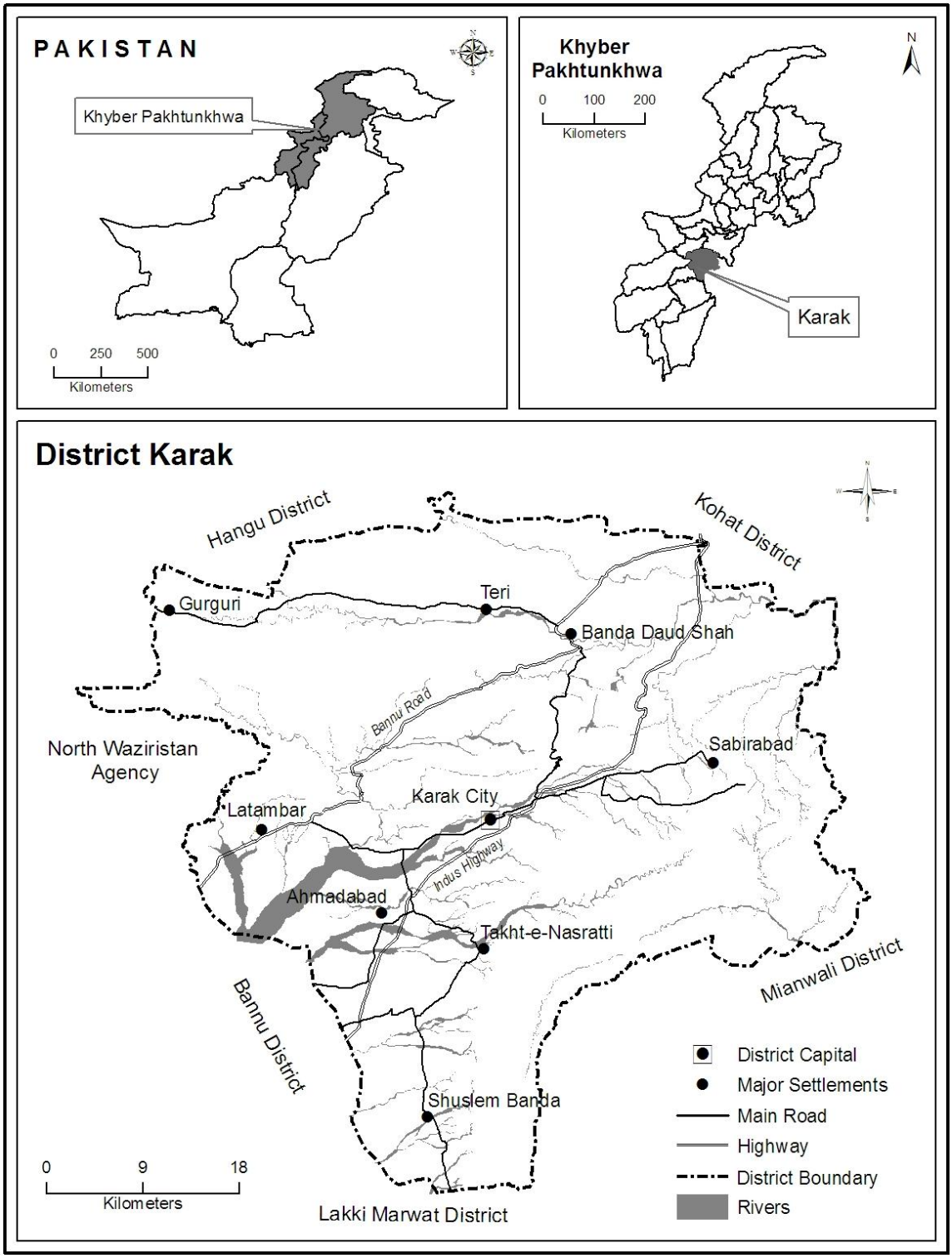
3.1 GEOGRAPHICAL BACKGROUND OF THE DISTRICT

The study area, Karak district was upgraded from a subdivision/tehsil level in Kohat district to an independent district on July 01, 1982. The civil administration is functioning through three sub divisions (tehsils), namely Karak, Banda Daud Shah and Thahkt-e-Nasrati. It comprises 21 union councils having 119 villages of varying size. The only urban center in the district is Karak town.

Geographically Karak district stretches between 32°42′ to 33°23′ north latitude and 70°40′ to71°30′ east longitude. District Karak is bounded on the north by Hangu and Kohat district, on the east by Mianwali district, on the south by Lakki Marwat district and on the west by Bannu district and North Waziristan Agency.

The district headquarter, Karak is located 164 Km South of the provincial capital Peshawar (map 4) on Indus highway, which passes through the center of the district.

Map 4: Location of the Study Area

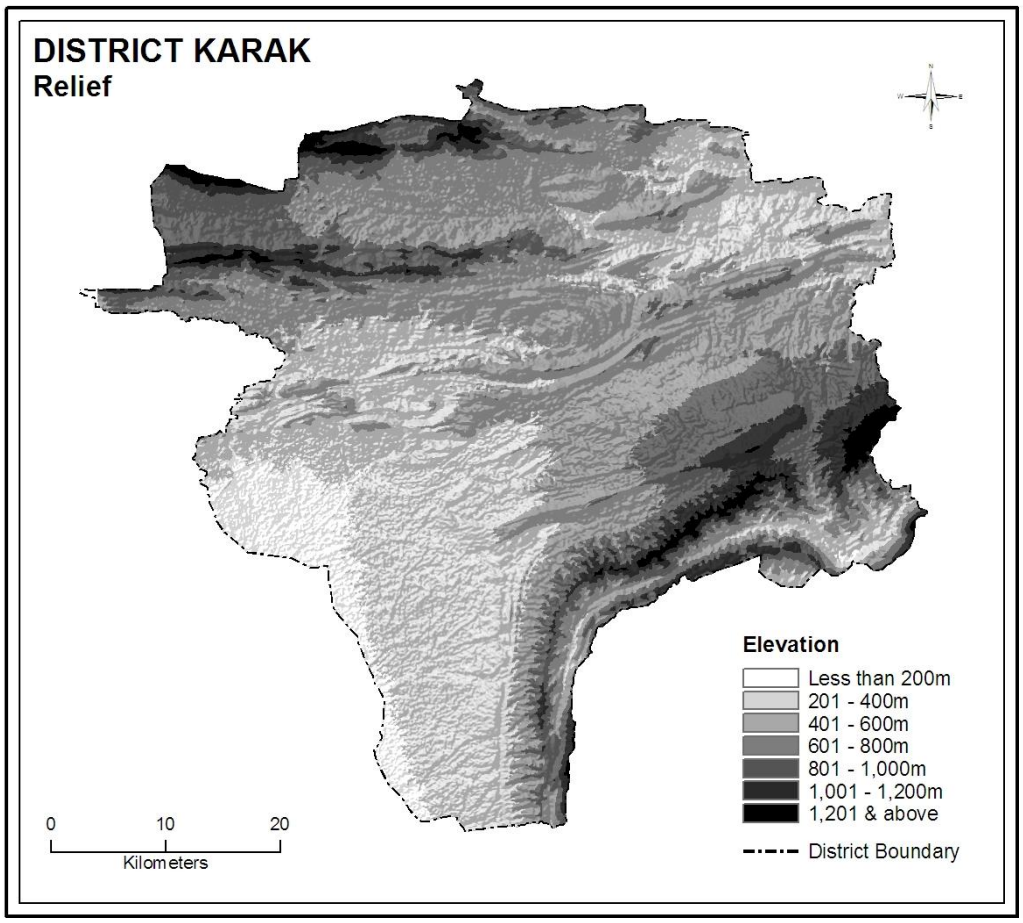


3.2 PHYSICAL SETTING OF THE STUDY AREA

Physiographically the whole district can be considered as low mountainous region as major part of the district landscape represents rugged hilly and mountainous topography. Generally the area has moderate relief with an average altitude of 600 meters ranging from 300 to 1500 meters above mean sea level. The topography of the area consists of succession of ranges of broken hills. The district slopes southwards and westwards, where it ultimately blends into Bannu basin. There are three main mountain ranges in the district. Khattak range starts from the boundary of Karak with North Waziristan and runs in east west direction up to the river Indus. Average height of this range is 915 meters above sea level with the highest peak of an altitude of 1531 meters (Shahdrang peak, 4900 feet). Two other important hill ranges are located in the south east of the district, one along the boundary of the Mianwali district called the Surghar and other in north-west is called the Shinghar. Highest point in this range is 1482 meters (Lawaghar peak, 4743). In between these hills there are several fertile valleys, seldom more than 5-7 Km in width. Steep slopes semiarid climate, torrential rainfall and the resultant high run off rate has caused severe soil erosion in the entire district, resulting in the development of gorges and isolated pillars of hard rock here and there.

The south-western part of the district consists of undulating plains with loamy soil. This part is called Thal which is physiographically the northeastern part of Bannu Basin. This is mostly flat plain having sandy patches of desert like characteristics and is sloping southwestward (map 5).

Map 5: Relief Map of District Karak



Source: Aster DEM Data 2008

Plate 4: General Topography of the Study Area

3.2.1 Geology and Soil Development

Soils of the area have developed in two major types, parent materials .i.e. piedmont alluvium and re-deposited loess (GoP, 2007). Parent bedrock of the district is predominantly of sedimentary origin and comprises of sand-stone, limestone, conglomerate and rock salt (GoP, 2004). There are several salt mines in Bahadar Khel, Mir Kalam and Jatta Ismail Khel, which is the extension of the salt range towards the north-western part of the district, while the south eastern part of the district comprise of Siwalik Hills making southern part of Koh-i-Safed. The hills are composed of very soft sand-stones and often subjected to the action of salt-charged water that has modified their appearance remarkably. In many cases nothing but an eroded stump or even a single slab of rock standing in an upright position remains to testify the huge tertiary sedimentary formation that once existed here.

Plate 5: Highly disturbed beds of Brown silt and sandstone in the Study Area

Type of soil is normally determined by the bed rock, relief, climate and vegetation types found in the region. In Karak, soil is highly variable. On the basis of soil Karak district can be divided into three distinct regions. Gravelly soil is found within the mountain valleys and piedmont areas of Banda Daud Shah and Chountra while there is predominance of loamy to sandy soil in these plains. The southern part of the district is characterized largely by sandy loam to sandy soil covering the upper 1.5-2.5 meters of the surface under laid by the heavy textured soil which conserve the moisture through restricting run-off, thus sand acts as mulch.

Salinized soil pockets are also quite common in the hilly areas, deprived of adequate drainage. Red clay soil can be seen in the mountain ranges between Banda Daud Shah and Karak tehsil. Soil cover is very thin on the hills and mountain slopes while the plain areas normally have deep soils (BADP, 1992). Most of the soil of the area has adequate mineral contents but are deficient in Nitrogen and Phosphorus. The deficiency of Zn and Mn has also been reported. Soil salinity is not a major problem as the soil are pure and well drained but the organic content is partially or totally absent, resulting into organic deficiency thus the inherent fertility is very poor (GoP, 2004).

Soil erosion is one of the major problems in the entire district particularly in the areas of salt rocks, where soil erosion is the work of salt charged water. Gulley erosion is common on the slopes of mountains as well in the plain areas of the district (plate 4).

Plate 6: Extensive Gully Erosion in Karak Leading to Badland Topography

(Photograph by M. Yasin)

Rainfall with short spells and high intensity in summer season cause severe damage to surface soil. In many parts of the district these gullies have turned into deep gorges leading to badland topography. Beside water erosion, dry climatic conditions and lack of vegetation cover has given way to the wind erosion as well. Bare soil and the fallow agricultural fields are subjected to wind erosion in dry season as during hot summers the entire region experiences strong winds particularly in afternoon. Due to combined effects of water and wind erosion the region is subjected to heavy soil erosion, in wet season due to high intensity

rain while in dry season on account of strong winds. Soil erosion is environmental as well social problem as land becomes unproductive and less valuable leading to increased poverty and marginality. Those farmers who do not have the resources to invest in land or to improve the land productivity through inputs are forced to leave the land uncultivated. They normally plant common local trees on these fields to get some benefits. However due to lack of knowledge about tree species they cannot get desired results. Common trees in the area like Ziziphus jujube (*bair*) is favored by goats and as free grazing is common practice therefore the growth of trees is very slow. The reduced productivity of these fields makes them less valuable and catches low price.

3.2.2 Hydrology/Drainage Pattern

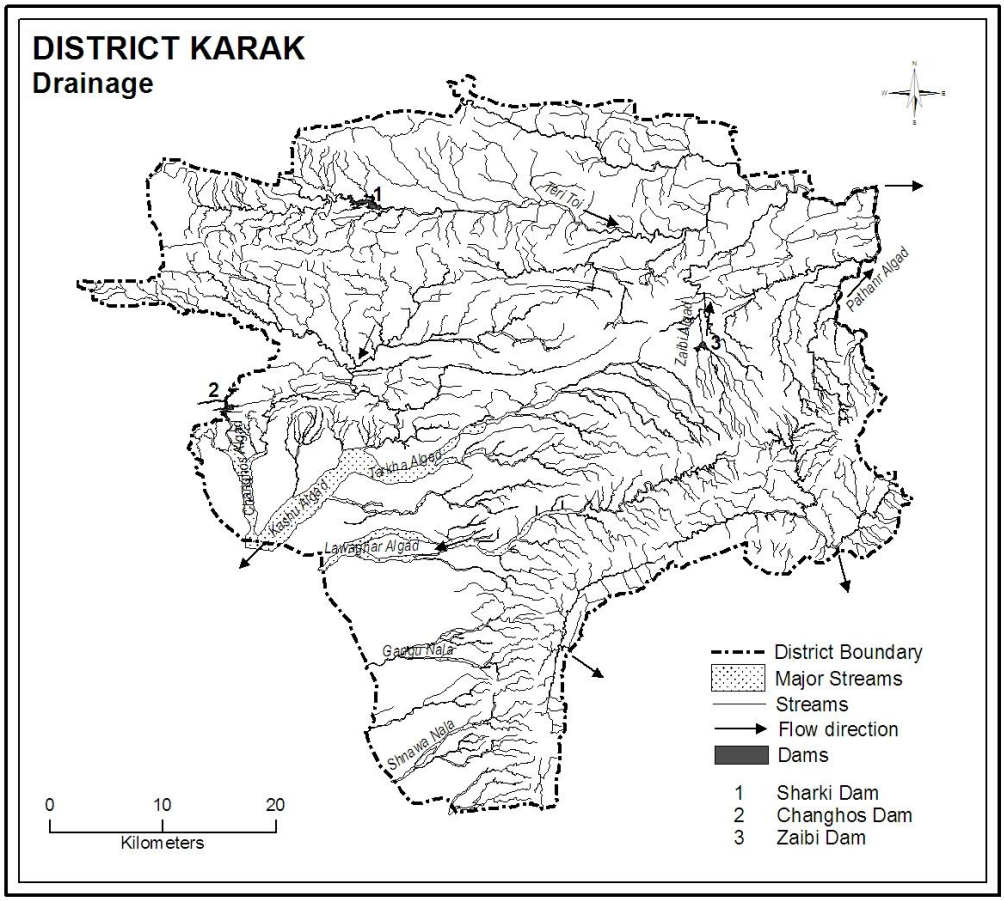
River Teri toi is the only perennial stream in the district. It takes its origin in the north western mountains of the Orakzai agency, passes through Teri, a large village of Banda Daud Shah Tehsil, and fall into the Indus river in the east of the district. From its source near Gurguri to its junction with the Indus it traverses a distance of 80 Kilometers. Other worth mentioning torrents of the district include Loaghar, Changhos, Tarkha and Latamar, which, take their origin in the surrounding hills of Samana and Surghar and meander their way into Kuram River in the west. Many other seasonal streams or *nullah,* are also found in the area (map 6). All these streams are seasonal and carry heavy flow in rainy season; some of these often overflow during torrential rains. These are also the major cause of soil erosion in the district. Storage of this water could not only control the excessive surface run off which causes soil erosion but also could be used for irrigation purpose in salt free areas. Torrent water cannot be harvested in salt rich areas because of high salt content. Ground water in most parts of the district is not easily accessible and at some locations also highly saline. Water table is located at considerable depth ranging from 45 to 120 meters. At greater depth, particularly in the western catchment it also becomes saline. The increased withdrawal of fresh ground water will result in a further intrusion of the saline ground water into the fresh water zone. The area west of Karak is particularly sensitive. However, in areas east of Karak the risk is less because the hydraulic head of the fresh groundwater is considerably higher than that of saline water (WAPDA, 1988).

In uphill areas and in the valleys water is stored in natural ditches by constructing mud/stone bunds and mainly used for livestock and in some area for small scale farming as well. These

water bodies were once quite common and were important place of recreation and game sites. Some of the ponds like Dhand Faqir and Dhandi were thickly wooded and were places of attraction for people from surrounding districts. In winter ducks, cranes and other birds were commonly visiting these ponds (Goodwins, 1975) but in recent past due to long dry spells, these ponds have dried up or have shrunk in size. These are commonly used for watering livestock (Plate 7).

Plate 7: Natural Ponds in the area: Places of watering of livestock

Map 6: Drainage Map of District Karak



Source: Survey of Pakistan

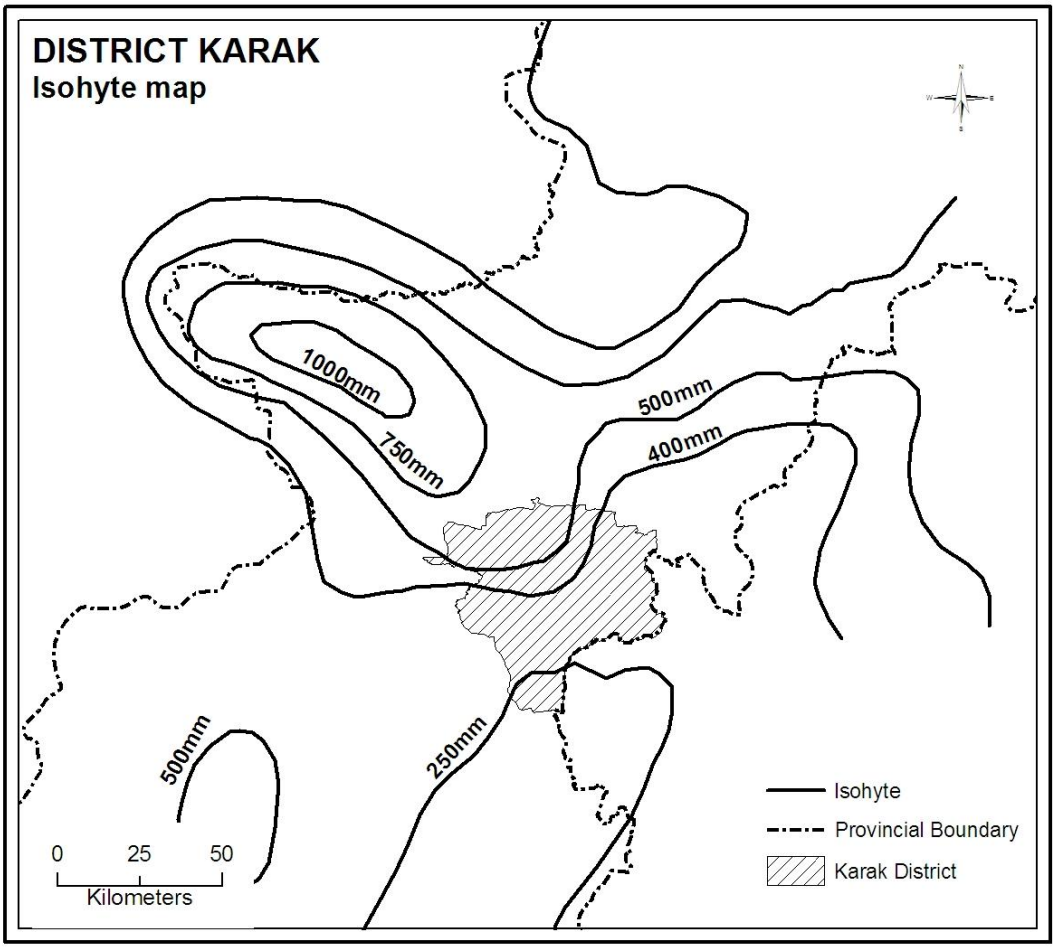
Plate 8: Torrent Beds Laden With Salts Near Bahader Khel

3.2.3 Climatic Conditions of the Karak District

Climatically, Karak district is situated in the semiarid region (GoP, 2001). It is characterized by low and erratic rainfall. Like other semiarid areas, rainfall variability is very high with short and torrential spells. Rainfall in summers is much higher compared to winters. The area also has convectional rainfall in spring and autumn, normally associated with hailstone, which cause heavy damages to the crops. Long drought spells are recurrent, which hit the entire study area. During 98-2002 severe drought that hit the country, Karak was among the severely affected districts, which experienced 40-60% less rainfall than the normal rainfall during this period (see annex 5). In terms of temperature, summers are hot and winters are cold. Temperature remains high in summer with very high potential-evaporation. Dust storms are widespread in the area during May and June which are one of the limiting factors for fruit cultivation in the area. They not only damage the trees and fruits physically but also increase the evapotranspiration rate. These storms normally hit the region in the afternoon. Winters are cold and night frosts are common.

Climatic conditions also vary within the district. Rainfall decreases from north west to south east. It varies from 700 mm in north eastern to 250 mm in the southeast. The data on rainfall distribution obtained from Pakistan Meteorological Department, (average annual data computed from 1930-1960) is presented on map 7. The southern plain receives the lowest amount of rainfall (250 mm) and annual temperature range is also very high in this region. North western part of the district, the Banda Daud Shah tehsil has relatively high amount of precipitation (above 400mm) see map 7. Climatic data for the district is now available from a metrological station established in 1985 by the Agricultural University Peshawar, at Ahmad Wala Agriculture Farm while the earlier climatic condition for the region were analyzed through the interpolation of the data from the nearby stations of Bannu, and Banda Daud Shah. According to the thirty years average (1961-90) for the region the mean annual temperature was 18°C and mean annual precipitation was 545.7 mm (GoNWFP, 1994). Detailed data for important climatic elements for the last ten years (1999-2008) is presented and discussed in the following section.

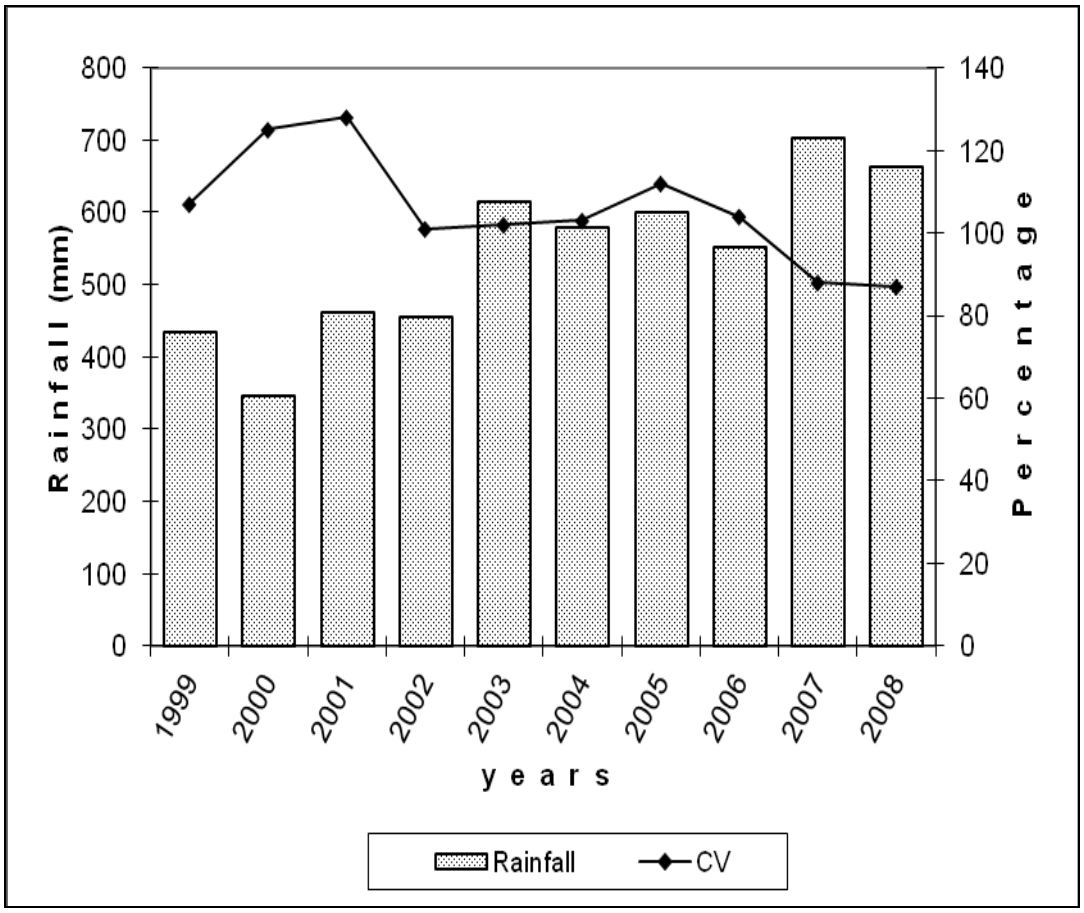
Map 7: Rainfall Distribution over Karak and KPK



Source: Modified from metrological map of Pakistan

Rainfall data of ten year periods (1999-2008) shows that the total annual rainfall ranges from 347 to 704 mm with average total annual rainfall of 541.7mm and the coefficient of variation was 20.7%. The annual rainfall within the area (300 – 600 mm) puts it under semiarid environments. However, rainfall variability is very high during various years with the coefficient of variation ranging from 87 to 128%. This variability has profound impact on the agriculture and natural vegetation in the area.

Fig 3.1: Karak District: Total Rainfall and Co-efficient of Variation (1999-2008)



Source: Data obtained from Ahmad Wala Agrculture Farm Karak

Annual rainfall variability is also very high in the study area. Almost 70% of the total annual rainfall is received during four summer months (June - September) with highest amount in July followed by August. Winters are dry with minimum rainfall received in November followed by October. Dry winter is the most significant threat to Rabi crops and water scarcity constrains the growing of wheat. Relative humidity in almost all months remained less than 60%, except August, September and February; during May it was the minimum at 40%. Data regarding precipitation and humidity indicate that the study area remains dry for most of the months and potential evaporation remained very high (Annex 5).

3.2.4 Natural Vegetation and its Status in the Area

Very small area of the district is under tree cover. These are not real forests but native trees and bushes found scattered on the hills in relatively large number. Some parts of the Chountra

region and hills of the Banda Daud Shah separating Karak from Hangu District are rich in trees. These areas once thickly wooded (Goodwin, 1975) were quite rich in biodiversity but the extensive tree cutting and the increasing use of wood has resulted in the depletion of tree cover. In Thal, the southern plain area, although proper forests do not exists but large number of trees and bushes can be seen here and there which provide fuel wood and fodder for the local community (Iffat and Fazlur- Rahman, 2010).

The area has semiarid type of natural vegetation. On the dry mountainous regions, Acacia Modesta (Phulai), Cappris Aphyeea (kirra), Dodonia Viscosa (Sanatha), Reptonia buxifolia (Gurgura) and Saccharum (Kahi Grass) are the common species. However on moist sites at higher altitudes (in chountra and Banda Daud Shah tehsil) sporadic vegetation of Olea Cuspidata (Olive) is also common. Ziziphus Maritiama and Ziziphus jujube (bair) is common on the plains, particularly in the Thal plain. Occasionally, Acacia Arabica (Kikar) and Tamarix (locally called *Gaz*) are also found on the plains. In addition arid subtropical shrubs such as Dodonea viscosa and Menotheca buxifolia exist on both hills and plains so do both subtropical forest and the desert scrub forest type, typical of rocky and hilly areas (see annex table 6). Melia azed racht (bakain), poplar mulberry and Eucalyptus Camaldulensis are successfully grown by farmer on their private lands and also in common lands for fuel wood and other benefits (Iffat, 2005).

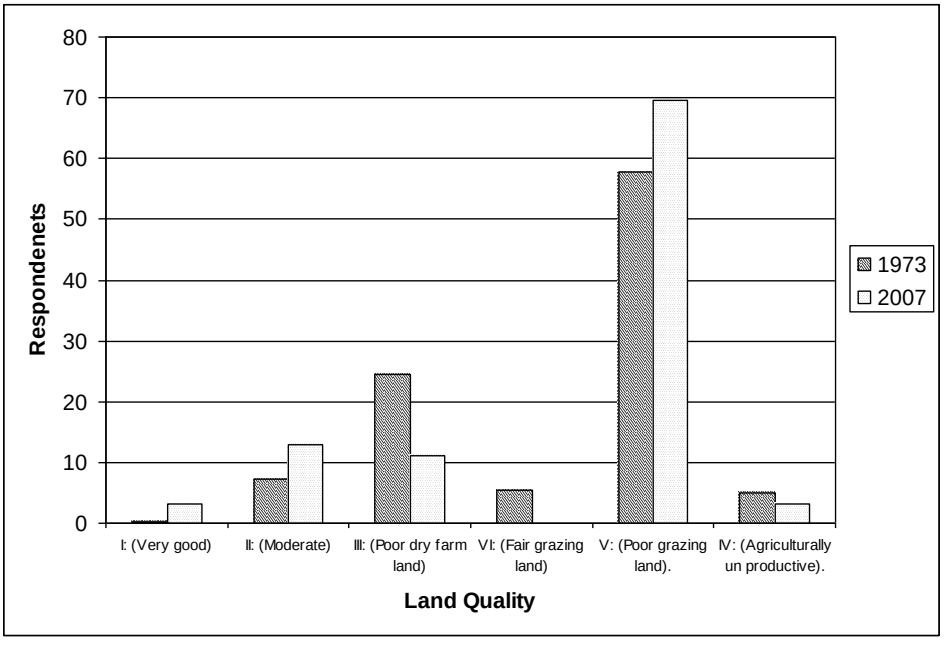
Plate 9: Natural vegetation is typical of dry areas

Due to overgrazing, the area has a degraded vegetation cover (GoP, 2002; 2004). According to the elders of the area these hills and piedmonts were once very rich in trees, bushes and grasses of different kinds, which were also rich in wild life. Even up to the first half of 20th century the hunting of wild animals was common. Goodwin (1975) has often mentioned about hunting, shooting and gamming in the district. He has included deer, hyena, urial sheep (olvis vignei) hill leopard, markhore and other wild animals in his account. Presence of these animals is the indication that once this area was very rich in grasses as most of them particularly, urial are found in grass covered areas. Amongst birds, the area was also rich in migratory and local birds like grey and black partridge, sisi partridge and chakore. In spite of massive tree cutting, prolonged drought, and overgrazing, the area still has good mix of trees, herbs and grasses that support the local economy. Besides it also provides seasonal hunting ground especially for migratory birds.

3.3 LAND RESOURCES IN KARAK DISTRICT

Land capability classification is a method of grouping the soils of an area to show their relative suitability for the sustained production of common agricultural crops, for grazing or for forestry (GoP, 1973). Presently Karak district has been divided into five regions by soil survey of Pakistan on the basis of land capability. (Table 3.2)

Fig 3.2: Karak District: Change in Land Quality Categories (1973-2007)



Source: GoP, 1976 and 2007

From the data above it is clear that the land of the district has changed over the time. The positive change has occurred in group I & 2, showing increase in fertile cultivated land. The increased application of farm inputs (primarily irrigation both through private tube wells and small dams constructed in the district recently) in group III land has converted it in next higher group. Grazing land with good quantity and quality of grasses, previously making more than 5% of the land area, have totally disappeared and have been degraded into poor grazing lands. As a result poor grazing land has increased from 57.8% to 69.64% of the total area. Conversion of unproductive land into agricultural area indicates the increasing trend of agriculture in the area.

3.3.1 Current Land Use Pattern of the District

Karak District occupies an area of 266162 hectares. Out of this, 76283 hectares (28.52%) of the area is under cultivation. Among cultivated area about 8461 hectares (11.1%) is under irrigation and the remaining 67288 Hectares (88.9%) is under rain fed agriculture.

Table 3.1: Karak District: Land Use Dynamic (1991-2007)

	1991		**2007**	
Land use intensity		88.93%		84.35%
Cultivated	74231	(28.04%)	75632	(28.52%)
Culturable waste	9244	(03.49%)	14032	(05.29%)
Uncultivated(incl forest)	181300	(68.47%)	175537	(66.19%)

Source: GoNWFP(1991,2007), Bureau of Statistics, Planning and Development Department, Peshawar

For the last 15 years land use intensity has decreased from 89% to 84%, and the land use pattern of the district has gone through some change. Although total cultivated area has slightly increased from 28.1% to 28.5%, but the net sown area in 2007 has drastically decreased from 83.85% to 53.21% (table 3.5) and the current fallow has increased almost three times (Cropping intensity has decreased). Culturable waste land has nearly doubled in this time period.

According to revenue office Karak record around 30% (compared to 28.5% by GoNWFP) of the total land in district Karak is cultivable land. Among the sampled areas Shnawa Gudi Khel has the highest share where around 40% of the total land is cultivable followed by Mitta

Khel (30%). Issak Khumari has the lowest cultivable land that is only 18% of the total land.

Table 3.2: Karak District: Cultivable Land in Sample Areas

Name of PC	Cultivable Land (in acres)	% of total land	Rain fed	% of total cultivated land
Shnawa Gudi Khel	24577	39	21889	(89 %)
Mitta Khel	3049	30	2154	(71 %)
Issak Khumari	3963	18	3275	(83%)

Source: Revenue record of District Karak 2007.

3.3.1.1 Characteristics of Cultivated Land

The unfavorable topographic and climatic conditions in the region have restricted the area of cultivation; hardly one third of the total area is classified as cultivated. The main constraint in the cultivation of the land is the non-availability of irrigation water particularly in dry farming areas. The soil is also not very rich in humus either. Occasionally failure of rain leads to stunted growth and poor quality of food crop; in such situation that crop is used as fodder.

The fields are often left uncultivated or fallow to gain fertility for next cropping season. Even larger areas are sometimes not cultivated due to low soil capability; slope and unavailability of water for longer period of time. More and more land in the region is being left idle and hence is prone to various types of erosion. Such type of idle land accounted for 16% of the cultivated land in 1991 which has increased to 47% in 2007. Growth of wild vegetation on this land provides opportunity for grazing livestock and also provides protective cover against erosion. Half of the cultivated area is net sown in the district. Net sown area has shown clear decrease between 1991 and 2007. In 1991 almost 2% of land was sown more than once which has decreased to less than 1% in 2007 (table 3.3).

Table 3.3: Karak District: Cultivated Land

Year	Cultivated (hectares)				Total	
	Net Sown		Current Fellow			
1991	62245 (1258)	83.85% 1.98%	11986	16.15%	74231	(28.1%)
2007	40238(73)	53.21% .18%	35394	46.79%	75632	28.5%

Source: GoNWFP(1991,2007), Bureau of Statistics, Planning and Development Department, Peshawar.

Note: Figures in parenthesis indicate area sown more than once.

Agricultural calendar of the district has two cropping seasons, *Kharif* (summer) and *Rabi* (winter). Major crops grown in the district include Wheat, Gram, Millet (*Bajra, Jawar*), Barley and Ground nuts. Fodder is also cultivated in both seasons. Area under different crops, their production and yield in 1990-91 and 2006-07 has been presented in the table below.

Table 3.4: Karak District: Major Crops (1990-91-2006-07)

Crops	Area (hectare)		Production (Tones)		Yield (kgs/hac)	
	1990-91	2006-07	1990-91	2006-07	1990-91	2006-07
Wheat.	85085	23639	76636	17189	882	727
Gram.	12383	5918	6534	2836	527	479
Bajara.	4229	2751	1858	1283	439	466
Jawar.	1589	1517	777	684	488	451
Barley.	490	362	280	212	571	260
Mustard.	481	430	212	112	441	260
Total.	48,636	34,617	35,407	22,116	--	--

Source: GoNWFP(1995,2007), Bureau of Statistics, Planning and Development Department, Peshawar

The table indicates that total area under crops has decreased drastically in 2007. All major crops have shown significant decrease in area like wheat, gram, millet (bajra and barley). Production of all the major crops including wheat has also tremendously decreased. This decrease is because of both decline in the yield and area under crop.

3.3.1.2 Uncultivable Land/ Area Not Available for Cultivation

The land not available for cultivation due to any reason, physical or social, comes under this category. It includes wooded land, steep slopes, river and streambeds cultural features etc.

Grazing and fuel wood land**:** The unfavorable climatic conditions, lack of irrigation, poor soils and rugged topography have restricted the area under crops and vegetation, leaving it to be used as rangeland. This includes steep to gently sloping hilly, broken and dissected rocky wasteland, forests, dry torrent beds and the banks of streams. Some un- mapable parts of this area have severe salinity and sodicity problem that is due to the presence of salt rocks in the area. Problem is more significant in areas where torrents bring dissolved salts. Their beds are highly enriched with salts as well. According to the land capability and land use statistics this category has the highest share in the land use of the area i.e. 69.64% (map 3).

On the basis of habitat type we can divide rangeland into the following types. Piedmont Plain: Nearly flat to undulating plains, dissected by local torrents, occupy considerable area of the district. These are also the transitional zones between actual cropped area and mountains, although not very rich in natural vegetation, firewood and grasses for fuel are generally collected from this region. Only herbs of different kinds and scattered trees can be found in this region. The common trees of the area include Acacia Arabica and Acacia Modesta which are best grown in this area.

Foot hills and hill Slope: Gentle slopes with relatively good soil often support a thick vegetation cover of mixed shrubs and herbs of different kinds; the dominance of the type depends upon ecological factors. Vegetation cover also varies according to the slope and aspect, shady aspect has better vegetation cover as compared to the exposed ones. They provide grasses, bushes, and herbs almost all the year round and some kind of vegetables in their respective seasons. With normal precipitation, this area provides enough grass and fire-wood up to early summers but during drought periods production is reduced and does not meet the needs of the community.

Hilly areas: These are rich in many kinds of vegetation. They provide resources even during dry years and in hot summers. The normal distances of these ranges from dwelling areas are not more than 2-5 kilometers but the routes are very difficult and pass through narrow gorges, and steep slopes. These areas are also used as hunting grounds. Wild fruit trees are also found in this area. Since they are difficult to approach, and also provide shelter for absconders, they are considered risky and as such people only visit such areas when fodder resources are not available in the lower areas and foothills.

Dry torrents beds and stream banks: The streams originating from eastern and northern mountains are occasionally flooded during rainy seasons and pass through narrow gorges, which ultimately spread out as gravelly alluvial fans. Vegetation of these alluvial fans typically consists of small and medium trees mixed with seasonal herbs. Large trees and tall grasses (*kanai*) normally occupy the sides of these streams and torrents and are used both for roof making and fuel. The remaining area is covered by small dams/open water, torrent bed and urban land.

3.3.1.3 Land Ownership in Study Area

In terms of ownership the area has three types of land - private land, state land and common land or open access land. Historical data on land ownership is not available, however according to the elders of the area the land distribution mechanism *wesh* system was practiced in the area like other parts of the Khyber Pakhtoonkhwa province. Initially land was divided among local tribes on the basis of number of people belonging to particular tribe. This land was further sub divide into households. Share in common land was allocated according to private landownership. The share was given only to the bonafide residents (original tribal people who have settled in the area since historic times). More recent settlers, even if they owned private land, are not given share in common lands. This is therefore, also considered as a status symbol in the entire district and people with share in common lands are considered the original dwellers.

Common land which is also named as community land or *shamilat* has many implications and play very important role in local economy as well as in the social life of the villages. There is common saying that in the villages four things are common, they belong to everyone but nobody owns them. These are water collection point (*Godar*), paths (*guzargah*), graveyard (*qabrestan*), and grazing land (*charahgah*). Two of them (*Godar* and *Charahgah*) are the important natural resources. Water points, located in the hills or even in the plains are considered as common resource and are used by all the people for drinking and for livestock.[3] Common lands or *shamilat* are further divided into *graeeza (mountainous)* and *samma* (plain area), plain areas *shamilat* are mostly located on banks of torrents. In case of sweet water the rules of right that is *sarseema* are different as in case of brackish water. All those who have land on the banks of torrent have the right of use until the middle of the torrent but in brackish water this is not the rule. In dry years these are normally cropped/ cultivated. The *graeeza* areas are extensively used as grazing lands or for grass and fuel wood extraction and are open to all the villagers irrespective of the tribe but the people from other villages are not encouraged particularly in drought periods. Common land can also be brought under cultivation by the shareholder under certain conditions (Goodwin, 1975).

[3] Until the end of the last century the drinking water in the district was transported from long distances. It is now available inside the houses in some parts of the district or at least at a reasonable distance. However, during the hot and dry summer the water is not readily available even for drinking. Transportation of drinking water in these areas is the routine task and consume pretty amount of women's time and energy. Donkeys are mostly used for the transportation of drinking water where distances are greater.

Private land is normally used for agriculture/crop cultivation and personal uses and is used according to individual will and capacity. State land is all the land which is owned by the state but the rights of use are with the community. This includes land under forest, water bodies and public buildings.

3.3.2 Mineral Resources of the District Karak

Karak has rich deposits of different minerals like salt, gypsum, limestone and clay. Although these are present quite in abundance but many of them have not been extracted to their full capacity (GoP, 2001). Besides, large uranium deposits in Shnawa Gudi Khel, oil and gas in several parts of the district like Gurguri, Makori and Nashpa banda areas are also found.

For last few years the exploration of oil and gas has been accelerated. Three wells have been explored in tehsil Banda Daud Shah (Daily News, 2009). The latest discovery of oil and gas in the Nashpa block in Salkhani Forest area in Karak covers an area of 979.69 sq km. Production from this well will enhance the daily oil production of the Karak-Kohat zone of the block by 4,000 barrels (BBL) and gas production by another 20 million standard cubic feet (MMscf). First well in the Nashpa structure has already been functional with the daily production of 3,000 BBLs oil and 10 MMscf gas (The News, 2009).

The well-head wise data of the Nashpa structure shows that during the year 2008 the Manzali well (Karak) produced 180,072 BBLs oil and its gas production was 18,000 MMscf and Makori well (Karak) oil production during the year stood at 599,874 BBLs, while its gas production was 7,096 MMScf (Khan, 2009). Large deposits of secondary uranium are found in Shnawa in Thakht-i-Nasrati tehsil. This mine will help in utilizing the 578 tones confirmed uranium reserves in district Karak. Extensive geo-scientific investigations have confirmed uranium reserves of 578 tons (The News, 2009).

3.3.3 Livestock Dynamics

Livestock make an important component of the rural economy throughout the district, especially in areas where physical conditions of climate and terrain do not support other economic activities. Agriculture in these areas is not the full year activity and is known as mixed mountain farming. Almost two third of the families keep livestock to meet their

household needs and also many of them generate income through this activity. There is preponderance of small ruminants followed by cattle and equines. Total number of livestock in district Karak increased from 277,500 to 303,000 heads during 1986 and 1996 but it shot up to 560,890 heads in 2006 (GoNWFP, 1986; 1996 and 2006).

Fig 3.3: Karak District: Dynamics of Herd Composition

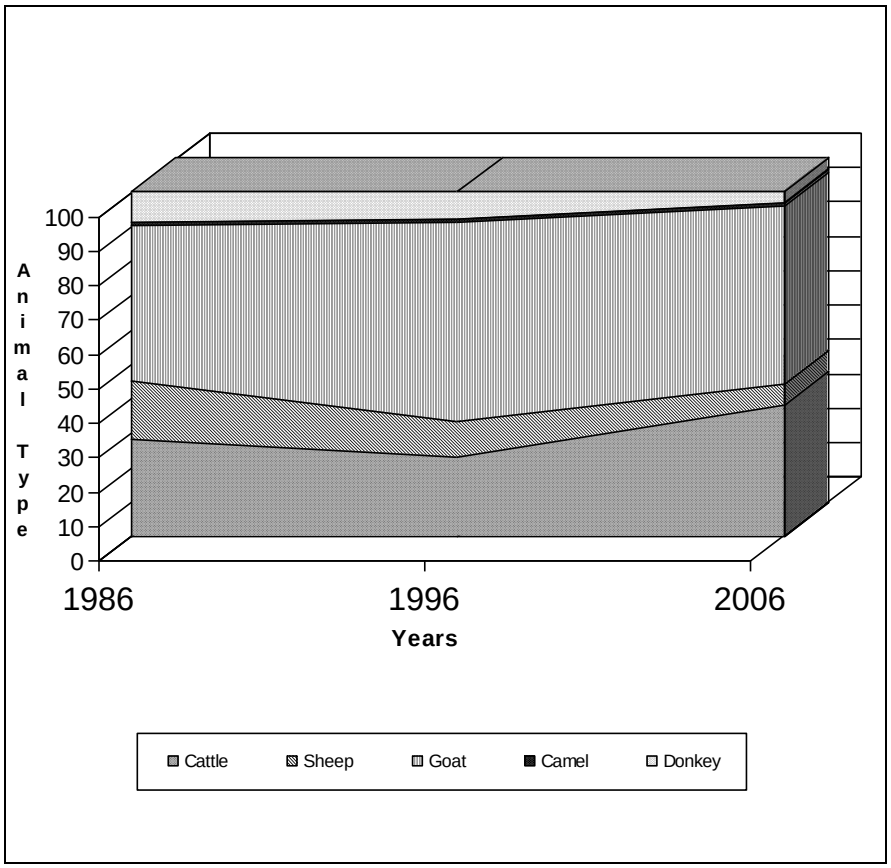


Figure show that share of cattle and goat increased remarkably while the percentage of donkeys and camels has decreased (Detailed discussion on animal husbandry in the district is presented in chapter 6).

Animal husbandry has greater scope in the area but fodder availability is the limiting factor. The common feeding methods of the livestock in the area are daily grazing and indoor stall-feeding. Fodder is normally brought from the common rangeland which is highly degraded. The crop residue is also used as winter-feed. Due to limited availability of cultivable land and scarcity of water, fodder is cultivated on very small scale. The animal health and productivity is also affected by imbalanced diet.

3.4 SOCIO- ECONOMIC AND CULTURAL ENVIRONMENT

3.4.1 Population Structure and Growth

According to population census of 1998, the total population of Karak district was 430,795 with inter-censal increase of 72.4% between 1981 and 1998. The average annual growth rate during this period was 3.3%. The figure is higher than both national and provincial growth rate. Population density has also increased from 74 people per sq km in 1981 to 128 person/sq. km in 1998 (GoP, 2001) resulting into increased pressure on land and related resources.

Historically, between 1951 and 1961, the population growth rate was 1.9 percent. Since then, however, the growth has surpassed 3 percent in all other intercensal periods (Table 3.8). The basic cause of this high growth has been the natural increase. It is due to declining death rate.

Table 3.5: Karak District: Population Growth since 1951

Year	Population in (000)	Intercensal change	Annual Average change
1951	100	--	--
1961	121	21.0	1.9
1972	191	57.9	4.0
1981	250	30.9	3.2
1998	431	72.4	3.3

Source: GoP, 2000 District Census Report of Karak.

Overall, in Karak district, the sex ratio is 96 male per 100 females, with slight difference in urban and rural areas. Age and sex based composition shows an interesting trend. In the age group below 14, males are more than females. After 15 years of age and up to the age of 64, the share of females was more as compared to males. In the last age group i.e. 64 and above, males again out-number the females slightly. The reason behind this is the sex selective out-migration in the middle-age group, leaving behind more children, women and elderly in the villages.

Projected population for Karak district as well for its tehsils, based on the inter-censal growth rate, has been given in table 3.9. This estimated population growth indicates that total number

of people living in the district has crossed the 600,000 population by 2009. Most populated tehsil in the district was Takht-i-nasrati, which is located in plains.

Table 3.6: Karak District: Tehsil-wise Estimated Population Growth

Year	Population in (000)			
	Karak district	**Karak tehsil**	**Banda Daud Shah tehsil**	**Takht-i-Nasrati tehsil**
1998	431	162	99	170
2005	545	205	123	217
2006	563	211	127	225
2007	581	218	131	232
2008	600	225	135	240
2009	620	233	139	248

Source: NWFP, development statistics 2008

3.4.2 Migration from the District

The study of migration pattern is important in this study because both out migration and emigration from the district for employment in other areas has helped in increased local income and investing in land for agriculture and augmenting land resources. In-migration is almost negligible in the district. The total numbers of lifetime in-migrants is very low - 1,141 persons during the census year 1998. Majority of them (691) have come from neighboring districts of Kohat and Bannu.

Out migration from the area is a common feature. Rapidly growing population and limited on and off-farm income generating opportunities have forced a sizeable population of the district to migrate to other regions of the country and overseas. According to rural settlement report for individual village and *patwar* circle data of 1988 Rural Settlement is presented in table 3.7.

Table 3.7: Karak District: Migration from the Sampled Villages (% of Total Male)

Name of union council/P.C	Name of Village/mouza	Total Males	Working abroad		Working in other parts of country	
Shnawa Gudi Khel	Shnawa	8481	32	(0.4)	60	(.7)
	Chak Manzai	926	2	(0.2)	140	(15.1)
	Total	**9407**	**34**	**(0.36)**	**200**	**(2.1)**
Mitta Khel	Mitta Khel	1281	20	(1.6)	415	(32.4)
	Lucky Ghundaki	946	2	(0.2)	369	(39.0)
	Total	**2227**	**22**	**(.98)**	**884**	**(39.7)**
Issak Khumari	Khumari	1154	200	(17.3)	180	(15.6)
	Issak	1091	46	(4.2)	268	(24.6)
	Total	**2245**	**246**	**(11.0)**	**448**	**(20.0)**

Source: GoP (1988)

International migration: The number of people working abroad or emigrants play very important role in the economic and social development of any area. Due to higher remittances it is more likely that some of the savings are invested in land and agriculture development. The trend of international migration has increased after 1970s. According to 1988 rural settlement survey 39962 persons from district Karak were working within the country (24.58 % of the total male) while 3521persons were working abroad (2.2%).

Migration pattern for the three sample villages from different ecological regions show very different picture in term of both national and international migration. Shnawa Gudi Khel which is located in predominantly rain fed agricultural zone has lowest figure both for out migration and emigration. Very few people have made their way out from this village, Although People, in this village, have large land holdings but they cultivate small fraction of the land. It may be because they also have off farm local employment. In term of national migration Mitta Khel located in irrigated agricultural area has the largest share of people who have made their way out. 39% of the out migrants total male were working in different parts of the country and <1% were working abroad. The third village Issak Khumari located in rain fed ecological region has maximum share in emigration making 11% of total male, while 20% of male had out migrated to other parts of Pakistan.

These people are not only playing important role in the economic uplift of the area but are an important agent of change in social life as well. They have brought great changes in life style. The better economic conditions have resulted in improved and raised living standard and also enabled investment in agricultural and land related resources.

3.4.3 Economic Profile

Economy of any area is closely related with its natural resource base and its utilization. Like all the southern districts of the province Karak is lagging behind in economic development compared to other areas of the province (IUCN, 1996). A feeling of economic deprivation and marginalization is commonly felt and is voiced by the people of the area.

Bulk of the people in study area practice mixed farming, with heavy dependence upon the available natural resources including soil and water. Although agriculture is the main economic activity in the area lately other avenues of income have opened from off farm employment outside the district. Nevertheless these two sources are interlinked in a way because income from off farm sources is often invested in farming or agriculture (Iffat, 2005).

Employment status in the district indicates high dependency on land as around 40% (39% in all areas and 42% in rural areas) of employed population was engaged in primary activities such as agriculture, forestry etc. This is a high figure considering the land capability and fragility of land in the district. 32.6% of the people were employed in community, social and personal services and the remaining were engaged in other sectors.

Table 3.8: Karak District: Employed Population by Industry (in %)

Industry	All Areas	Rural
Agriculture, Forestry, Hunting and Fishing	39.4	41.8
Community, social and personal services	32.6	31.2
Transport	8.5	8.5
Construction	8.5	8.6
Others	11.0	9.9
Total	100.0	100.0

Source GoP, 2001.

According to 1998 census (GoP, 2001; 30), Refined Activity Rate (RAR)[4] in the district Karak was 22.4% for both sexes while for male it was 28.4%. Little more than half of the employed males were self employed; around 30% were government employees; while the rest were either working in private sector or employers. Among the 71.6% inactive males 38.1% were children under the age of 10 years , 22.7% were students, 1.8%were domestic workers 9.0% were land lords, disabled, or retired personals. RAR for female was only 0.7%, which meant that most females were considered economically inactive. Among those un-employed, highest share was house wives (63.1%), while female children under the age were 34.2%. Among employed female (out of 0.7%), 60% were government employees and little more than 20% were self employed, rest were either working in private sector or were family helpers (see Table 3.9). Employed population by structure is given in the table below.

Table 3.9: Karak District: Employment Structure

Employment status (%)	**Male**	**Female**	**Both**
Self employed	51	21.3	50
Employees (Govt)	29	59.5	29.9
Employees (Private)	12	4.3	11.3
Un-paid family helpers	5	14.1	5.5
Others	3	0.8	3.3
Total	100	100	100

Source: GoP, 2001.

3.4.4 Literacy and Education Status in the District

Literacy and education are the important socio economic development indicators, which also have bearing on the husbandry of land resources. Education has been given great importance by the people of the district, which is reflected in a very high school enrolment ratio (GoP, 2001). Large number of educational institutes both in public and private sectors are serving the population and still there is demand for more. People of the district are also investing in this sector as there are no other alternative opportunities for them.

[4] RAR is referred to population above 10 years of age.

Table 3.10: Karak District: Literacy Ratio

Census year	Literacy		
	Male	Female	Both
1981	34.8	3.6	19.3
1998	68.2	18.1	41.9

Source: GoP, 2000.

The overall literacy rate in the district increased from 19% in 1981 to 42% in 1998. The gender gap in literacy rate was quite wide (68% literacy ratio among males and 18% among females). However, female literacy rate has increased almost six times compared to that of males which only doubled during this period.

3.5 MANAGEMENT OF NATURAL RESOURCES: ROLE OF SOCIAL INSTITUTIONS AND COOPERATIVES

Local people, since centuries have set norms for utilizing natural resources of the area in a sustainable manner. They have adopted local approaches to cope with the threats of population dynamics and climatic variability. These adopted strategies can be classified under various headings like local norms/rules, religious believe and myths. Collectively these can be termed as social institutions, which though weak, are functional in almost all the villages. These locally formulated rules and regulations are particularly relevant to the utilization and management of common resources. These are also very important for the conflict resolution between the villagers and in fact they help minimize the risk of conflicts between various communities. The degree of strictness and compulsion of the rules varies from village to village and from resource to resource. The maximum restrictions are on tree cutting while the minimum on grass harvest. There is no restriction on the collection of edible products from the rangeland.

Village level social or tribal heads such as *Maliks* are responsible for the implementation of the rules for the use of different resources. Collection of wild fruits and vegetables are free for everybody all the time but there are restrictions on other resources in terms of time and user groups for example to stop people from cutting down trees and taking away too much grass and firewood, axes and wheels are not allowed in the area. In some villages camels and donkeys are banned for the same reason. Apart from these norms and rules religion also play important role in natural resource management in the area. Right from a very early age, elders

of the area particularly mothers and grandmothers train the children on Islamic rulings in the management of resources. They are told that in Islam, it is a sin to cut down a green tree. On the other hand planting of trees is encouraged and is associated with 'sadqa-I-jarya' meaning 'eternal reward'.

Some positive myths about the use and management of rangeland resources are also popular in the area. For example, one myth is that one should not go to hills to cut trees in the evening because at that time fairies come to play and if you disturb them they will harm you. Another one is that if a pregnant woman cuts a green tree she will be punished by having an unhealthy child.

Traditional and indigenous knowledge of local women also play very important role in the management and utilization of resources. For example they know when to harvest vegetation and which parts of plants to harvest in order to maintain sustainable supply of the rangeland resources. They do not uproot grasses and never graze animal after rains. In fact, the rangeland is completely off-limits to everybody for 15 days after rain to ensure its re-growth.

Many tasks in the study area are performed on cooperative basis. Shared labor is the most important aspect of rural life, which is required for example in the repair of houses. Usually women are responsible for the mobilization of shared labor to help housing repair or white washing of houses. Women usually obtain the red color clay for consolidating roof of the houses from rangeland and blue color clay for plastering of walls. They normally mobilize their friends and relatives for such purposes; work together and traditionally serve meal after the work is finished. This is also a social event through which women spend some time together. During marriages and interment ceremonies they also share the workload such as transportation of water and fuel, cleaning and grinding the grains and cooking the meals. In case of death in any house the villagers irrespective of the family status serve the first three days meal to the family as well to the guests. In harvest time both men and women of the neighborhood work together to harvest each other crops on turn basis.

Construction of the irrigation channels, bund and ponds is also carried out on cooperative basis. These devices are also managed by the group of farmers whose farm lands are irrigated by such structures. The whole group of such farmers helps in building, cleaning and repair of these structures. If any of the farmers does not participate in the process he is supposed to pay

(labor wage per day) in cash. This amount is normally used by the other farmers for having meal. If somebody refuses the payment his fields are not irrigated.

Role and Status of Women: Although women of the area play active role in the economic and social life, their contribution is highly under enumerated in national population census and surveys. For example, according to the Population Census of Pakistan, 1998, economically active women, in the district, are only 0.7%, while case studies show that; they are actively involved in all sectors of rural economy. The highest participation of women is in rangeland activities and livestock rearing. The formal employment, recognized by the Population Census only comes next to these activities (Iffat, 2005).

Majority of the women in the area do field work. During the productive season from March through mid-November, a woman may spend as much as sixty (60) per cent of her time in economic activities. With the inclusion of household chores, a typical working day for a farmer's wife is seventeen hours long. It includes important task of harvesting crops, and collection of ground-nuts. In addition, collection of fuel-wood and fetching water is two other important tasks performed by women. They are also responsible for storing and managing grain. Besides food grains and hay storage and management, women also collect wild vegetables and fruits such as berries, dates, spinach, and other vegetables and dry these for preservation during sunny days and store these for family consumption during winter months. Additionally the cultivation of vegetables like okra, garlic, onion, squash melon and bitter guard on small scale, mainly for house consumption, is also a task performed by women in the area. These vegetables make essential part of the daily diet and are also used as medicines for the treatment of several diseases in the area (Hussain, et al., 2009). Further, a large majority of women are engaged in poultry farming and livestock rearing. This involves work such as health care of animals, shed cleaning, feeding and providing water to animals, care of pregnant and lactating animals, milk processing and preparation of milk products such as butter oil (”ghee”) and butter milk. Collection and processing of farm manure, hay and silage making are also the responsibility of women. Preparation of handicrafts like woolen mats, knitting and embroidery as well as making of mats, baskets, boxes, utensils for grain cleaning and storing from *mazari* and date leaves, are also the tasks performed by women, particularly during those months when they are less involved in agriculture. These are sometimes the main source of family income but more often supplement farm income of the family (Iffat, 2007).

3.6 CONCLUSION

The study area has physically rugged terrain and semiarid climate with land resources prone to the risk of desertification. Water scarcity is the major limitting factor resulting in low agricultural productivity. Livestock raring is common practice in the area but its productivity is also on decline due to shortage of feed and detoriating status of rangelands. Population growth is rapid, exerting high pressure on the scare resources. Environmental setting of the district very clearly indicate that study area is fragile and landuse of the area shows that dependency on land is higher compared to its capability. In such a situation desertification and land degradation is inevitable. The next few chapters are devoted to the analysis of mechenisms that have been adopted to cope with the harsh environment and how far these strategies have worked.

CHAPTER – 4

LAND UTILIZATION IN THE CONTEXT OF SUSTAINABLE LAND MANAGEMENT

This chapter on land utilization and sustainable land management has been divided into three sections. The first section discusses the major characteristics of land like ownership, landholdings, type of land and irrigation in the context of Sustainable Land Management (SLM). The second section highlights the dynamics of land use and its impacts on the sustainable land management and development of local community. The concluding section sums up the finding the chapter.

Like other areas of the country land is in Karak district is considered as the most important physical resource. Land and its biological diversity is a source of provision of basic needs including food, fodder, energy and shelter. It is a high value asset and a status symbol too. Although land is abundant in the area but limited water availability, harsh climatic conditions and unsuitable topographical setting restrict the capability of arable land. Pressure on arable land is further increasing due to rapidly growing population, land fragmentation, and outmigration from the region due to lack of opportunities for employment in non-farm sector.

The farmers in the area practice mixed farming. Along with growing of crops, livestock rearing and off farm activities constitute important part of the economy. Proper utilization and management of natural resources particularly land is central as they provide basic ingredients for farming. Realizing this, local community has set rules accordingly to access and utilize resources, which clearly define rights and responsibilities of the owners and users. For example land resources according to these rules have been divided into four property regimes including open access, state property, common land and private or individual land. Each property regime has legal and social implications. However, these property regimes are not static and can be transferred from one to another. In practice two categories are more visible and important regimes for utilization and management of land; individual property and common land. State land, in the area is also treated as common land except those lands which are under government buildings. Common or communal land is locally called *shamilat*.

4.1 FARMING

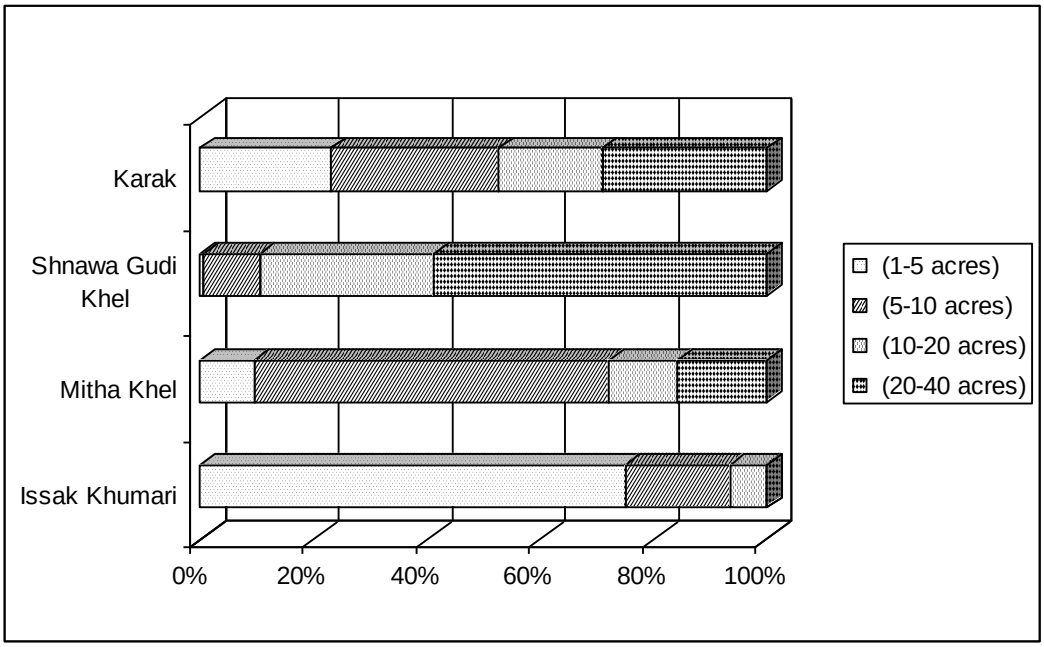
Farming or agriculture is practiced mainly on the private land, which is utilized and managed according to personal decision. Although agriculture in the area is not a full year activity but still it is one of the most important land-use categories that have bearing on the overall economy of the area. Among various characteristics of farming that have impact on the sustainable land management (SLM) are size of land holdings, type of farming, tenural status, land dependency, crops grown and changes in agriculture with time.

4.1.1 Land Holding and SLM

There are very few landless households in the study area. None of the land owners have less than one acre of land and average landholding per household is 30.4 acres. Most of the households have landholdings between 1 to 150 acres. The survey revealed that the landholdings per household are the largest in rain-fed areas represented by village Shnawa Gudi Khel. However, large land holding does not mean assured economic prosperity as agriculture in the region is highly un-economic. Water availability restricts the cultivation of these large landholdings and normally less than a quarter (25%) of the total land is brought under cultivation and remaining is left fallow. In statistical terms average landholding for the sample village Shnawa Gudi Khel was 48.6 acres per household. All respondents had landholdings above 5 acres. More than 75% of the respondents had landholdings above 20 acres and almost half of them (44%) had land holdings 40 acres and only less than 6% had land below 10acres. As in this region flat and vast plains of cultivable land is available. Joint family system still prevails in the area and land in most of the household has remained undivided for about three generations.

The smallest landholdings were in Issak Khumari, a village representing North Western ecological zone. The piedmont plains in this zone are inhabited and parts of woodlands here have been converted to farming. In Issak Khumari the land holding is small with average size of 6.3 acres per household. Almost 90% of the households had landholding below10 acres and only 3% households had land above 40acres. This is due to limited availability of cultivable land as this area is mostly mountainous and cultivable land is limited. In this area previously more households were engaged in livestock and forest related activities compared to agriculture. Household size is small and nuclear family system is common in the area.

Fig 4.1: Karak District: Farm Size



Source: Field survey 2010.

In Mitha Khel located in third ecological zone, the north eastern (with relatively more irrigated agriculture) had medium size land holding, average size being 10.2 acres per household. 63% of the households here had land holding between 5-10 acres and 15% had above 20 acres of land. In this region plain land is limited. People are educated and employed in government as well in private jobs (33%) and had lowest share in farming sector. Agricultural land has also decreased here over time due to the problem of decrease in availability of good quality irrigation water.

Relatively larger landholding in the district is due to larger family size. In large households normally joint family system prevails and land remains undivided.

Although landholding is one of the important variables in agricultural land use and large landholdings are normally considered having positive impacts on productivity. However, in the study area due to physical constraints (water scarcity and high demand of inputs) large landholdings are not manageable particularly in rain-fed zone. Due to prevailing poverty farmers do not have the required capital to invest in these large marginal landholdings. Therefore only a small portion of the land is cultivated and rest is left uncultivated and is prone to erosion and desertification. Land with irrigation on the other hand is cultivated entirely.

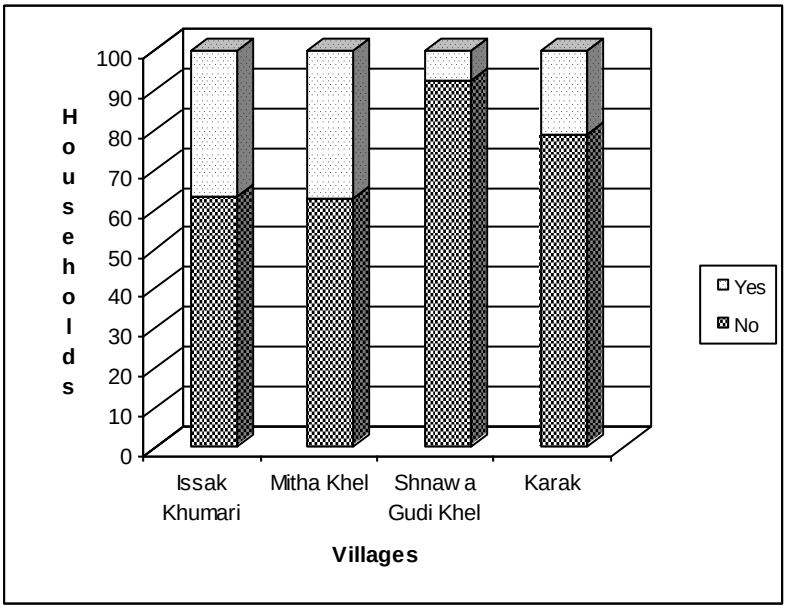
4.1.2 Type of Cultivated Land and SLM

Agricultural land can be divided into two distinct categories, rain-fed and irrigated land. Water is the main constraint to the agricultural development, according to recent soil survey report only 11 % of the land is under some kind of irrigation and rest of the land is classified as rain-fed. Broadly the entire study area lies in rain-fed region of the country where agriculture is mainly dependent on rainfall. No perennial river or large scale irrigation system exists in the district. However irrigation on small scale has been practiced since long and various traditional methods particularly *Bunds* (blockades of stone for water storage) and *Rod Kohi* (irrigation through channels derived from mountain streams or water points) were quite common in the area. In both cases water was stored for very short period of times after rainy season. Dug wells were another irrigation type used in areas where water table was relatively shallow locally known as *Chahi*. With the increasing demand of water for agriculture due to both climatic variability and increased pressure on land, these traditional irrigation methods have been replaced by methods that provide regular and more assured supply of water like tube well irrigation and small dams (table 4.6).

The proportion of irrigated land in three ecological regions varies due to varied environmental conditions. According to revenue record in rain-fed Shnawa Gudi Khel, 89% of the cultivable land is totally rain-fed. Bulk of this land is also used as rangeland when it is not sown. Even in Mitha Khel, located in irrigated ecological zone only about a third of agricultural land is irrigated, while 63 % of remaining land is dependent on rain (table 4.1). In Issak Khumari, belonging to North Western wooded ecological zone around 85% of cultivated land is classified as rain-fed.

Statistics for total irrigated land in Karak district was not available in revenue record. However field survey conducted under this study reveals that only 21% respondents had some land under irrigation while 79% were totally dependent on rain-fed agriculture.

Fig 4.3: Karak District: Households with/without Irrigated Land

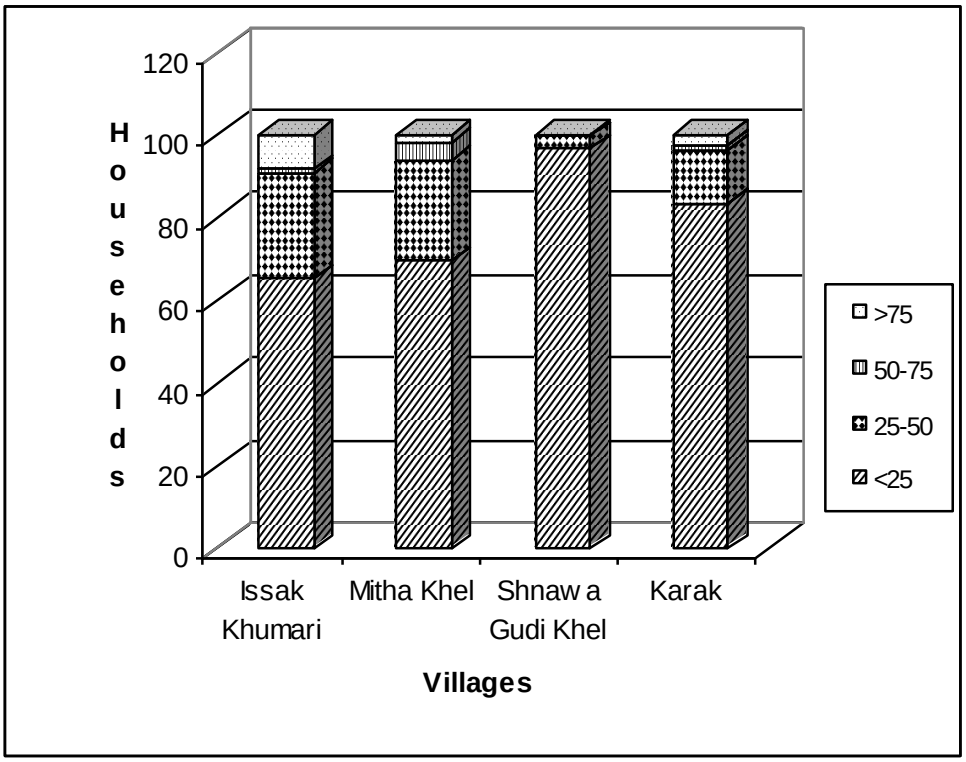


Source: Field survey 2010

Results from the representative individual *patwar* circle show that in Mitha Khel 37% households had some of their land under irrigation, followed by Issak Khumari where about a third of the household had some irrigated land, while in Shnawa Gudi Khel a small fraction of sample households (7.8%) had cultivated land under some form of irrigation.

Proportion of cultivated land under irrigation in sample villages can be seen in Fig 4.4. Majority of the respondents (83.4%) had less than a quarter of cultivated land under irrigation. Around 13% of the respondents had more than a quarter but less than half of their cultivated under irrigation. Only a very small proportion of farmer i.e. 1.3% had more than half of their land under irrigation. Little more than 2% of people had more than 75% of their land under irrigation. The last two categories of households were either those having land very close to irrigation channels, springs or were those having their own tube wells.

Fig 4.4: Karak District: Proportion of Land under Irrigation to Total Land Holding



Source: Field survey 2010

In Shnawa Gudi Khel village located in primarily dry farming/rain-fed agriculture, the phenomenon of abandoned agriculture land is common. Land holdings in this region are quite large but proportion of cultivated land to the total land is very small. During focused group discussion two major causes for this were identified. Inhabitants were poor and financial cost of bringing the entire land under cultivation was beyond their means. Moreover, the migration of the young and robust members of the households to other parts of the country as a labor was also common due to which farm labor was in dearth (see chapter 7). The remaining members of the family consisting mainly of children, women or aged persons did not have the required strength and resources to cultivate land in adverse and uncertain climatic conditions. Thus only the most fertile portion of the landholding is brought under cultivation, and the rest is left as barren and abandoned land. This land is then used for grazing, and over time, the increased livestock pressure, beyond the carrying capacity results in total removal of the grass cover and loss of top soil through erosion. As a result barren rocks are left, which have no utility for growing crops, grasses or trees.

The degraded land besides a short decline in the productivity is also associated with the loss of the other benefits and services in the form of environmental degradation, reduced biodiversity, loss of medicinal plants and other non-timber forest product such as Saccharum, *mazari* and Date palm.

Irrigation is important but inappropriate irrigation methods also lead to desertification. In Karak during recent past increasing number of tube wells have resulted in outflow of saline water because underlying bedrock in most areas is gypsum and rock salt. This problem has resulted into abandonment of land in Mitha Khel and its nearby village Tarkh koi (The very name of this village is bitter water),

Water table in the district is very deep and water extraction is not an easy task, additionally the high cost of electricity has further increased the cost of irrigation. Therefore only those who have enough financial resources can irrigate their land through tube wells. Poor farmers normally had un-irrigated land (table 4.1).

Table 4.1: Karak District: Income Level and Type of Cultivated Land

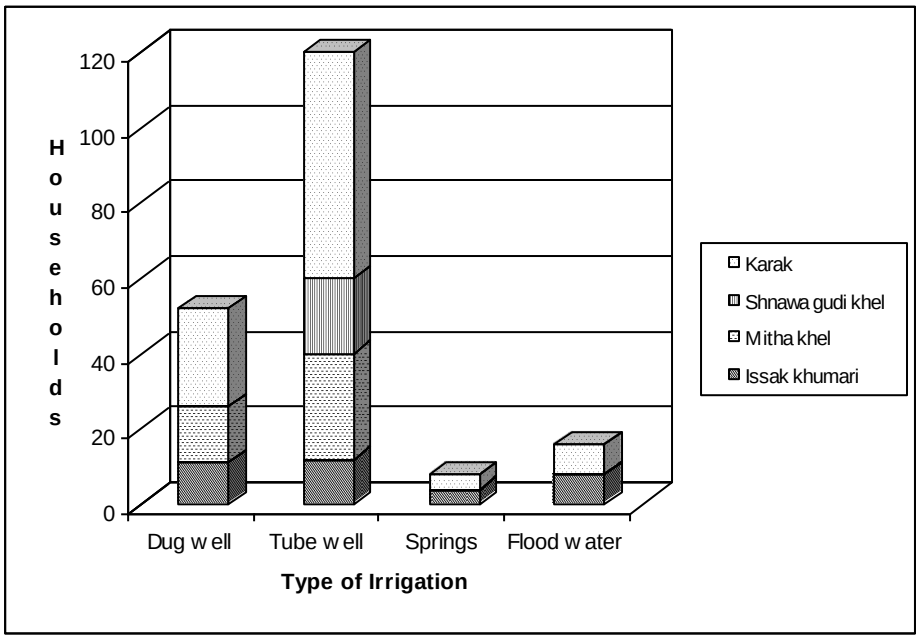
Family income groups	**Irrigated Land**		**Total**
	No	**Yes**	
Very Poor	5	0 (0%)	5
Poor	52	8 (13%)	60
Middle Income	146	17 (10%)	163
Rich	118	42 (26%)	160
Very Rich	46	31 (40%)	77
Total	367	98 (21%)	465

Source: Field survey 2010

Type of irrigation is highly dependent on both the ecological setting of the area and the economic status of the household. The most common method (67%) of irrigation used in Karak is tube well, followed by dug wells (29%). Tube well is the most common method of irrigation in all sample villages and is the only method used in Shnawa Gudi Khel. This is followed by Mitha Khel where 65% of the respondents were using this method. Flood irrigation was once a common method in the area but due to increased variability of rainfall it has become less important and used on a limited scale particularly in Issak Khumari where few hill torrents carry sufficient water. Small dam has also been constructed to tap water from

hill torrents few years back.

Fig 4.5: Karak District: Type of Irrigation



Source: Field Survey 2010

4.1.3 Land Dependency & SLM

In rural areas of Pakistan people are predominantly engaged in agricultural activities and primarily dependent on land. However, in marginal areas like Karak low productivity of the land has forced people to seek other sources of earning. Consequently People of the district are involved in other nonfarm activities.

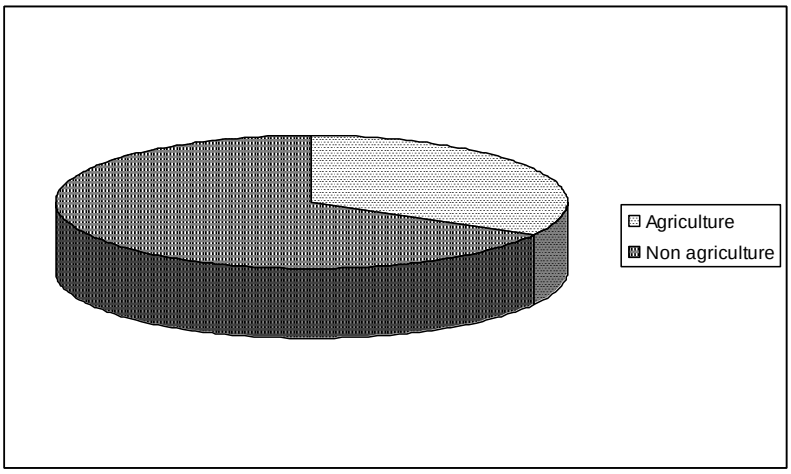
According to survey conducted in this study, there were 1614 gainfully employed people in the sample villages. These were earning their livings from different sources including employment in public sectors, armed forces, private organizations, business and agricultural activities. For general comparison these have been categorized in agricultural and non agricultural activities. One third of the working population was found in agricultural activities and two third were dependent on non agricultural activities (table 4.2).

Table 4.2: Karak District: Region-wise Working Population in Sample Households

Activity	Issak Khumari	Mitha Khel	Shnawa Gudi Khel	Karak
Agricultural	57	56	426	539
Non agricultural	169	226	680	1075
Total	226	282	1106	1614

Source: Field survey 2010

Fig 4.6: Karak District: Working Population in Sample Households



Source: Table 4.2

Significant variation can be seen from one area to another. Agricultural population is 20% in Mitha Khel and almost double that is 38.5% in Shnawa Gudi Khel with overwhelming dependence on land in the area.

4.1.4 Tenural Status and SLM

Land tenure expresses the relationship, both legal and customary that exists between landowner, the tenant, the cultivator and others who have some stake in the land (Khan.F, 1991). Most of the farmers (85%), in the study area, are owner cultivators who care a lot for their land. Since the land productivity is low, the owners prefer to cultivate the land themselves rather than giving it on tenancy and share the output with the tenants. In all sample villages owner cultivators predominate (table 4.3). In Shnawa Gudi Khel number of owner cultivator is highest (91%) followed by Mitha Khel (83%) and Issak Khumari (74%). This variation could be dependent upon land productivity. In those villages, where land productivity is higher along with larger amount of agricultural land the owner may share part

of it with tenants while reverse is the case for villages where land productivity is low. In Shnawa Gudi Khel, for example where land is least productive and household size is much larger, the share of owner cultivators is highest. While in Issak Khumari with highest land use intensity, small household size and increased rate of international migration the ratio of owner cultivators is the least.

Table 4.3: Karak District: Land Tenure

Village	Owner Cultivator	Tenant/owner	Tenant	Total
Issak Khumari	(74%) 71	(22%) 21	(5%) 3	95
Mitha Khel	(83%) 96	(3%) 4	(14%) 15	115
Shnawa Gudi Khel	(91%) 232	(7%) 18	(2%) 5	255
Karak	(86%) 399	(9%) 43	(5%) 23	465

Source: Field survey 2010

At the time of sowing and harvesting the whole family is engaged in the agricultural activities. Besides family, neighboring farmers and friends also help each other in certain activities for example in harvesting crops. These collective action practices leave little room for hiring labor or giving land on tenancy (Fazlur-Rahman, 2007). About 5% of the farmers, in the area are tenants. These tenants working on others people's land normally use their own land for tree plantation. The produce from these trees are used for house hold and also sold in the market for fuel wood and in some cases for timber. Share of tenants is highest in Mitha Khel and Issak Khumari as these are the areas that produce groundnut, a more labor intensive crop compared to wheat, millet and other crops of the area.

4.1.5 Cropping Pattern and SLM

Agriculture calendar has two distinct seasons in the area: winter *(rabi*) and summer (*kharif*). Major crops grown are wheat, gram, millet, groundnuts and fodder. Wheat, gram, brescia, barley, sorghum & vegetables are grown in *rabi* and in *kharif* mainly groundnuts and millet (*bajra and jawar*) are the major crops. Rapeseed and mustard are cultivated on the marginal lands and along field boundaries. Vegetables are grown on very limited scale mainly in irrigated areas. The most important crop of the area is wheat, which often faces problem of water shortage in rain-fed areas. Gram is quite resistant to water scarcity but its productivity

is greatly constrained by pests and strong winds normally blowing in April in the district. Marginal land is given to fodder cultivation in both seasons.

Wheat, being the staple food, is the most important crop of the entire district and is grown on the best cultivated land. It is sown in mid October to mid November before rains and harvested at the end of April. Both local and improved varieties (like maxi pak, *inqilab* and *khatakwall*) are grown. Yield of wheat is dependent on rainfall which is highly variable. In years of good rains average yield of wheat is around 1050kgs/ha. The yield has significantly risen during last 30-40 years. Most of the farmers are getting between 600-1200kgs/ha while few farmers produce above 2400kgs/ha. Village wise variation is shown in table 4.4.

It can be seen that the lowest yield was in Shnawa Gudi Khel that is about 800kgs/ha. The yield here has also shown little variation over time, apparently because the poor farmers of this low productive rain-fed ecological zone have little means to enhance the yield. Mitha Khel, located in irrigated area, which was previously known for its best quality wheat and highest production in the entire Kohat division (Gazetteer, 1990) has shown decline in the yield of wheat from 1250kgs/ha to 1100kgs/ha in the same period because the farmers preferences have changed in this area, who have been allocated lands more to groundnut cultivation, which pays much more and has less risk compared to wheat particularly in un irrigated areas.

Table 4.4: Karak District: Change in Mean Yield (Kg/ha) of Major Crops

Village	Wheat		Groundnut		Millet		Gram	
	Current	30 years Back	Current	30 years Back	Current	30 years Back	Current	30 years Back
Karak	1054.97	980.65	425.05	179.03	432.52	749.42	382.28	507.53
Issak Khumari	1699.37	1258.95	1212.63	797.89	522.11	642.53	-	-
Mitha Khel	1093.57	1257.04	697.39	64.78	435.48	640.00	72.35	84.87
Shnawa Gudi Khel	797.49	752.31	8.82	.00	397.80	838.59	664.47	887.22

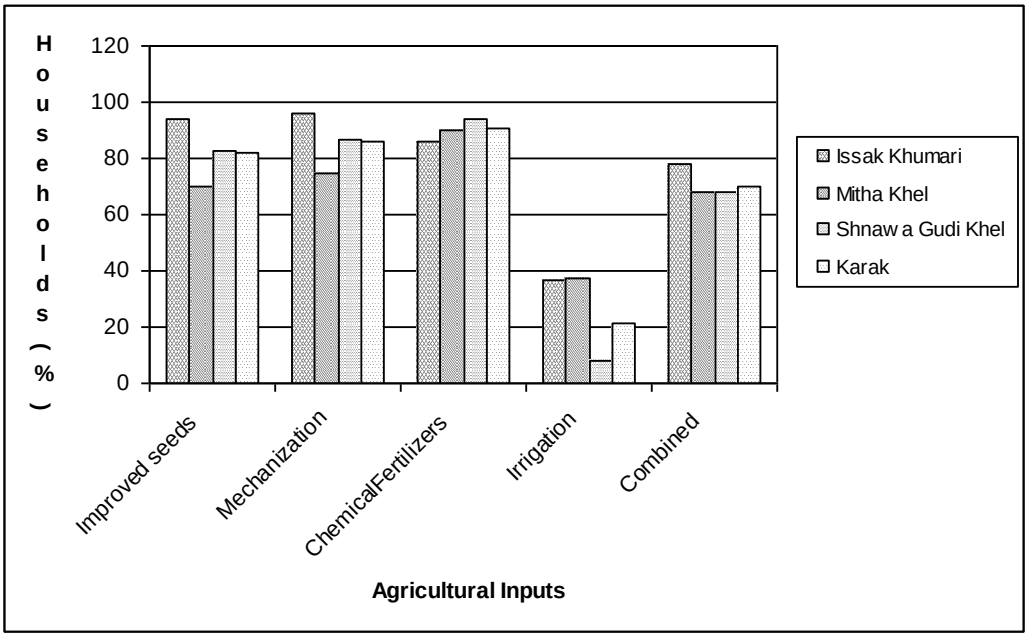
Source: Field Survey 2010

Improvements in crop yields are dependent on a number of factors including farm and labor inputs, as well as technological investments. On the whole 70% of the households in the district today apply farm in-puts. The number of households using farm inputs and

technology, in Issak Khumari is much higher compared to other two villages. Consequently, higher increase in yield of wheat and groundnuts has resulted in this village (Fig. 4.7). Yield of millet has declined as it is now only grown on marginal lands and mostly utilized as fodder. The extent of effort in generating soil in the area can be gauged from the fact that majority of the head of household interviewed during the survey informed that after monsoon rains, they level their fields and add the soil that was taken downward by flash floods more than once. The shifting of this soil material is quite labor intensive. The use of better seeds, fertilizers and mechanization particularly use of tractor and thrasher has been made possible due to investment from income of emigrants from this region.

Yields of main crops in Shnawa Gudi Khel have significantly declined. This area faces very harsh physical conditions because of low soil productivity and water scarcity.

Fig 4.7: Karak District: Use of Farm Inputs in Sampled Villages



Source: Field Survey 2010

Gram and millet are two other traditional crops of Karak besides wheat. Yield of gram has declined from 507.53 to 382.28kgs/ha in last few decades. It is a commercial crop and is an important source of income. It is also used as food item providing nutrition that is used both in green and dried form. Some parts of the district are highly suitable for cultivation of this crop like dry farming region (*Thal*), where it has always been the most important crop due to well drained plain area with deep soil. Its better resistance to aridity makes it most suitable

for the area. According to survey results the yield of this crop has declined significantly even in this zone (Shnawa Gudi Khel). In the past the average yield of gram was much higher (887.22kgs/ha). Currently more than 60% of the respondents were seriously concerned about this decline (664.47kgs/ha). Most people argued that destruction due to winds and hailstones were responsible for declining yield. It is also grown in the other ecological regions but on very limited scale.

Yield of millet has also declined from 750 to 430kgs/ha. Dry farming region, home for gram was also well known for this crop and highest yield was also obtained here. Currently the yield of this crop is hardly 400kgs/ha less than half of yield 30 years ago. Average yield of the crop has also declined in other two ecological regions. Millet has been very important in the region as beside its use for food it was also used as fodder crop.

A relatively newly introduced crop of the area is groundnuts. People of Mitha Khel believe that the crop was introduced by those laborers of Karak, who were working in the fields of large landlords of Punjab. After sowing winter crops in late summer many poor people from Karak used to migrate to Punjab along with their camels. They would work on the fields over there and on their return were paid in form of grains in late winter. It seems that they were the ones who introduced the crop in Mitha Khel.

In case of Issak Khumari, which was known for its livestock trade, it seems that the traders who used to come from Mianwali, Dera Ghazi Khan and other parts of the Punjab in search of hide and skin, introduced this crop locally. They would spend some time several months in the area for skin and hide collection and would leave before the winter.

Whatever may be the case but this is a fact that groundnuts in the district were introduced during the last 30 to 40 years. It was grown by only 114 households 30 years back, and the number has now increased to 248 in surveyed households. Out of these 114 farmers only 19 were from Mitha Khel and it was unknown in Shnawa Gudi Khel. All the other households were from Issak Khumari. This indicates that this crop was first introduced in Issak Khumari of tehsil Banda Daud Shah which is today very famous for its production.

There was no mention of this crop in any of the historical writings and books. Now it is successfully grown in all ecological regions. However, its production is higher in rain fed and irrigated zones, where Yield of the crop has increased significantly in recent years

(occasionally the crop fails during drought period). The crop was introduced during the last two three years in third zone, dry farming, on the advice of Soil and Water Conservation Department on experimental basis and the results have been quite encouraging. Table 4.4, shows that yield of groundnut has increased in all the three regions. Overall yield of the crop is 425kgs/ha in Karak. Maximum yield is recorded in Issak Khumari while lowest is recorded in Shnawa Gudi Khel where it is recently introduced. Village wise number of farmers growing groundnut also varies. In Issak Khumari for example all the sampled households were growing it while in Mitha Khel also most of the farmers were growing groundnuts but only 6 responded have started growing it in Shnawa Gudi Khel (Plate 6).

During the focused group discussions many of the respondents were of the view that they grow very little grains compared to what they need. More than 60% of the respondents claimed that they grow even less than half of the grains they consume or what they need (table 4.5). Most of their earnings go in buying food grains alone so they are barely able to either save or invest their earnings in agriculture. They argued that although production of some crops has increased compared to what was grown 30-40 years back but agriculture has become so expensive that much of it is used in provision of farm inputs. In the past they were using only local green fertilizer and were growing a variety of crops and also harvesting wild vegetables and lot of herbs which were used as edibles both for human and livestock. The fallow period has increased significantly and nothing grows in that period. Lack of fodder has also resulted in decreased dairy products. In areas where groundnuts are grown are in much better position as both production and income from this crop is higher.

Table 4.5: Karak District: Food Security

Time Duration	Number of respondents	%
<4 months	91	20
4- 6 months	193	41
6-8 months	76	16
8-10 months	63	14
Year around	42	09
Total	465	100

Source: Field Survey 2010

4.1.6 Agricultural Dynamics and SLM

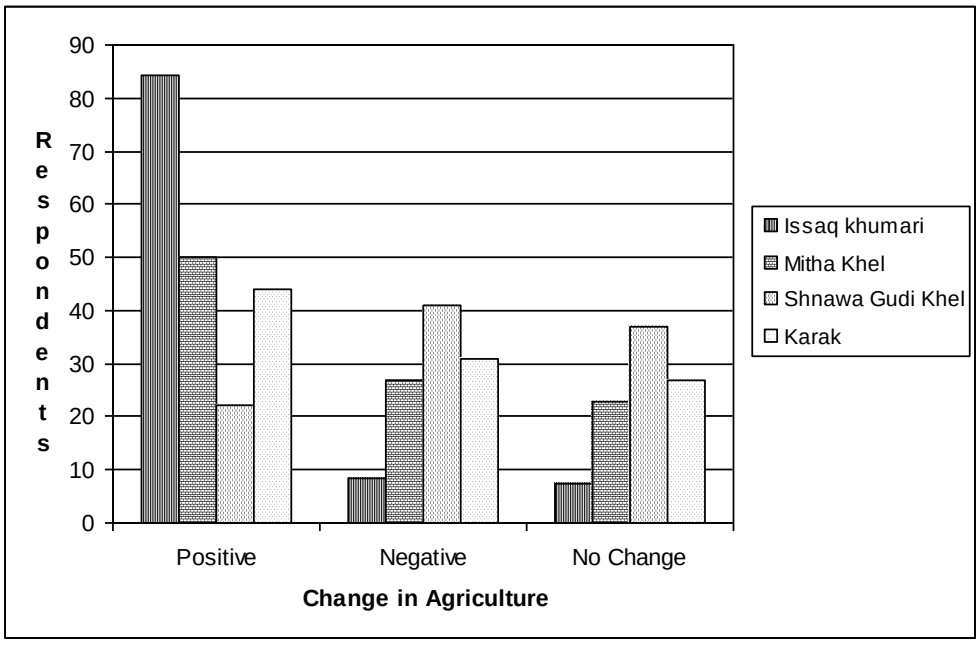
Changes in agricultural are inevitable with changing physical characteristics like climate (Shakir et al, 2011), soil, water and social changes such as level of technology, raised awareness, increased opportunities, growing demands and raised economic status. Although the dependence of local people is decreasing on farming due to their increased involvement in non-farm activities but the increased income from other sources such as remittances from abroad has lead to enhanced investment in agriculture in the district. During field survey a question was asked from the respondents that, whether any change positive or negative in agriculture has been noticed in their life time? The nature of noticed change, thus recorded has been presented in figure 4.8.

Respondents (73%) stated predominantly that changes have occurred in agriculture with most changes taking place in Issak Khumari, where more than 90% of the respondents informed that noticeable changes have occurred. This was followed by Mitha Khel where 77% of respondents mentioned about change in agriculture while in Shnawa Gudi Khel more than 60% of the respondents informed that change had taken place (Fig 4.8).

The nature of change was both positive and negative, resulting into either improvement or deterioration of the system. The factors that have contributed to positive change included introduction of modern technology, access and availability of improved seeds and fertilizers and increased awareness. Most of the respondents (47%) from Issak Khumari for example answered that positive change in agriculture was due to improved seeds and fertilizers. Agriculture was not a profitable activity due to uneven and rough topography, small land holdings and poor soil in the area. However, due to increased inputs and better leveling it has become more important than forest related activities. This is a mountainous area located in the monsoon region. Precipitation during rainy season is relatively high which results into increased frequency of flash floods. Soil erosion (field wash) in the area was a severe problem which was considered the most important cause of decreased productivity and low participation of people in agricultural activities. Nevertheless, with the help of tractors better leveling of fields had become much easier and now fields are leveled more than once and soil washed out by rains is brought back from the down streams.

In Mitha Khel 50% of the respondents identified positive changes and considered mechanization as more important factor compared to others. This region although have moderate climate but shallow and mainly gravely loam soil underlain by Gypsum and Salt (1st chap) restricts agricultural productivity. Topography of the region is hilly and in many cases leveling of land and field making manually was hard due to presence of gypsum in the soil used to cause damage to human hands. Use of tractors for this purpose has helped considerably in this regard. Number of tube wells has also increased in the area significantly in last two decades. Earlier flood irrigation was common method here followed by dug wells. Due to increased variability of rainfall springs and torrents had dried up and the water table depth had enhanced. In such a situation use of tube well had become inevitable as the most important source of irrigation. This form of irrigation is now utilized by 65% of respondents. Groundnut is the most important crop of the area. Its harvesting needs very deep tilling. Before the introduction of tractors much of the production was lost in the use of manual techniques. Mechanization has improved it considerably increasing the yield. People of this region are well educated and their participation in nonfarm activities is higher compared to other areas. Due to higher literacy, they also have better access to agriculture loans, extension workers and are well aware of the advantages of application of improved seeds and fertilizers. Their purchasing power is also better than in Shnawa Gudi Khel. Almost a quarter of the respondents considered this as the important factor in positive change in agriculture.

Fig 4.8: Karak District: Change Noticed by Respondents

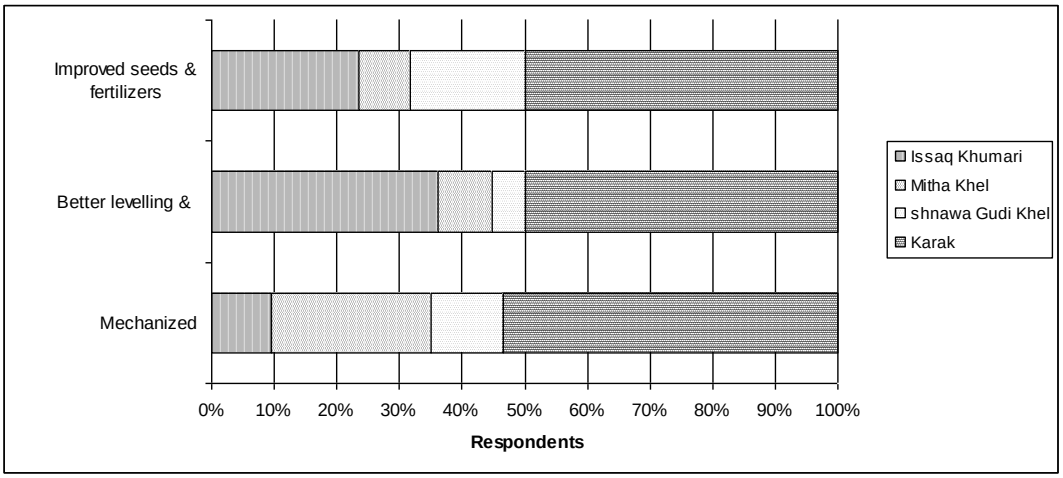


Source: Field Survey 2010

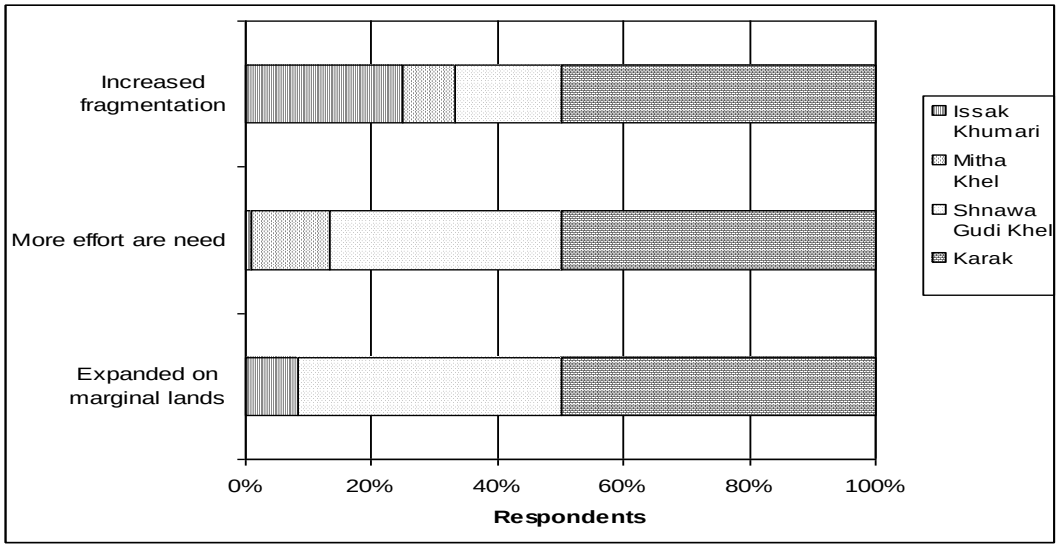
Perception of the respondents regarding the type of change is presented in figure 4.9. In Shnawa Gudi Khel less than a quarter of the respondents mentioned about the positive change and around 40% informed about negative changes while almost the same proportion of people didn't notice any change. Economic condition of this region is poor and majority of households have large family size. Poverty is the main constraint due to which they cannot invest in agriculture through inputs or technology to maximize the production. Additionally this region is physically very fragile. Soil is highly deficient in water and humus, therefore very vulnerable to wind erosion. Due to higher demands of inputs, only a fraction of land is cultivated and rest of it is left as fallow as in villages like Shnawa Gudi Khel. The fallow land is cultivated when it replenishes its fertility and hence leads to increasing the yield but leaving the land idle also opens it to erosion by wind and water.

Fig 4.9: Karak District: Type of Change in Agriculture Noticed by Respondents

Positive



Negative



Source: Field Survey 2010

Fragmentation as a factor of negative change has been mentioned by a few respondents but is not regarded as significant. Mechanization and improved inputs i.e. seeds and fertilizers were mentioned as equally important for positive change in the form of increased crop yield.

Women have always been involved in agricultural activities in Karak. However, in past they were more involved in livestock sector. With the introduction of crops like vegetables and groundnuts, however, their involvement in agricultural labor force has increased substantially. Women participation in vegetables production has brought positive change in their life, and also leads to positive changes in agriculture.

Involvement of women in agriculture varies from area to area. For example, village Mitha Khel located in irrigated ecological zone has more women involved in agriculture compared to other areas perhaps because of cultivation of more labor intensive crops like vegetables and groundnuts. Besides processing of groundnut seeds, women also have higher share in the picking and even marketing of vegetables on small scale.

In Issak Khumari women were mainly confined to indoor activities although this area predominantly grows groundnuts but farmers here hire labor for farm work. The crop was introduced some 40 years back in the region and has played very important role in the economic uplift of the area. This area employs highest number of tenants and labors who are paid both in form of cash and grains.

4.2 COMMUNAL LAND (*SHAMILAT*)

Land that is the common property of a village, tribe or kinship group is locally known as *shamilat* or communal land and includes forests, wetland, wasteland (rangelands), denuded lands, dry torrent beds and the banks of streams. In most of the villages on the basis of ownership there are two types of *shamilat*: 1) the land that belongs to the entire village or *shamilat-i- deh* and 2) land that belongs to the individual clan or *shamilat-i- kandi/pati*. In both cases only those who are the original inhabitants and have some agricultural land can have share in *shamilat*. Migrants though have the right to purchase individual property in the village, yet they can never get the share in *shamilat* or communal property. In contrast, the original land owner of the village who may have sold his land would still have his share in *shamilat*. In brief no individual can sell or buy land or right of use of *shamilat*. Those having share in communal land are therefore considered more honored.

4.2.1 Characteristics of the Communal Lands/ *Shamilat*

The land which due to un-favorable climatic conditions, lack of irrigation, poor soils and rugged topography has restriction for crop production is kept as common property. This category occupies considerable area of the district, mainly the hills, flat and undulating plains dissected by local torrents originating in the nearby hills and mountains. Soil in these areas is normally very shallow and deficient in humus. These are also the transitional zones between

actual cropped area and mountains, and usually do not have very rich natural vegetation.

4.2.2 Access and Withdrawal of Rights, Share in Communal Land / *Shamilat*

In contrast to privately owned land, communal land (*shamilat*) is, in theory, owned and managed by local tribal institutions, which traditionally set the rules for access and utilization. In practice the rights of withdrawal of natural resources from communal land are variable. These are dependents on the type of *Shamilat*, type of resources and their economic value. *Shamilat* are further bifurcated into *graeeza* (mountainous) and *samma* (plain area) on the basis of location of the land.

Rules for right of use vary from place to place and for type of *shamilat* as well. Right of access and use is much relaxed for *shamilat-i-deh* while *shamilat-i-kandi/pati* has more restrictions. *Shamilat-i-deh* cannot be cultivated by rule (although in exceptional cases in certain villages the rule is relaxed through consensus) nor can any construction be made for any reason. *Shamilat-i-kandi/pati* can be cultivated by the share holders as well by the others (if allowed by the share holders). For share holders it is relaxed and they can cultivate land adjacent to their private land up to half of the communal land or equal area at a different location (However, because of low productivity rarely local farmer wants to cultivate it but the right is sometime given to very poor landless people or nomads who grow little bit of grain or fodder in the area for their use). Until the division of the communal land they can take out the production on behalf of *sarkar-i-malia*. This practice is locally called *naature.* For fixation of *sarkar-i- malia* consent and consensus of both the village community leaders and local revenue officer are needed. This tax is a nominal amount which is payable to the revenue department and afterward it is given to the community or tribal leader for utilization on the welfare of the people. Some time it is given in cash if amount is significant, otherwise meal is arranged in *hujra* (community guest room). There is growing argument among the community leaders in the area that whether there should be additional tax for non-share holders or they should be treated equally. One suggestion is that some amount of grains must be fixed (*Batai*) for them along with the *Sarkar-i- malia*. But majority of the leaders and individual are opposing the idea and are in the favor that they should be equally treated like the share holders. Their argument is that cultivation of these areas is very costly and production is very low, therefore this will be un-just to tax these cultivators who are normally the most poor of the community.

Construction on *shamilat-i-deh* is not allowed for anyone and in any form while in *shamilat-i-kandi/pati* the co-owners are allowed to construct rooms in the *shamilat* subject to the condition that these will be demolished if the owners decide to subdivide the *shamilat* among them.

Plain area *shamilat* or *saamma* are normally located along the torrents and stream banks. In case of sweet water the rules of right that is *sarseema* are well defined and implemented very strictly but in case of brackish water there is no concept of *sarseema*. According to the rule of *sarseema* all those who have land on the banks of torrent have the right of use until the middle of the torrent coinciding with the boundaries of their fields. They can also cultivate this land beside extraction of resources. These are normally cropped/ cultivated in dry years.

4.2.3 Utilization and Management of Common Land

Communal land is widely used for grazing animals, grass and fuel wood collection, collection of other non-timber products and construction material. Local tribal institutions which traditionally set the rules for access, utilization and management of *shamilat* (communal land) are based on common ethnic, religious and linguistic background (Buzdar, 1988). The manner in which *shamilat* are managed varies greatly. The survey during this study found that some villages were still practicing their traditional management system, while others were doing nothing or little to protect the *shamilat*. The most active villages were those whose *shamilat* were still productive or those who have noticed that degradation of communal land has negative implication for the entire community and environment. They still practice *nagha* (ban or closure) and fined those villagers and outsiders who extract wood or graze livestock during this period. In most areas the ban extended only to the cutting of trees. In line with tribal customs, decisions about *nagha*, fines and responsibilities for watch-and-ward and enforcement were made either by the village committee (council of elders) or in more widely attended village meetings.

Shamilat in many villages are degraded and have only limited resources. There could be various reasons for it. Most important cause is the mismanagement of *shamilat* due to non availability of labor as large number of young people has moved to take up more profitable employment inside the country or abroad. They have shown little interest in these resources

over the years. Those who were left behind (women, children and elder man) have not been able to look after the *shamilat* properly. Therefore the increased pressure (population growth and pressure from farmers of neighboring villages or nomadic livestock herders) have caused degradation. In some other cases, however, selective controls mechanisms were still being enforced. For example in Issak Khumari, Wednesday and Friday are closed days on which, nobody can extract any resource from *shamilat*. Besides, camels are also banned in the area so that the trees and woody shrubs can get chance for regeneration. In other areas the *shamilat* have been opened up for free use of all (including neighboring villages) but Afghan refugee families which collected fuel-wood were charged Rs 2,000-3,000 per year.

Degraded *shamilats* need to be rehabilitated for the economic benefits as well as to safeguard the environment. Investment from the community in term of money is almost non-existent in the area. Investment by the government and nongovernmental organizations is also being constrained by the absence of an effective local forum for collective decision-making. Local communities did not have a mechanism to develop consensus for the sharing of costs and benefits among different groups like the right holders, and between the right holders and other users. During focused group discussion in Mitha Khel it was felt that the large number of users and dwindling role of social organization made it difficult to arrive at an agreement in sustainable use of *shamilat*. For example in the implementation of *nagha* (when trees and grasses are planted) some alternative sites need to be identified for livestock grazing and to obtain other resources needed for daily use.

Link between the governmental/nongovernmental agencies working for the protection of environment and local people in the area is almost non-existent. Although some Government agencies and NGOs are working like Soil and Water Conservation, Barani Area Development Programme, Farm Forestry Organization and Dry-land Livelihood Programme for the improvement of both the environment and people. But it was felt that in reality whatever work is conducted by these agencies, it is carried out without participation or consultation with the local people. For example, the Forest Department is concerned mainly with developing vegetative cover, for which it favored to grow Eucalyptus spp. because it is seen as a fast growing tree with a high survival rate under various soil conditions. The people consider that the Department's approach does not address their needs. They argue that this tree cannot be used for fuel wood and fodder additionally it was realized that it has increased the fragility of the environment by enhancing the depth of water table.

4.3 CONCLUSION

Study of the collected information from household questionnaires and focus group discussion/ interviews revealed that to cope with the increasing demands of growing population, land use in the area has gone through significant transformation. Indigenous and traditional methods have been replaced by technological/ mechanical agricultural practices in order to get more food from fragile land. New crops like groundnuts and vegetables have brought new hopes to the farmers in the area as these are not only profitable, but are also helping in providing nutrition and healthy food to the local people. Groundnut is a cover crop which is one of the agronomical measures against desertification.

Size of land holding has close relationship with family size and economic status. Large landholdings are common in areas where joint family system prevails. However large size of land in rain-fed agricultural zones has negative impacts as high demand of inputs restricts the cultivation of entire landholding. Fallow land in these areas increases the vulnerability of land to erosion both by wind and water. Farmers in the area are mostly owner cultivators who invest all their money and energy on sustainable land management.

Economic status of the farmers has considerable impacts on agricultural productivity. Introduction of modern technology, availability and access to improved seed varieties, chemical fertilizers and increased awareness regarding new crops have contributed towards positive change in agriculture in the area, particularly Issak Khumari. In contrast in Shnawa Gudi Khel agriculture is on decline as productivity of the land has decreased due to both physical and social problems. Large household size, poverty and acute shortage of water have led towards negative change in agriculture.

Communal land in the area has also shown declining productivity, particularly in hilly communal land. Most of these hill slopes have been degraded due to over exploitation of rangeland products and climatic variability. Expansion of agriculture on the communal land is another significant cause of land degradation as these areas are most fragile lands and cannot support agriculture. Rehabilitation of these degraded communal lands will need close collaboration between different agencies and local farmers.

CHPATER – 5

DYNAMICS OF NATURAL VEGETATION AND ITS ROLE IN SLM

Beside its vital role as natural resource natural vegetation also acts as a protective cover against soil erosion, one of the important factors contributing to desertification in semiarid areas. Therefore detailed analysis of natural vegetation cover has been carried out in the present study. This chapter deals with the natural vegetation and its dynamics in term of time and space in the study area. First section of this chapter gives general description like type of vegetation, rate of its extraction for different purposes and its importance to local community. In second part of the chapter issues like changes in vegetation type and location, its impacts on ecology and community are discussed while third section is about threats and management mechanisms adopted for sustainable use of natural vegetation in the study area.

5.1 NATURAL VEGETATION TYPES AND THEIR USE

Since arable land in Karak is restricted by physical constraints (climate and topography), large areas are left uncultivated. These areas in time get sparsely covered with various types of natural vegetation. In addition, natural vegetation is commonly found on *shamilat* both in hilly areas and low lands. They cover the hill slopes, torrent beds and stream banks, along the roads and in abandon lands.

Natural vegetation of the area is typical of the semiarid type. As described earlier in chapter 3, the common species include Acacia Modesta (Phulai), Cappris Aphyeea (kirra), Dodonia Viscosa (Sanatha), Reptonia buxifolia (Gurgura) and Sacharum (Kahi Grass). However on moist sites at higher altitudes sporadic vegetation of Olea Cuspidate (Olive) is also found. In the plain areas Ziziphus Maritiama and Ziziphus jujuba(bair) grow abundantly, particularly in the Thal plain. Acacia Arabica (Kikar) and Tamarix (locally called *Gaz*) are also very common in the plains, along road side and also on the mountain slopes. Arid subtropical shrubs such as Dodonea viscosa and Menotheca buxifolia are common too. Both subtropical forest and the desert scrub forest type, typical of rocky and hilly areas are found in all the three ecological zones (Iffat 2005, 2007) (see annex table 8). Beside these drought resistant trees, hard and tough grasses, herbs, wild fruit and vegetables are also found in the area.

These not only provide basic essential for daily life like fuel wood, fodder, edibles but are also the source of additional income for many families.

Table 5.1: Karak District: Utilization of Natural Vegetation

Utilization	**Types of vegetation and their characteristics**
As edibles	These include vegetables like wild spinach, *choongah,* wild melon and cucumber. In fruits berries, dates, grapes, wild melon and *gurguray* are found throughout the study area, olives are also found on higher altitudes. These supplement nearly every meal when available fresh and are also dried for use in other seasons. Villagers also collect large amount of honey from these areas. Significant amount of cash is also generated through sale of honey and berries.
As medicinal Plants	A wide range of bark, fruits, roots, seeds and flowers from local trees and herbs are collected by women and are used as medicines, both for human being and livestock.
As detergents	One wild plant known as *tamman,* after processing is widely used as detergent for washing clothes, and hide and skin for making utensils.
As raw material of cottage industry	Draft plant (*Mizzary* & date palm) grown on hills and mountain slopes are collected and used for making many household items like mats, baskets and boxes of different types. Many households also earn cash by processing these items and selling in the local market.
As fuel-Wood	Branches and roots of trees, uprooted plants, thorny bushes and hard grasses not eaten by the cattle are often used as fuel. These grasses are used for cooking of the traditional bread or *chapatti* as it needs hot flame for short time. Animal dung is also collected from rangeland and used as fuel
As fodder	Apart from the grasses, there are a large number of trees and herb species, which help to meet fodder requirement in form of branches, leaves, fruits, and roots.
For construction	Wood and roofing grass are brought from rangeland for construction and repair of houses.
For recreation/	There are small ponds with trees around them in the hills and many

Game/ hunting Grounds	families on occasions of religious festival e.g. *Eids* visit these points, as there are no other recreation spots in the area. The area although is not very rich in term of fauna but birds of different sizes and types are found in different seasons. They include sparrow, eagle etc. These areas are also used as hunting ground for birds.
As grazing Grounds	Areas under natural vegetation also serve as the grazing ground for the livestock for most of the time of year. Livestock are taken to these areas early in the morning and are brought back at noontime. In winter the non milk providing cattle are normally send to the mountains unattended and women who visit the rangeland for cutting grass bring news about their welfare to the village.

5.2 RESOURCE EXTRACTION FROM NATURAL VEGETATION AND SLM

The local community uses natural vegetation of the area in variety of ways. It provides food, fodder, medicinal herbs, construction material, material for fences and handicrafts. Beside house sustenance cash income is also generated through selling of natural vegetation both in raw and processed form. Fodder is the major product, which is collected by almost every family and among them more than 90% collect it daily. It is collected both for self use as well for sale purpose. The foothills are used in early summer and in post Monsoon times when grasses are available in abundance in the area. In dry months of May, June and October, November it has to be collected from hilltops which normally are rich in grasses and trees.

Collection of wood is not a daily task for majority of the families; rather it is collected on weekly basis. They also use bushes and dry grasses collected from the wasteland for fuel along with dung cakes. The weight of the head load varies between10kg-15 kg. Those who are involved in commercial activities collect daily particularly in villages in the foothills like Issak Khumari. Very few families were involved in the seasonal collection of wood. These were the families who grow trees on their fields, normally acacia and *ziiziphus* and use them as fuel wood.

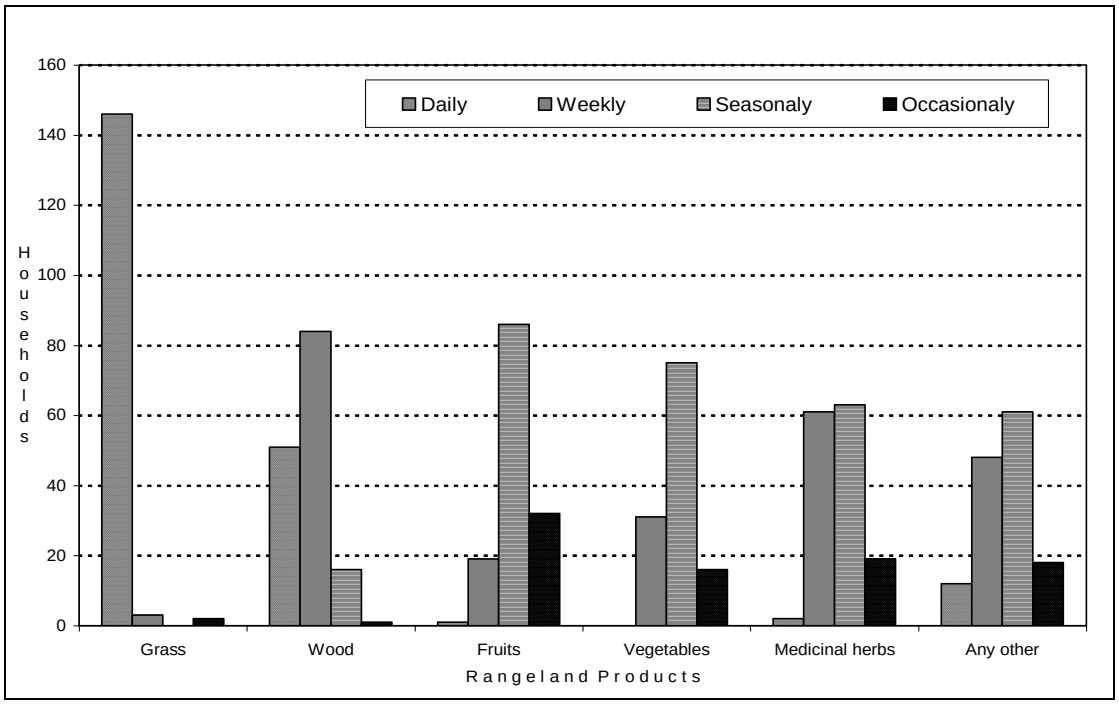
Wild fruits and vegetables are not very common in the area, only some fruits like berries,

gurgura and dates grow in the region. Olives grown in isolated patches are found in eastern hills and "*gurgura*" on both western and eastern hills. "*Keerrarha*" is another fruit, which grows in wasteland irrespective of slope. As all these are seasonal fruits, hence their collection is also season dependent. In vegetables too, limited types and quantities is found. The most common vegetables are spinach of different types and other wild vegetables like pumanki, *kurkundi*, and wild *melon*. Majority of household collect fruits and vegetables seasonally.

Plate 10:Local Fruit Tree Cappris Aphyeea (*Keerrarha,* very rarely found now)

Almost all households also collect medicinal herbs. Majority of collector were either weakly or seasonal collectors. The medicinal herbs grow in different seasons and are collected in their respective season. Their use is important both for human and animal.

Fig 5.1: Karak District: Collection of Non Timber Forest Products (NTFP)

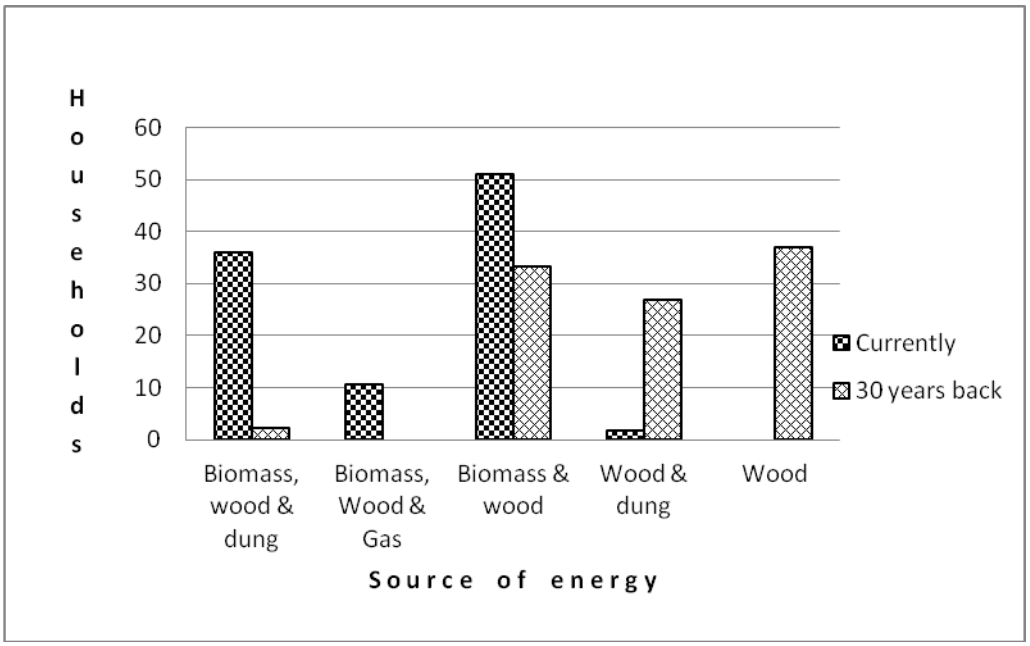


All other products like honey, draft palm, and grass used for broom making are either collected seasonally or according to the need and demand.

5.3 ENERGY EXTRACTION AND SLM

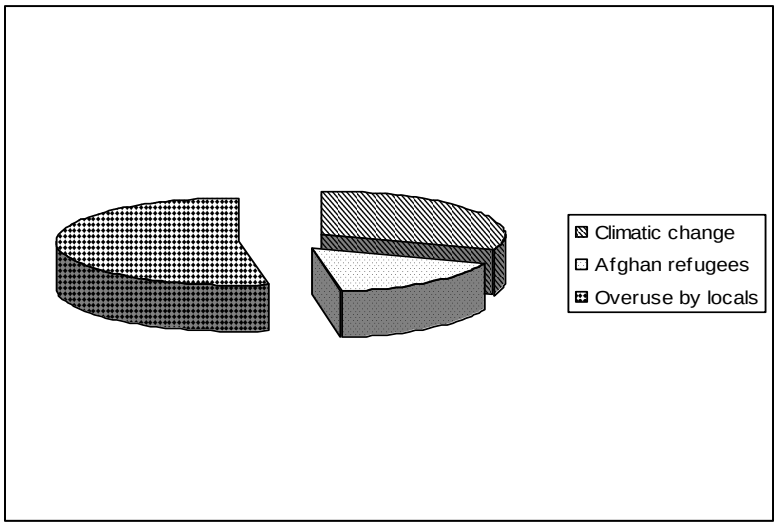
In Karak like other rural areas wood is the major source of energy both for cooking and heating. Due to rising demands and frequent droughts, natural vegetation of the area is under great pressure. The most noticeable change has occurred in the hills & mountain ecosystem. It has lost the tree cover and now predominantly occupied by bushes and grasses. Wood has become scarce and people are now searching for alternatives. In the past almost 70% of the respondents were predominantly dependent on wood. Others were using biomass and dung but wood was the major type of fuel consumed, in past, even in these households (Fig 5.2).

Fig 5.2: Karak District: Energy Source Used Currently and 30 Years Back



Rising demand and decreasing availability of wood has brought a change in the type of energy used in the study area. Biomass is the most common source of energy and is used by many households in combination with wood, dung and natural gas (table 5.2). No household reported that wood is the only type of energy used for cooking. For heating, wood is still the major type except in Issak Khumari where natural gas has been supplied to most of the houses. Reason for scarcity of wood in the region was asked and tabulated. About 40% of the respondents were of the view that wood production has not decreased. They argued that although wood availability from natural vegetation has declined, energy plantations are on the rise. However, 60% of the respondents considered that overall wood availability has decreased. Almost 40% of the respondents blamed the human being for this decrease of trees while some 18% considered change in climatic conditions, particularly variability of rainfall, as a major cause of degradation of vegetation in the area.

Fig 5.3: Karak District: Perception of People Regarding Major Causes of Vegetation Degradation



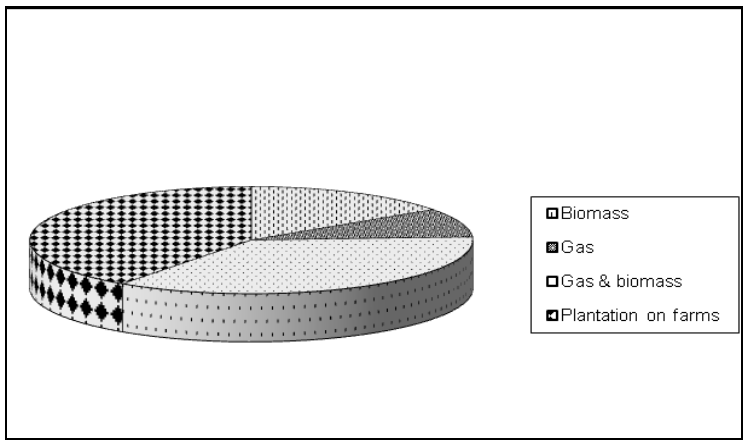
Previously fire wood was normally collected from *shamilat* both in the hills and lowland. Hills, in past, were thickly wooded but tree cutting was normally not allowed. Only dry twigs and branches were brought for daily use in summer months from hills. Trees in low land were lopped before the winters and were stalked. According to the locals these hills and piedmont areas were once very rich in many types of natural vegetation, including trees, bushes and grasses of different kinds. Almost all households were extracting firewood from these common lands. Only 5% of the respondents were previously collecting fire wood from their private farms in the past (table 5.2). Common lands have lost the natural vegetation cover particularly in hills. Now more than 85% of the households are bringing wood from their fields and farms and only 15% from common lands (table5.2). Some of the households also sell wood from their farms. These are the abandoned fields which have been planted with trees for fuel wood.

Table 5.2: Karak District: Source of Wood for Energy Use

Source of wood	Present		30 Years Back	
	Frequency	Percent	Frequency	Percent
Private Farms	397	85.4	26	5.6
Common land (Hills)	53	11.4	216	46.5
Common land (plains)	15	3.2	223	48.0
Total	465	100.0	465	100.0

The *shamilat* of the study area have been extensively overused for wood collection in the last few decades (table 5.2). To overcome the problem of wood shortage, people have adopted alternate mechanisms. Use of other types of fuel is one way but most of the people have planted trees on their farms, field boundaries and even in their backyards. These trees are lopped for fire wood as well for fodder. Increased plantation in the area has not only assured the supply of wood but also has many positive environmental impacts. In addition to fuel switching, energy conservation means such as adoption of new utensils is also on the increase

Fig 5.4: Karak District: Alternate Sources of Energy Used to Overcome Local Wood Shortages



5.4 CHANGES IN NATURAL VEGETATION & THREATS TO SLM

Although the vegetation in communal land presents a degraded cover as the hills and mountains have been cleared but planted greenery has slightly increased in village lowlands see map 8 and tables 5.3, 5.4.

More trees both fruit and others have been planted on farms, field boundaries, backyards and along the roads (fig 5.4). Major tree types that have decreased include *Gurgura, Olive, Date, Ghaz, Keera, Sheshum* and *Sreen*. These native trees are slow growing species and were used for a variety of purpose. These were once very commonly found in the entire study area. Beside these, some types of grasses were also common which are very rare now and are only found in previously inaccessible areas due to lack of transport. These are now used for new and lactating cows and goats only to produce better quality milk and milk products. *Mizzary* is a draft plant, which used to grow on higher altitudes and hill slopes where the higher amount of precipitation is received. For example, Teri area was very rich in *Mazzari* which

was extensively used as raw material for cottage industry by local people. It was also exported to other parts of the province both in raw form and as processed goods manufactured from it. Prevailing drought conditions in last decade and over extraction of this plant has resulted into declining availability and it is one of the rare species in the area now. Other tree types are also on the decline. Tamarix (*Ghaz)* for example was seen throughout the district but now it only occurs in parts of Banda Daud Shah.

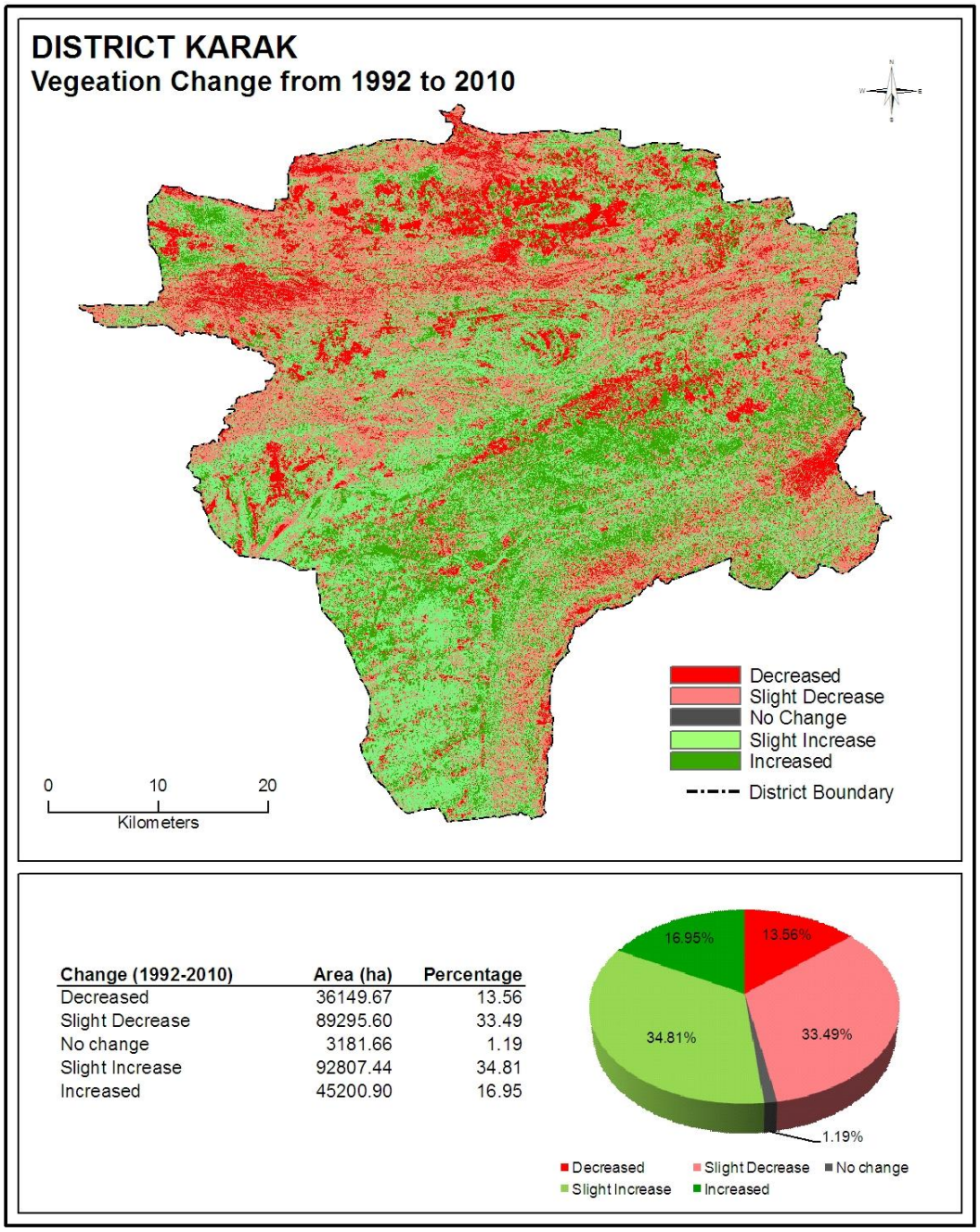
Plate 11:A Native Rare Tree Tamarix *(Ghaz)* along the Roads Near Banda Daud Shah Karak

Olive trees were very successfully grown on the hills of the entire three ecological regions but their growth has also decreased significantly. Sheeshum trees have also declined due to their use in furniture. As the regeneration of vegetation in the area is very slow due environmental constraints it is feared that these trees may disappear entirely from the district. The forest fires of the last few years on the eastern hills have also resulted in the decrease of vegetation cover as these are now reported more frequently compared to the past.

In lowlands, common trees in planted vegetation include Ziziphus jujube (b*air)*, *Kekar*, Mulberry, Eucalyptus, *Palosa*, Wild *Kekar* and Grasses like *Kahi.* Plantations in lowlands are on the increase because of efforts of Individual farmers, NGOs as well as the government organizations. For example in sandy areas of southern part, among government organizations, forest department and Soil and Water Conservation Organization have made plantation on private farms. These farmers are now getting the harvest from these trees. They are earning 3-5000 thousands rupees per month. Many other people have also started the same practice on their private farms. Barani Area Development and Dry land Livelihood programme have also worked in the area and have introduced some engineering and agronomical techniques for water harvesting and soil stabilization to combat desertification. In southern part of the district, where moving sand dune was a common problem, *Kahi* grass has been planted for sand dune stabilization. Similarly in Banda Daud Shah *tehsil* Eucalyptus plantation has been carried out on extensive scale (plate 9) particularly on the banks of torrents to control lateral erosion. Some of the trees, beside land protection have other benefits like they provide fire wood, fodder, wood for fences and fruits. Honey in the area has also increased due to increased Ziziphus jujube (*bair)* plantation. Bee keeping has become a flourishing economic activity in the area particularly in dry farming and rangeland zone.

Plate 12:Eucalyptus Plantation by Soil and Water Conservation Organization Along Torent Banks as Agronomical Measure Against Water Erosion

Map 8: District Karak: Changes in Natural Vegetation between 1992 and 2010



Change (1992-2010)	Area (ha)	Percentage
Decreased	36149.67	13.56
Slight Decrease	89295.60	33.49
No change	3181.66	1.19
Slight Increase	92807.44	34.81
Increased	45200.90	16.95

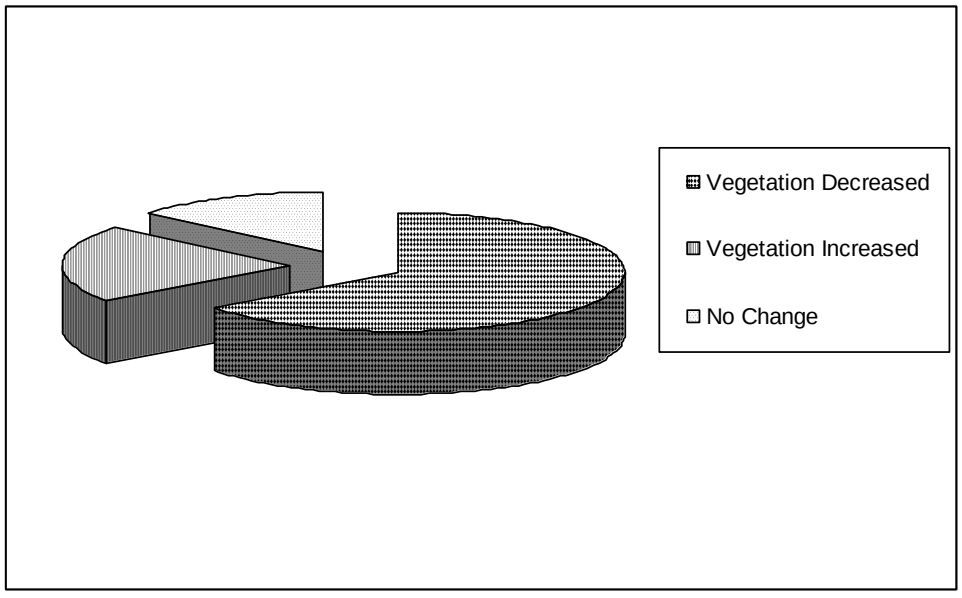
Source: image 1992 and 2010

Some respondents however were worried about the rapid growth of invasive trees in the areas. They noticed that these planted invasive alien species (IAS) besides beneficial also have negative impacts on local environment both agriculture and rangeland (cf. Zahidullah and Ahmad, 2011). Eucalyptus recently introduced exotic species was quoted as one example which has very extensive root network that sucks water from all around and do not allow other tree species or grass to grow beneath them. This has resulted into shortage of fodder for

animals, thus creating a problem for local farmers who depend on rangeland. This tree is neither browsed by livestock nor can be used for any other purpose in rural life. According to them the wood is of very low quality and can't be stored or stalked. In short this tree has minimum benefits for farmers although it is spreading at a very fast rate because its plantation by government organizations. Another type of increasing vegetation reported by most of the people is wild Acacia. This is actually a bush growing on waste land and along the roads in the entire district. It is also spreading at a very fast rate although not considered beneficial due to thick thorns because of which the livestock do not browse on it. It is mostly used for fencing the fields. In areas where it grows along the roads or near villages it also damages vehicles (punctures their tires).

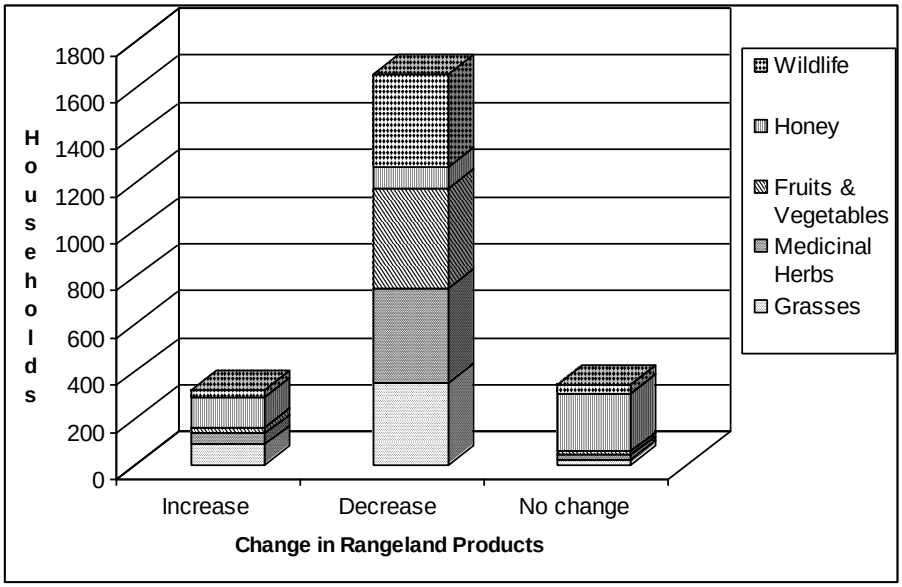
Over use and extraction of their products like grass, Non Timber Forest Products (NTFPs) and medicinal herbs and their slow regeneration rate has resulted in degradation of rangelands. However production of honey in the area has significantly increased which has opened new avenue for local people. There is an increasing demand for honey of the area from other parts of the country due to its superior quality. On limited scale it is also exported to some Middle Eastern countries. Bair (local berries) one of the common fruit of the area has also significantly increased and now sold in local markets and sent to surrounding towns like Kohat and Bannu for sale hence providing opportunity of cash earning to its collectors.

Fig 5.5: Karak District: People's Perception about Change in Natural Vegetation



People were seriously concerned about de-vegetation of hills which have lost most of trees (see maps 7 and 8) as in their opinion dynamics of vegetation has direct relationship with rains. In years of good rains there is plenty of vegetation (mainly shrubs) even in Thal zone but growth of hard wood trees need very long time in such an environment.

Fig 5.6: Karak District: Change in the Productivity of the Rangeland



(Note: I. increase, D. decrease, S. stayed same)

Generally the productivity of the rangeland whether grass or other products including fruits and vegetables is on decline in the study area (Fig 5.5) as indicated by most respondent households in table 5. 4. In Issak Khumari highest decrease is noticed in the production of fruit and vegetables followed by medicinal herbs. While in Shnawa Gudi Khel decrease has been noticed in all rangeland products.

Region wise most of the respondents in Shnawa Gudi Khel and Issak Khumari blamed the misuse as the main factor for this while majority in Mitha Khel blamed climate for the same. Less than 10% were of the view that productivity has not declined while slightly more than 10% claimed that the productivity has increased particularly that of grasses and medicinal herbs in Mitha Khel (55% and 35%). This could be due to decline in the herd size of livestock and reduction in number of large animals such as bulls and cows. Availability of employment in alternate activities, particularly due to outmigration and associated economic uplift was also considered as an important reason for reduced dependence and less extraction of resources from rangeland by these respondents.

Among wildlife, pigs once unknown in the region are now found in large number especially in Issak Khumari. Various arguments were given by local people for their increased number. Amongst these reasons, disturbance in their habitat in nearby areas (war and Army Operation in Waziristan and war in Afghanistan) was reported by majority of the households. Another reason given was the increasing cultivation of groundnuts which is a crop preferred as food by pigs. Some people associated it with the foreigners (Chinese and Japanese) working in the surrounding areas in developmental projects (Kohat Tunnel and Gas and Oil Company). Pigs have created many problems like attacking humans and livestock and spoiling standing crops in the area. Local people have formulated vigilance groups to guard against these animals.

Table 5.3: Karak District: Change in Rangeland Productivity (Respondents Perception in %)

	Grass			**Medicinal Herbs**			**Fruits & vegetables**			**Wild life**		
	I	**D**	**S**	**I**	**D**	**S**	**I**	**D**	**S**	**I**	**D**	**S**
Issak Khumari	17.9	78.9	3.2	.0	98.9	1.1	.0	100.0	.0	28.4	70.5	1.1
Mitha Khel	55.7	40.0	4.3	35.7	56.5	7.8	6.1	88.7	5.2	4.3	80.0	15.7
Shnawa Gudi Khel	3.5	90.2	6.3	1.6	94.5	3.9	7.8	89.0	3.1	.4	91.8	7.8
Karak	19.4	75.5	5.2	9.7	86.0	4.3	5.8	91.2	3.0	7.1	84.5	8.4

(**I: increase, D: decrease, S: stayed same)**

5.5 MANAGEMENT OF NATURAL VEGETATION FOR SLM

Rules and regulations have also been devised by local people for the sustainable use of the natural resources and natural ecosystem. These are implemented by village institutions comprising respectable, influential and key persons. The degree of strictness varies from village to village and from resource to resource. The maximum obligations are on tree cutting while the minimum on grass cutting. There is no restriction on the collection of edible and other products. In some areas they are followed more strictly then the other but these are practiced and followed in almost all villages. The local people are well aware of the rules and in general follow them. The non-followers are charged heavily both in term of money, up to Rs. 4000, and are also punished through social boycott.

Before 1960, the social institutions were very effective and there were regular "*nagha*" system practiced for the sustainability of the rangeland. The restrictions on the visits and reopening of the rangeland were announced well before the implementation. The restrictions

normally started before the spring season for two weeks and after the heavy rainfall in July and August for two months. With changes in the social life these rules also became less effective and people for the last four decades have been using these resources throughout the year. During recent drought the reliance on the natural resources increased as there was no production from agriculture during this period. In areas with more woody vegetation, the extraction and selling of wood to the other areas also increased. Droughts and over extraction of wood/grass and overgrazing in the rangeland resulted in loss of vegetation cover which had no chance to regenerate.

Since last few years the local people have realized that the erosion of social institutions has devastating effects on the natural environment. New rules are therefore being formulated to safeguard the vegetation to give it the chance for regeneration (see section 4.2.3).

All the residents of the village are allowed to use the natural resources of their respective villages, within the prevailing rules and norms. There are definite boundaries between villages for resource extraction; normally watershed is taken as a boundary. Afghan refugees are also banned and are required to get permission for use of village resources. In this case they are charged in cash 3000 to 5000 rupees per year. There have been many quarrels with Wazirs, the tribal men on the same issue.

There is a ban now on taking axe and draft animals in most of the villages of the district. Camels are banned everywhere but in some villages people are allowed to take donkeys. Cutting of trees are prohibited everywhere but in certain areas there is little relaxation like it is allowed to cut branches but to cut roots and stems are strictly banned.

In order to effectively implement the rules, the community, in some areas, has now recruited paid guards for taking care of the common natural resources especially the trees. They usually are on duty till evening. One of the problems reported by the locals was that those who live near to the hills do not follow the rules and cut the trees after the watchmen leave.

5.6 CONCLUSION

Natural vegetation in the study area appears to be on the decline. Thickly vegetated hills have been cleared during last few decades mainly due to over use and climatic variability. Norms and rules for the utilization and management of natural vegetation in the study area, in past, were very strong. However, change in social life with time has restricted their effective implemention and many such rules are no longer strictly implimented.

Due to resulting devegetation many native species are facing threats particularly those grown on higher altitudes and a decline in biodiversity. It has shown serious consequences like increasing flash floods in north eastern parts and dust storms in southern plains leading to water and wind erosion; factors of desertification. Deteriorated vegetation cover has also adversely affected livestock sector, one of the major activities of the area.

Vegetation on lowland has increased as people have made extensive plantation on their abandon fields and farm to assure the supply of fire wood. However, some of the species planted are invasive like eucalyptus, wild acacia and mulberry. To some extent this has decreased the scarcity and distances to be covered for fuel wood, and is also likely to stabilize the soil in low land. But it has also contributed to the loss of biodiversity and erosion of native species.

For the rehabilitation of vegetation on hills and communal lands, in some parts of the district, previously eroded social norms and rules have been revived and implemented. However, to compliment these local level efforts, close and supportive interlink is essential between line agencies and local people for the sake of environment and well being of inhabitants. Massive programmes like plantation on hills/ areal reseeding, provision of alternate energy means (natural gas in the district should be provided on subsidized rates) and other incentives are indispensible.

CHAPTER – 6

LIVESTOCK DYNAMICS AND SLM

Livestock keeping is one of the most important components of agriculture in the study area. It is closely linked with SLM as over grazing is considered a major anthropogenic factor in rangeland degradation and desertification in the district. Therefore this sector has been evaluated in the light of SLM in this chapter. The chapter has been divided into three sections. After brief discussion about significance of livestock herding and its role in economy, the next part is about the analysis of livestock management like, herd size, herd composition, feeding methods and herding mechanisms and their impact on SLM. The last section discusses the changes that have taken place during the last three decades in livestock herding and their impacts on SLM. The final section concludes the findings of the chapter.

6.1 SIGNIFICANCE OF LIVESTOCK IN DRY AREAS

Animal husbandry has always been an important component of the agricultural system in the area like other dry mountainous parts of Pakistan. It is an essential strategy of economic diversification as farming had never been a full year activity. In such circumstances different spheres of the farm economy and their integrated crop-animal husbandry, normally referred as 'mixed' (Rhoades and Thompson, 1975), 'mixed crop-livestock farming system' (Tulachan, 2000) or 'combined mountain agriculture' (Stober and Herbers 2000) have close interrelationships and interdependence. Traditionally, it has remained important for providing the long-term investment in harsh environment (Fazlur-Rahman, 2007) when other economic options and modes of investment are scanty or lacking.

Beside economic importance livestock is also considered as the symbol of status, item of exchange between tribes and clans on occasions of conflicts and an asset for emergency. There are many social factors attributed to this sector like live goats and sheep are presented to honor the *Jirga* (locally called *nanawatay*) and to any public figure visiting the area. It is also gifted to daughters at their wedding and at the birth of their first baby. Many religious occasions like *sadaqa, aqeeqa* and *qurbani* (involving sacrifice of animal) also increase the significance of keeping livestock. In past it also provided hair and hides for handicrafts and was the only mean of draft power and source of manure.

Animal husbandry has historically been the most important part of traditional subsistence economy in Karak. Almost all the households in the area keep livestock for sustenance. The size and type of the herd varies from house to house and depend upon the needs and affordability of the family. Animal husbandry is closely integrated into the economic system of combined agriculture like other marginal areas of the country (Fazlur-Rahman, 2007). Provision of dairy products for food, raw material for handicrafts and traditional utilities, dung for fuel and manure for fields are some of the basic benefits derived from livestock. In many houses cash income is also earned through selling different livestock products (milk and butter) and live animals. During the period of hot weather and scanty rain when water supply is deficient, donkeys are extensively used for transporting water from far flung areas for drinking as well as for other uses. Besides, livestock is also considered as a safe mode of investment for the emergency situations and an item readily exchangeable into cash money when needed.

Dairy products like meat, milk and milk derived products serve as an essential component of daily diet of the inhabitants in the district. Although most of these products are now easily available in the local market but due to reduced affordability, the people tend to keep their own livestock and poultry for the purpose. In this way they not only intend to minimize daily expenditures but also ensure in-time and better quality products to meet their needs.

The major constraint to livestock herding are the limited availability of fodder and feed as the productivity of the rangeland has decreased significantly (Iffat, 2005) during last few decades. Fodder cultivation is limited due to competition with cereal crops, so use of rangeland as grazing ground is indispensable. In recent droughts particularly that of 1998-2002, which affected almost the whole country, Karak district was the most severely affected areas of Khyber Pukhtoonkhwa, where people were forced to sell their animal at very low price due to their deteriorated health conditions (Annex 8, map 9). Labor availability and lack of veterinary and training facilities appeared to be most serious constraints during that period.

6.2 HERD SIZE AND ITS IMPACT ON SLM

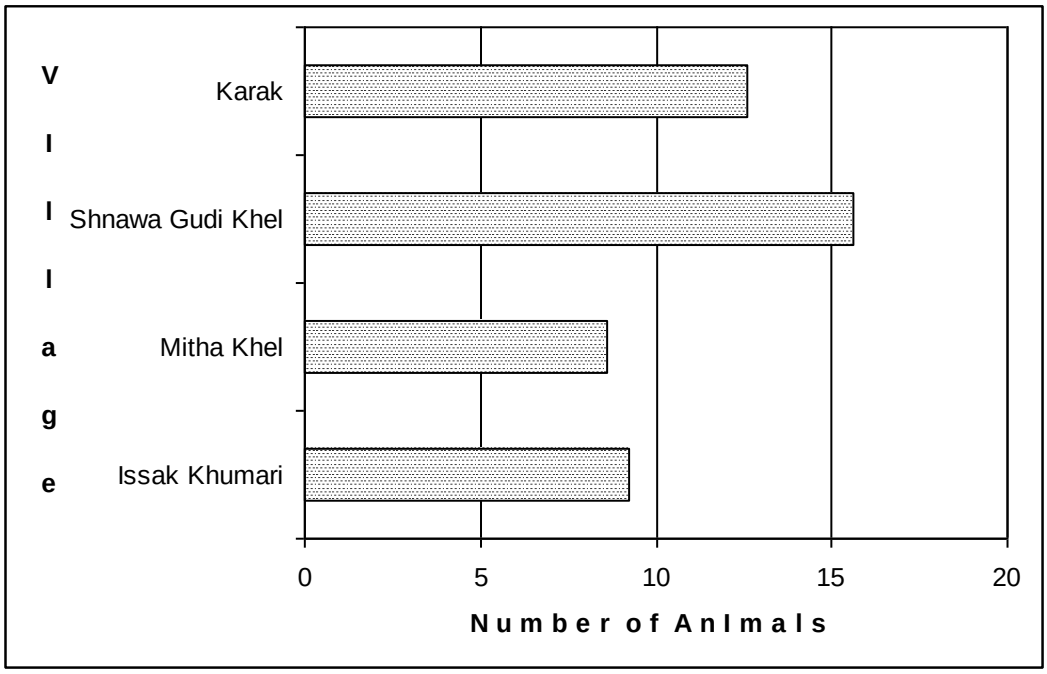
The size of herd depends upon many factors including the affordability of the farmers, man power and availability of fodder/grasses. Number of animals varies from house to house as well as from time to time. In years of good rains it is more likely that the herd size increases while in dry years normally some of the animals are sold to minimize the pressure on land. Seasons also have an important impact on herd size as during summer when grass is abundant; farmers tend to increase the herd but as winters are drier and fodder availability reduces both in low lands and hills farmers are forced to reduce the number of animal. Nomads from Baluchistan locally called *lawonrree*, arrive in winter in the district along with their animals in late October or early November and stay till February. Previously they were made to pay some sort of tax normally in form of lambs and goats but since last decade or so this practice has been abandoned. They exert additional pressure on already scarce resources of the rangeland.

Table 6.1: Karak District: Region-wise Average Herd Size and Composition

Village	Cow	Bulls	Donkeys	Camels	Goats	Sheep	Total
Issak Khumari	1.25	.35	1.35	.19	4.33	1.78	**9.21**
Mitha Khel	1.57	.53	1.28	.06	3.47	1.71	**8.61**
Shnawa Gudi Khel	1.82	1.15	1.89	.84	6.58	3.38	**15.61**
Karak	1.64	.83	1.63	.52	5.35	2.64	**12.57**

According to the survey conducted in this study, the average number of animals per household in the district is 12.57 and most of the households have 10 animals - 1or 2 cows, a bull, a donkey, 5-6 goats and 2-3 sheep. The total number of livestock in the sample households (n= 465) was 6000 heads. Considering the ecological conditions of the area, this appears to be a high figure. Distribution of herd size by the geo-ecological setting and economic condition of the areas is given in table 6.2.

Fig 6.1: Karak District: Average Herd Size



Average number of animals in Shnawa Gudi Khel is highest, almost double than the other two ecological regions. Larger herd size in the region is due to the prevalence of joint family system (availability of man power), and traditional nature of the society. Since markets and shops are few and people's accessibility is limited therefore, they prefer to keep livestock despite of low rangeland productivity. In addition, lack of other income generating sources also enhances their dependence on livestock. Often the small herd size has direct relation with higher involvement of people in secondary and tertiary activities as was noticed in village Mitha Khel. Herd size is also dependent on availability of winter stock which is mainly derived from crop residuals and hay. In Shnawa Gudi Khel millet and Barley are main *Rabi* crops which are predominantly used for animal feed. While in other two regions they are minor crops and groundnut is the main crop which produces very little residual to be used as animal feed.

As animal husbandry is one of the main sources of living, and there is no restriction on the number of animals, the people always had the tendency to increase the herd size. This trend has many important consequences both on the animals (health, productivity) and on the status of the rangeland resources. The continuation of this process of enhancing herd size without any control is deteriorating the land as excessive removal of vegetation cover (grasses) is accelerating runoff and increasing soil erosion.

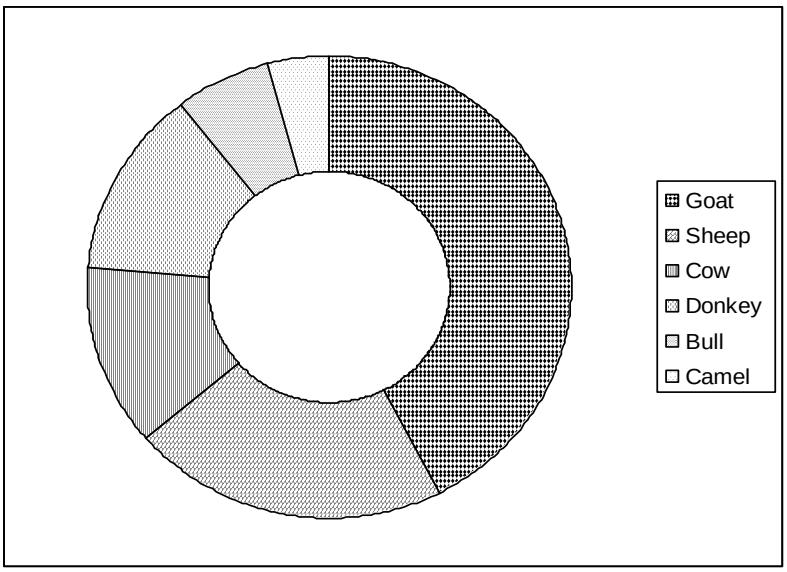
6.3 HERD COMPOSITION IN THE CONTEXT OF SLM

The common livestock types in the district include cattle, goat, sheep, donkeys and camels. Those types of livestock are preferred from which farmers can get maximum benefit without investing too much. The more common animal types were goat, sheep and cow. Donkeys were also common throughout the district. The heard composition clearly indicate two things, first that milk animals are more dominant as compared to the draught animals. Further, there is a greater share of small ruminant like goat and sheep in the herd composition. Because of the environmental conditions, buffaloes were not found in significant number in the area. There were very few households where buffalos were reported. Camels were also present in almost half of the sampled households (table 6.1).

There are several factors that affect the composition or type of animals that a household has in its herd. Among these, affordability of the family and availability of feed and appropriate manpower are most important. For example buffalo is an expensive animal. Although its productivity is higher but also carries elevated risk. Moreover it needs to be fed by stall feeding throughout the year though availability of fodder in the region is uncertain and totally dependent on rain. In years of good rains abundant grasses grow and good amount of crop residual is available but in dry years there is hardly anything to be provided as fodder. Besides fodder, even the availability of required water for buffalo is an important limitation in hot summer season. In contrast cows are more popular due to their low fodder and water requirements and better adaptability to the environment. Another important factor determining the animal type is the time and amount of labor required for tending the animal. Goats and sheep, for instance, need minimum stall feeding as these are grazed in rangelands and in fallow lands all the year around. In winter when there are limited grasses in grazing grounds leaves and branches of trees compensate for the green fodder. Every household in the study area had at least two or more goats and sheep. Goats get priority due to their higher resilience to diseases, their diverse feed, rapid multiplication (as they produce large number of off springs), higher fetching price in market and availability of better breed. NGOs have played a significant role in popularizing high grade breed animals in the district. Female involvement in animal husbandry is also an important factor in the selection of type of animals in the herd. As mentioned earlier, women are the key managers of livestock therefore they play important role in the animal selection. Normally women prefer goat because they

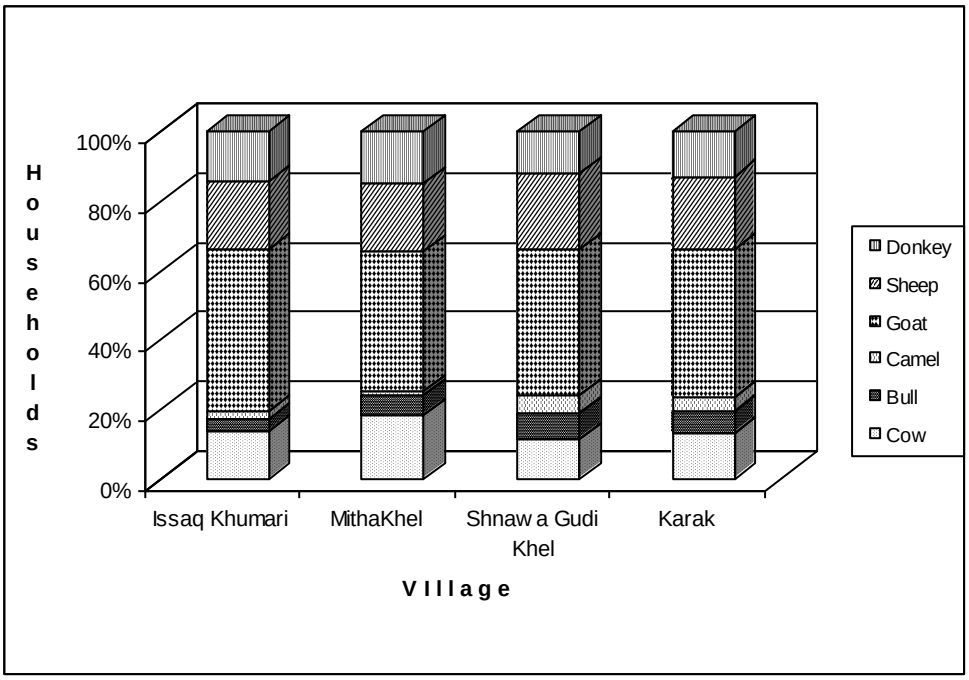
can own and sell these themselves. In other words goat is their mode of investment which gets higher return and can be sold readily to obtain money in emergency or when needed. Meat and milk of goat is also considered superior to other animals. Therefore, goats are in preponderance and their share in overall animals is almost 40%. It is followed by sheep accounting for around 20% animals. In draught animals donkeys have the highest share and camels are least in number because they need more feed and are banned in many of the areas due to their destructive nature for trees. Donkeys are higher in number due to their lesser dependency on fodder and need for water transportation, which is one of the persistent problems in the area.

Fig 6.2: Karak District: Present Day Composition of Herd



Ecological region wise distribution of different animal types is given in fig 6.3 Sheep, goats and donkeys have almost same share in different ecological regions of the district because of their adoptive nature and diverse feed demands. In contrast camels are distributed very un-evenly in the district with highest percentage in Shnawa Gudi Khel as they are well-suited to the sandy plain areas. Mitha Khel has the minimum number of camels. In Issak Khumari once this animal was very popular but has tremendously decreased due to strict ban imposed over camels since 1994. Number of bulls is also higher in Shnawa Gudi Khel as this region is economically very poor and bulls are still used in agriculture as farmers have low affordability to practice mechanized agriculture. Number of cows is slightly more in Mitha Khel compared to other regions.

Fig 6.3: Karak District: Region Wise Composition of Herd



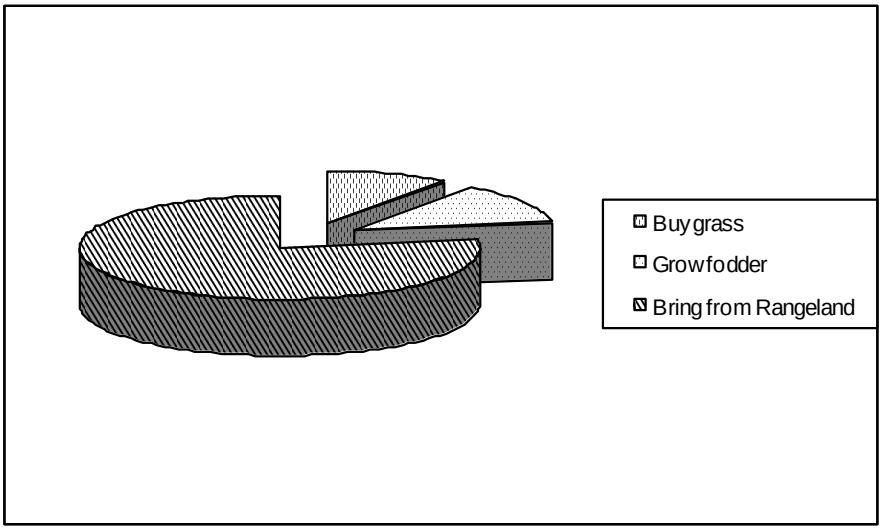
6.4 FEEDING METHODS

Livestock in the area are kept inside the houses but away from the human living area. Both stall-feeding and daily grazing were found as the common practices in the study area. Feeding method varies according to type of animal, season, number of livestock and size and type of landholding of the family. Young calves, lactating cows and goats and sheep are normally kept in house and stall fed. Stall feed consists of hay, dry grasses, branches of small trees and bushes and crop residuals. Transportation of hay and crop residues involves physical work by both man and women while all other activities were performed entirely by the women. In summer the normal feed consists of hay and green grasses, only new mother cows get "*egrah*" the mixture of grains cooked in sugar syrup with oil. In winter they are additionally provided with "*gothawa",* grasses with grains and hay and "*khal*" the feed prepared from oil seeds. Grass is mixed with hay/straw for the larger animals to fulfill their needs while goats and sheep are normally fed by grass and tree leaves only (Iffat, 2005).

Most of the households (75%) collect grass from rangelands mainly hilly areas. In families with higher income (10%) grass is bought from the grass cutters, majority of whom are the poor local women (Iffat, 2005) while those having lower income bring grass by themselves. Fodder is grown by some households (15%) on marginal lands not suitable for cereal crops.

When natural vegetation is limited in amount, fodder is grown where possible on farm or brought from the nearby towns (Bannu and Mianwali District) to feed the animals. In winter months when green fodder is not readily available and has higher price crop residuals and hay is used more often as feed for animals.

Fig 6.4: Karak District: Common Livestock Feeding Methods

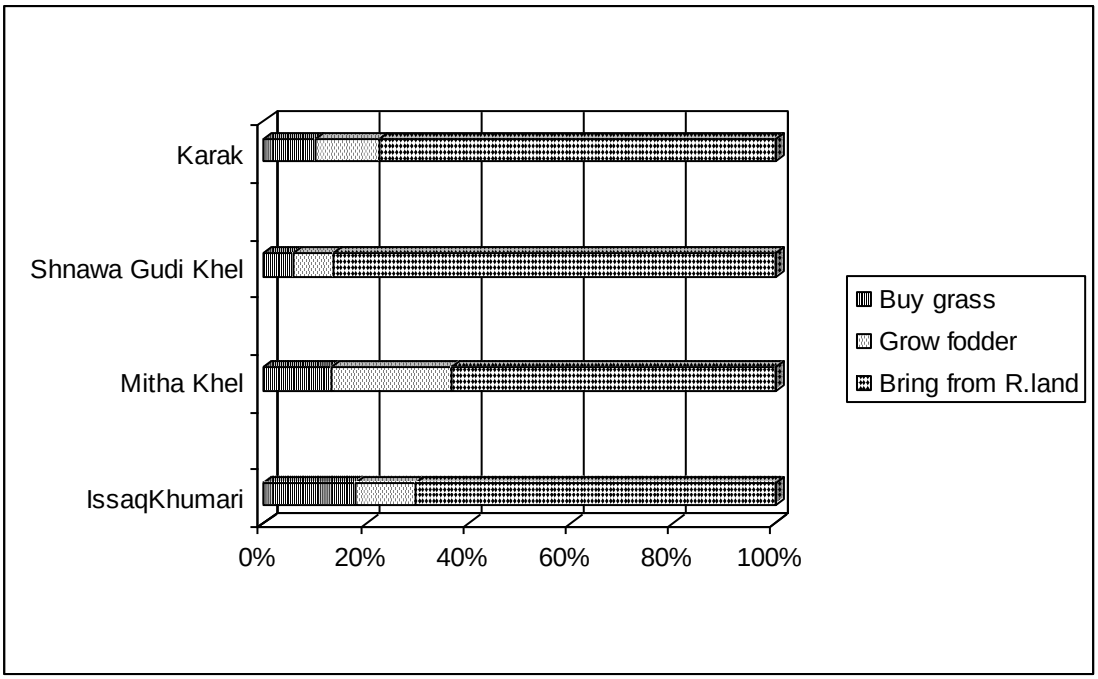


There is some variation in livestock feeding pattern by ecological regions. In Shnawa Gudi Khel, rain fed region, more than 80% of the households depend on grasses from rangeland while another 10% grow fodder on marginal lands. This situation shows increased pressure on already degraded land or land with lower productivity. In Mitha Khel, biggest number of households grows fodder. This region has the highest share of irrigated land (fig 4.3) where some of the land is always allocated for fodder cultivation.
This has resulted in increased grasses in rangeland (table 5.3).

In Issak Khumari, located in the third ecological region, about one fifth of the household buy the fodder, indicating the better economic status of the area. However, around 70% of the households here obtain feed of their livestock from rangeland and only 10% grow fodder. This is due to limited arable land in the area. The scanty shrubs and grasses growing naturally on hillside in the area are mostly open for animal grazing, collection of fuel wood by the villagers. Most animals particularly small goat-flocks are left for grazing openly and un-guarded as free grazing is widely accepted in the area. However, this free grazing is a major threat to the natural vegetation of the area. Due to reduced amount of grasses in the hills

livestock is now grazed in private fallow lands which are also usually open for grazing, but grass cutting, fuel wood and fodder collection is prohibited.

Fig 6.5: Karak District: Region-wise Source of Feed for Stall Feeding



6.5 HERDING METHODS

Taking livestock to the rangeland for grazing is a regular practice (plate 10 grazing in rangeland). They are taken to the rangeland early in the morning and brought back in after noon (Iffat, 2005). There are several systems in the area like free grazing, private herdsman (employed) turn based grazing and self grazing. Amongst these two systems of herding are more common. Private herdsman locally known as *shporhan* graze the animals on cash. Every herdsman normally takes care of 60-100 goats and 25-40 cows, earning Rs. 5000 to 7000 per month. Fee per head vary from place to place depending upon the type of animal and distance of rangeland.

Plate 13:Grazzing in rangeland. Predominance of small ruminants (Goat) in herd composition

Another common method is turn based grazing through co-operative grazing organization. This system is widely practiced throughout the mountainous areas of Pakistan and has different local names (Fazlur-Rahman, 2007). In Hindukush area this system is only used for grazing goats while in Karak there is no restriction on the type of animal/livestock. This system has been adopted by the farmers to reduce pressure on household labor resources. The grazer, while grazing animals for the day also cut grass and wood and bring it with them. Cooperating group of households for grazing often reside in same neighborhood or are relatives and family friends from other neighborhoods. Livestock from all households collectively known as *raama* is gathered in an open space in front of that household from where it is taken to range land. Normally two adults and a child from household take care of the *raama.* On return of the livestock in afternoon a person from each household comes to take back their own animals. Turn of the particular grazing households is decided in advance. In some families with large household size and many livestock heads one of the family member takes the herd by himself. These are either women or the elderly man or may be both if the size of herd is large.

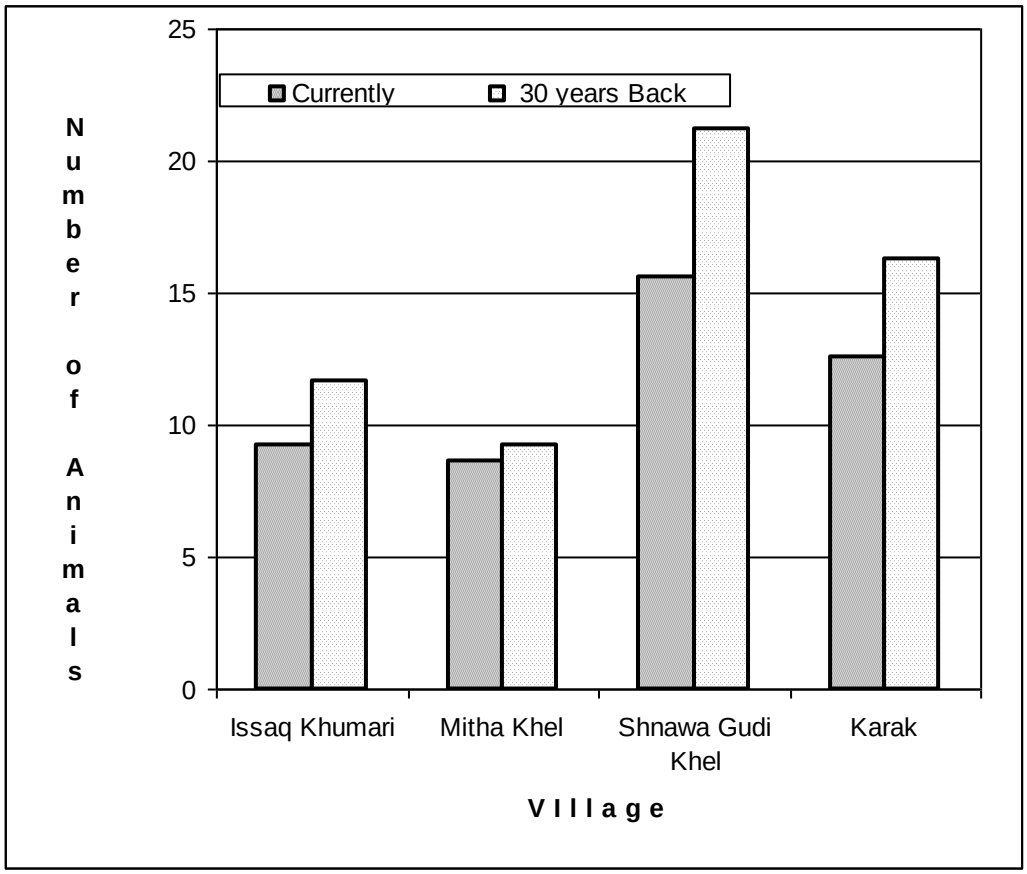
Livestock grazing fluctuates according to agricultural activities and season. It is a regular activity during cropping season when the fields are cropped and fenced for protection from

livestock. At this time farmers are very much concerned about crops and many times conflicts arise if livestock enter into any field. Elderly man and women spend a lot of time to guard their fields particularly when the livestock is being taken to or brought back from grazing fields. This activity decreases after harvest times when fields are open and animals are left to graze on crop residuals. They are encouraged for the purpose because their droppings provide manure to the fields. Rangelands at this time are almost closed for animal grazing.

6.6 CHANGES IN HERD SIZE AND LIVESTOCK TYPES

Total number of livestock has increased (chapter 3.3.3) during last 30 years but livestock per house hold has decreased in the district. Although its significance and contribution cannot be over looked in economic terms but today its proportionate contribution in the economy has declined due to opening of new opportunities in nonfarm employment outside the district. Moreover, due to economic uplift and socio- cultural transformation of the indigenous society including growing use of motorized transport dependence on beasts of burden or draft animals has declined. Further, traditional handicrafts which were produced by hair and hide processing have also reduced drastically. They can no longer compete with machine made imported items. As a result dependency of local people particularly women folk on livestock products have declined. Traditionally women were the prime managers and care takers of the livestock and children both male and female helped as their assistants. Due to increased participation of children in education, however, women’s work has enhanced and therefore they do not like to have larger animals in their herds.

Fig 6.6: Karak District: Average Herd Size in Sampled Villages (1970 & 2010)

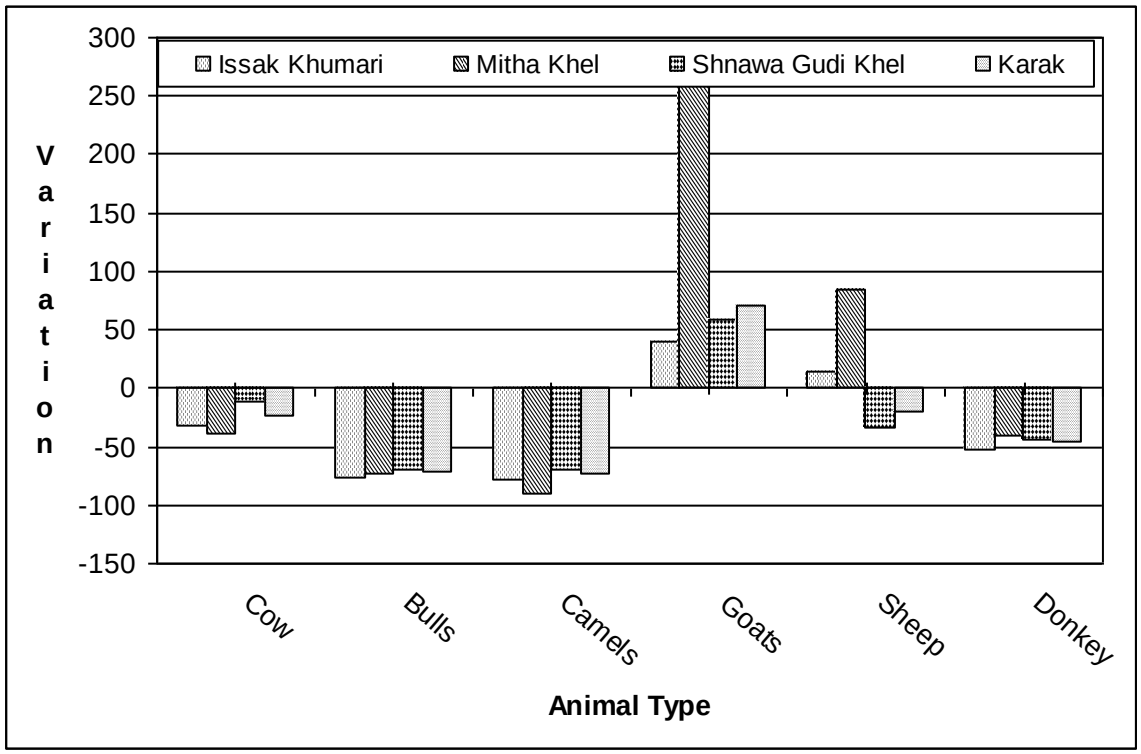


Among draft animals bulls, camels and donkeys have decreased in the area. Milk animals show transformation from large ruminant to small ruminants. Among small ruminants goats show highest increase in all regions but more significant in Mitha Khel where decrease in number of cows is also maximum.

The transformation of milk animals from large to small ruminant has close relationship with dietary habits and requirements of the species. Goats constitute browsers, which primarily consume forbs and leaves and tender twigs of woody species and consume the young growth of many woody plants that are less appetizing to other kind of livestock (Plate 11). They avoid dry, mature grass and prefer to consume green grass during growing seasons (Vallentine, 2001). They also have the ability to survive upon forage of lower quality and can consume hard and needle leaves of tall trees by bending them to reach the leaves on higher branches (Child, et.al 1985). Goats are least affected by the droughts because during dry spells in the area they survive on woody plants (having deep roots) and even that vegetation, which is resistant to drought. As a result, goats are considered as the livestock that is a major cause of desertification (Saizen.et.al, 2010).

Plate 14:Goat Browsing on New Leaves of Plants

Fig 6.7: Karak District: Region-wise Variation in Different Livestock Types



Number of sheep has also increased significantly in Mitha Khel where grass is abundant. Their number has also increased slightly in Issak. However, their overall number in the district as well as in Shnawa village located in rain-fed ecological region has decreased. Sheep are highly selective foragers and consume large amounts of forbs and grasses. Their diets therefore, consist of a large proportion of grasses compared to that of goats (Gordon & Illius, 1992). Sheep are more vulnerable to diseases particularly high temperature, and therefore people prefer goats compared to sheep.

6.7 CONCLUSION

Animal husbandry has always been an important strategy for economic diversity in Karak. The proportionate contribution of livestock in overall economy in Karak has declined. Nevertheless, it still carries lot of significance in agriculture and socio economic life of the people. Along with the growth of human population overall number of livestock has increased but average number of animals per household has declined during last three decades. Beside herd size change in the composition of herd has been noticed. Draft animals have decreased tremendously in all parts of the district. This change is associated with arrival of other means of transportation and mechanized agriculture in the area. Milk animals have increased with goats surpassing in number all other kind of livestock. This is due to their better adoptability to physical environment, need of less investment, high growth rate and diverse feed habits. Currently the trend of private herders has increased in most villages replacing the cooperative herding, common practice of past.

Increase in total number of livestock in the area indicates increasing pressure on already scarce resources of the range land. Dominance of goats in herd composition has negative repercussion as being browsers they are mostly grazed in rangeland or in fallow lands. They damage new leaves and plant roots, drought resistant trees and nibble the thin grasses for their survival, therefore considered as a threat for natural vegetation as well a factor of desertification. Earlier most animals (except milk cows, goats and sheep), as large ruminant was dominant, were sent to rangeland during winter crops. The dropping of these livestock was important source of green manure for rangeland, which has now decreased significantly. Daily grazers (now mostly private/ paid grazers) are also playing important role as they bring back the livestock earlier which decreased the time spent on rangeland and allow them for free grazing, one of the major threat to SLM.

CHAPTER – 7

OFF FARM ACTIVITIES AND SLM

Off-farm activities have significant impact on the land management practices by affecting households' income, and labor availability for agriculture. Although, it reduces the land dependency but it also reduces labor availability for farming activities. By supplementing income, it opens avenues for investment in land but reduction in farm labor also brings changes in farming activities. Hence in both cases there is impact on land productivity. This chapter therefore examines the status and role of off farm activities in context of SLM. It has been divided into two parts. First part describes the types of off farm activities, ratio of off farm workers, their characteristics and place of work. It also compares the regional variations and its probable consequences. Second part discusses the causes and consequences of out-migration and emigration in the context of land resources. It also describes the role of remittances in the development of household and improvement of land and agriculture. The last part concludes the discussion.

7.1 RELATIONSHIP BETWEEN OFF FARM ACTIVITIES AND SLM

As expected, higher involvement in off farm activities contribute significantly to higher household income and hence improved socio economic status of the family. In terms of land productivity, by reducing dependency on land it helps in less utilization of land with low fertility and soil conservation. However, in many areas land left uncultivated, particularly short term fallow land is highly vulnerable to soil erosion. Thus off farm activities are context-specific, having both positive and negative aspects.

There is some relationship in declining land productivity and off farm activities in Karak. For example decreased access to firewood and fodder, reduced agricultural productivity, a growing scarcity of agricultural land and increase in population density is increasingly motivating people to seek participation in off farm activities outside the district. Scarcity of firewood, for example, generally requires the use of an alternative fuel, such as wood from market, kerosene oil, gas, or electricity, which increases the household expenditure. Research reveals that a significant fuel transition is underway in Karak (Iffat, 2007). In this situation when environmental degradation reduces availability of firewood and brings about a shift to

alternative particularly commercial fuel enhances expenditure hence the need for additional income from off-farm sources. Likewise, reduced fodder either requires households to shift away from animal husbandry or purchase commercial feedstock for their livestock. In both cases additional income will be required either to purchase dairy products or animal feed resulting thereby in creating a need to seek jobs locally or outside. In the absence of local jobs, it has led people to get employment both in other parts of the country as well as abroad.

Pressure on agrarian resources, however, continues in the wake of growing population. Enhanced production from these resources can be achieved either by expanding agricultural land or increasing the intensity of cultivation on the present farm land, which will require mechanization, use of irrigation, increased use of inputs such as fertilizers, and improved seeds. In either case it increases cost of agriculture and creates a motivation for off farm activities and labor migration.

With the labor migration and enhanced off farm income, economy in Karak is passing through a transitional stage of shift from pure agrarian economy to agrarian cum non agrarian one. Till first half of the 20th century very few people were engaged in off-farm activities and most of the population was deriving their livelihood from subsistence farming. Seasonal movement between different altitudes (Issak Khumari) and between different plain areas (to Punjab from Chountra and Thal) was a common practice in order to use resources sustainably.

As stated in the earlier chapter, indigenous community was managing natural resources through different social institutions which were deeply woven into the traditions. Apart from agriculture small number of people of the district was serving in British army. They were known for their hard work and honesty which made them good solders, who were admired by British army (Goodwin, 1975). Hence a large number of young males joined the army. Their involvement in Armed forces continued till the second half of the century. Later, people started to seek other off farm jobs outside Pakistan in large number to Gulf countries particularly in the decade of seventies and its aftermath.

7.2 ECONOMICALLY ACTIVE POPULATION

The age and sex structure reveals that more than 40% of the total population is children under the age of 14 years and 9% are elders above the age of 60 years. Economically active population (15-60years) constitutes the remaining 50%.

Share of male population in this age group is around 53% including those working outside the district. Out of total population (3436) of working age group around 1720 persons (5o %) are engaged in off-farm activities. As off-farm economic opportunities are limited in the district in general particularly for female, participation of women in off farm recognized economic activities is very low. In sample population very small number of women (70 out of 1600 women) is involved in formal off-farm economic activities. Most of them were employed in private sector, some were working for the government and very few were found in small scale business. However, their participation in non formal economic activities such as maid servant in the district is very high (Iffat, 2009) Contrary to female, ratio of economically active male was very high in sample households.

Table 7.1: Karak District: Population Structure and Composition of Sample Households

Age/Sex	**Male**	**Percent***		**Female**	**Percent***	**Both**	**Percent****	
up to 5years	631	51.2		603	48.8	1234	17.8	
6-14 years	756	47.4		842	52.6	1598	23.1	
15-45 years	1116	52.6	**53.4**	1009	47.4	2125	30.8	49.8
46-60 years	719	54.8	**%**	592	45.2	1311	19.0	%
60years & above	331	51.6		311	48.4	642	09.3	
Total	3553	51.5		3357	48.5	6910	100.0	

***** Out of total age group

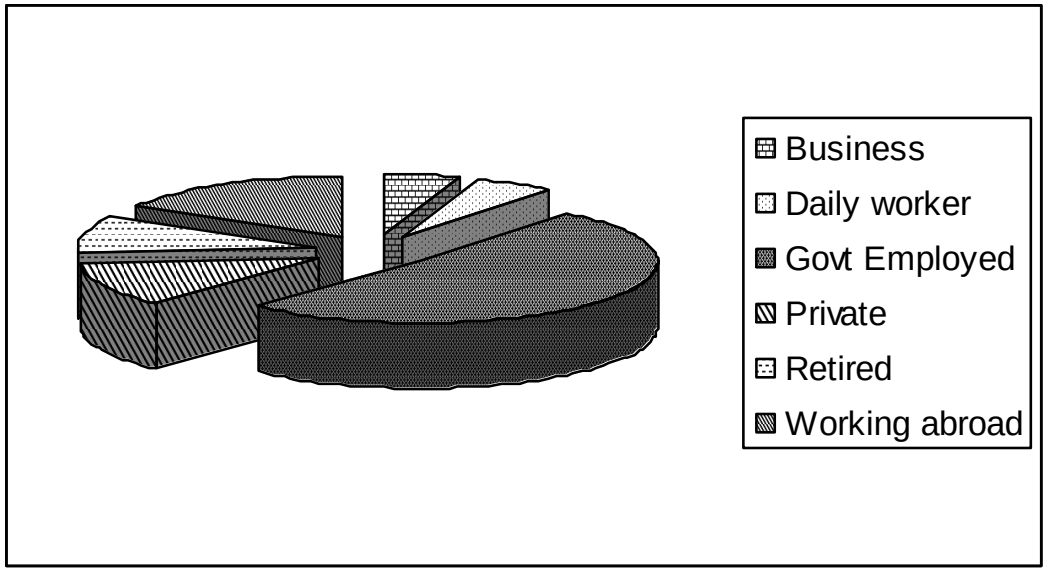
** Out of total population

7.3 MAJOR OFF-FARM OCCUPATIONS

Out of total working population one third (33%) are farmers while remaining are involved in off farm activities. Among the nonfarm activities share of government employs is high where more than half of the workers are engaged. Majority of people in this group are either employed in armed forces or in the education department. Most of the retired workers were

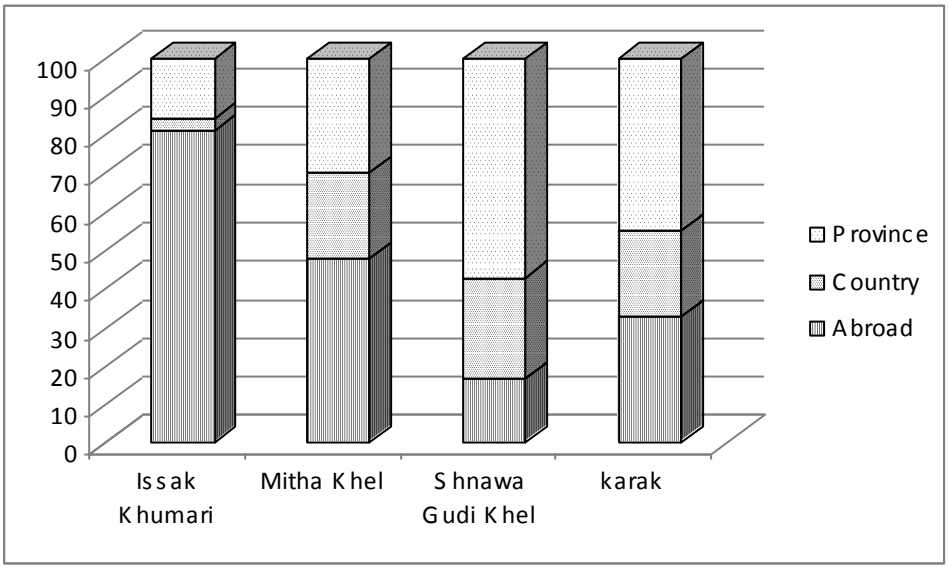
also from the army. International migrants constitute around 17% of off-farm workers. Remaining are low wage earners engaged either in small scale business, daily wagers or working in private institutions.

Fig 7.1: Karak District: Off-farm Working Population in Sample Households



Involvement in off farm economic activities is also the indication of the high migration rate from the district as due to lack of nonfarm options in the area, most of the employed population is working in other parts of country or provinces beside those working abroad. Out of total migrant in the sample households, 33% are international migrants. Internal migrants include 22% working in different parts of the country while 45% work in the same province mostly in large urban centers.

Fig 7.2: Karak District: International Migration versus National Migration by Source Region



Decision to migrate is based on a number of factors. Beside push factor (stresses and shocks at the place of origin, such as low productivity of agricultural land, lack of local investment and growth opportunities, and natural hazards) and pull factors (attractions of jobs, fascination of living in large urban centers and aspirations for better future). Improved means of communication is also helping in opening avenues as well as opportunities and prospects for quick processing of papers for migration particularly abroad. Additionally, individual, household, and community perceptions significantly influence the decision to migrate (Brown, 2008) particularly in deciding the destination. New migrants are normally dependent on information and support provided by earlier migrants in finding jobs and shelter at destination. Effect of such networking is apparent in predominance of migrants in a few countries. Economic status of the family is also important as it determines the affordability to travel. Other attributes such as age/sex, education, marital status, occupation, and individual motivation, in the study area are equally important in national and international migration.

Two third (67%) of the migrants from Karak district have moved with in Pakistan while another one third (33%) have moved abroad (see fig 7.2). This was also reported by a previous study which indicated that the predominant type of migration in Pakistan is from remote mountain districts to regional market towns and metropolitan cities located in the plains within the country (Hoermann, 2010). International migration to Gulf countries and Middle Eastern countries is growing as earnings from these countries are higher. Moreover,

existing migrants from Karak in these countries are a source of encouragement for their relatives to migrate too.

In terms of ecological regions the number of international migrants from Shnawa Gudi Khel, located in rain-fed region is still low as the cost of international migration is extremely high and most households in this region do not have financial means to afford international travel. Its share in national migrants is far greater. These migrants are primarily employed in arm forces. Issak Khumari has the highest share of international migrants and economic status of the people in this region is better compared to other regions. Large number of men from this region is working abroad; at least one but in many cases more than one person from almost each household is an international migrant.

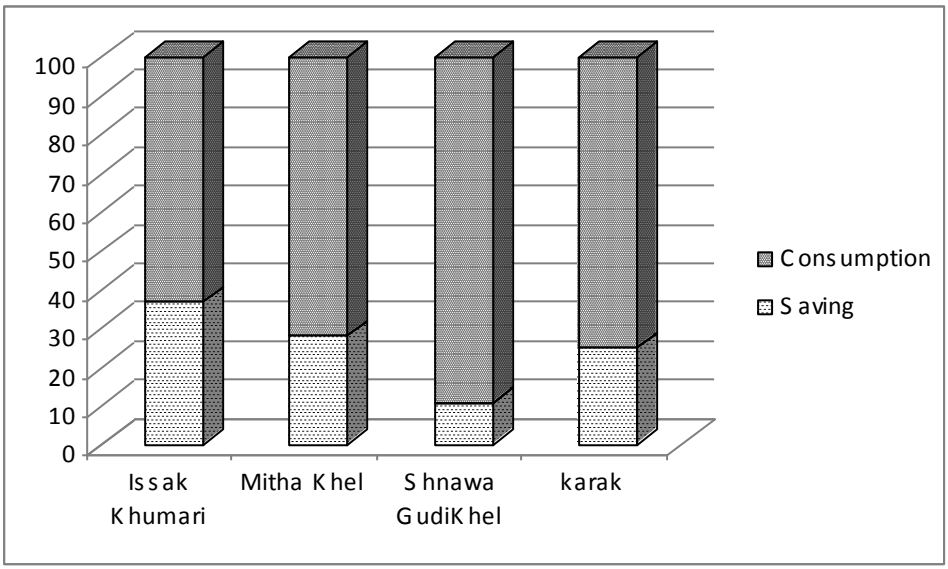
It is generally perceived that migration reduces poverty as it generates financial and human capital (skills and knowledge). However, the complete reimbursement of migration can only be obtained if it is leveraged for development and remittance is managed in a rational way. Migration, however, also results in loss of human capital which leads to mismanagement of land resources. For understanding its role and the way it affects a society it is important to recognize the process, the flows of remittances and the way it is used by respective households. Financial remittances provide the immediate, direct and most important contribution to the livelihoods of the poor households as a safety net for the dependents left behind. While social remittances, beyond the effects of financial flows such as the acquisition and transfer of new skills and improved knowledge, can play an important role in long term and sustainable development. Migrants acquire new ideas, skills, perceptions, and technologies, which they carry back to their place of origin. The benefits are not limited to recipient households, but have a wider impact on the receiving society, as remittances are spent, which generates demand and jobs for local workers (UNDP, 2009).

Most of the emigrants are earning between Rs.60 to 90 thousands rupees a month while few were earning less than Rs. 60,000 and others more than Rs. 90,000. Amount is mainly dependent on two factors, the nature of job and the duration at destination or experience. Although most of the emigrants were unskilled and initially worked as laborer for long time (some time more than ten years), but with time they learned new skills and found different ways of earning which resulted in raising their income.

Major portion of the remittances received in the district goes to meet the daily needs and to cover domestic consumption. Saving rate is low and only 25% of the surveyed recipient households were able to save small amounts. It is very close to international situation where only 20 per cent of remittances are used for investment and about 80 per cent are required for household consumption (IFAD 2009). Beside basic household consumption segments like food, clothing, health and education, large amounts of remittances are also used to build new house, renovate or improve housing, improve land, irrigation like digging wells and to repay loans.

The consumption rate tends to be higher for poorer households (in Shnawa Gudi Khel it is 89%) where remittances ensure immediate relief during hard times. Furthermore, household consumption has many positive long-term benefits as it contribute to family welfare in term of better nutrition, living conditions, education, and health care.

Fig 7.3: Karak District: Distribution of Remittances in Sample Areas



Migrants have also brought new ideas and knowledge back home which had a significant impact on the development of their community. Besides contributing to community development it has brought positive changes in the personalities of the migrants improving their self-confidence. They have become the agent of social change and are normally respected by the community. Some of them have also become the opinion leaders and advisor for youth.

7.4 MIGRATION AND LOW AGRICULTURAL PRODUCTIVITY

As stated earlier, the major determinants of migration from the region are many but need for earning through off farm activities (lack of employment in villages) emerged as the strongest intention for migration among the respondents, closely followed by low agricultural productivity. Lack of interest in working in agriculture sector due to various reasons has also acted as push factor for youth. Climatic variability was considered as indirect cause of migration too. The influence of migrant friends and relatives is another very significant reason for migration acting as a strong pull factor. Several migrants mentioned about lack of basic facilities and services in rural areas as the reason to migrate from their villages.

Table 7.2: Karak District: Major Determinants of Migration

Major determinant	Respondent perception (%)
Lack of employment	61
Low agricultural productivity	58
Declining Interest of Youth in Agricultural Sector	41
Climatic Variability	31
The influence of Friends and Relatives	1
Lack of Basic Facilities	2

Note: Multiple answers are possible

Major determinants of migration in the area are briefly discussed in the following section.

1 Lack of opportunities at place of origin

Unavailability of employment opportunities at place of origin is a strong factor in the rising migration numbers, particularly among youth. Poor industrial set up and lack of investment options have resulted into limited opportunities. Increased awareness regarding available options and prospects in outside world through electronic media, and education are increasingly stimulating people to migrate.

2 Low agricultural productivity – An Established Factor Exaggerated Recently

Due to predominance of subsistence agriculture traditionally people have been migrating to supplement household income from the study areas. However, the progressive decline in agricultural productivity, in the region for the last two decades, has increased the need to

migrate. With increasing climatic stresses, particularly recurrent droughts, erratic rainfall, and global food price instability agriculture has increasingly become less reliable livelihood strategy in the region.

Most of the people attributed declining agricultural productivity to be a major reason for migration (see Table 4.5). Many claimed that they do not have sufficient food grain to support their family (table 4.6). During focused group discussions in Mitta Khel, respondents said that currently agriculture fulfils their food grain requirements for less than 6 months, whereas earlier, it was enough to fulfill the complete annual household demand. Therefore migration has become inevitable now.

3 Declining Interest of Youth in Agricultural Sector

A growing lack of interest in agricultural sector was observed throughout the survey among youth with some educational background. During focused group discussion in different villages of Karak, majority of young participants pointed out that they had no interest in working in agriculture and were looking for alternate livelihood opportunities (Field Study, 2010). Lack of interest in agricultural work could be the result of reduced productivity as well as the prevailing norm in the society which promotes the perception that agriculture is only pursued by illiterate and less educated people. Once very prestigious occupation, agriculture in the area is now seen as a 'demeaning' occupation. Increasing education has therefore emerged as a vital push factor among those disheartened with agriculture. Even people with only school education are reluctant to practice agricultural work because they feel that there are better livelihood opportunities for them outside their villages (Fig 7).

4 Climatic Variability

Climatic variability is considered as an indirect cause of migration as it has decreased productivity of land in the study area. The region has highly fragile ecosystems, which are vulnerable to the external change. Agriculture in the area is predominantly rain-fed, depending heavily on weather conditions and rainfall while productivity of rangeland is also directly dependent on adequate rainfall, making it more vulnerable to climate change.

During the field studies, majority of the respondent said that they had observed a significant decrease in agricultural productivity over the last two decades. Most of them attributed changes in climatic condition as a significant cause of declining agricultural productivity and

hence migration. Many respondents reported about erratic rainfall pattern during the past few years. Farmers also complained about untimely and excessive rainfall during harvest times, which damaged the crop grains and hay, leading to food insecurity both for human beings and livestock in the region. The water flow in local springs and ponds in most villages have declined considerably; some now dry up during the summer. Rising temperatures was also reported, resulting in hotter summers and warmer winters, with negative impacts on agriculture. The elderly in the villages of Issak, Khumari and Mitha Khel said that earlier they used to wear warm clothes even during the summer months, but they did not need them anymore.

7.5 ROLE OF REMITTANCES IN REDUCING LAND DEGRADATION

The amount of remittances sent by individual international migrant is low initially. It has many reasons but a more common one is that most migrants are employed in low paid jobs. Due to lack of technical skills and appropriate education they work as drivers, construction workers, security guards, waiters and cooks. Some of them also work as salesmen in shops. After bearing their expanse of living, they are left with only a small amount to remit to the home country. On average, Pakistani migrants remit only US$ 46 per month, but this is still significant in terms of local household income (Arif, 2009).
The way in which current remittances are utilized is given below.

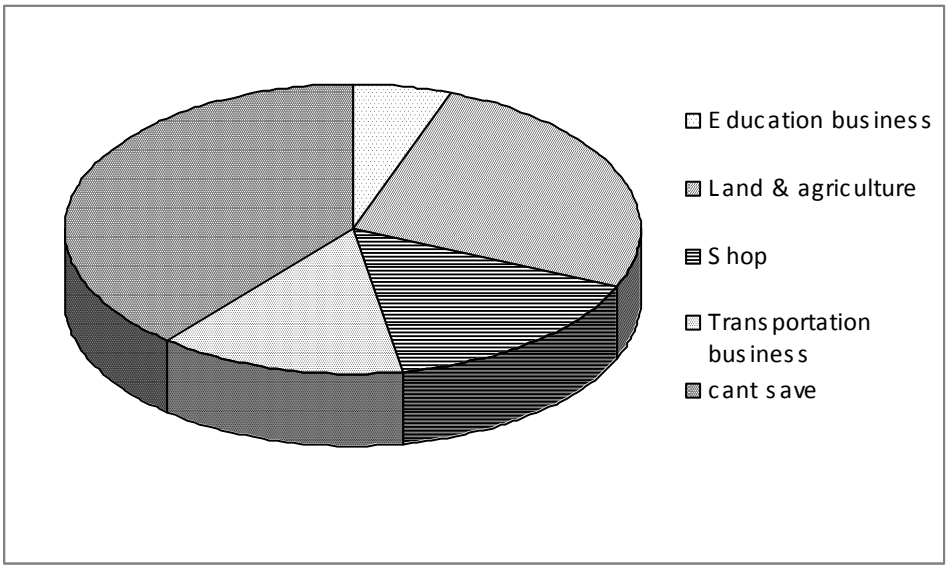
Due to prevailing poverty migrants do not have enough cash to bear the cost of migration and normally obtain loans for the purpose from various sources. Their first priority is the repayment of loans and this reduces share of investment in land. Migration, particularly international migration is expensive. Finding employment opportunities and making essential arrangements independently is not an easy task for majority of people in the study area. If migrants rely on relatives and friends to arrange for a job, they still have to bear expanses of travel etc. However, the burden increases if they do not have friends and relatives to find jobs abroad. In such cases, they seek assistance from employment agencies. These agencies offer a wide range of services like arrangement of employment, processing visas, travel, and paperwork. They also arrange accommodation and support at the destination initially, which considerably increases the already high cost.

Remittances both financial and social have differential effects. Investment of remittances,

whether financial or social need opportunities which are limited in the study area. Households more often are the direct recipients and utilize the remittances for their day to day expanses or immediate needs of household. After meeting household needs very little money is left as saving, and hence investment, is low (25%).

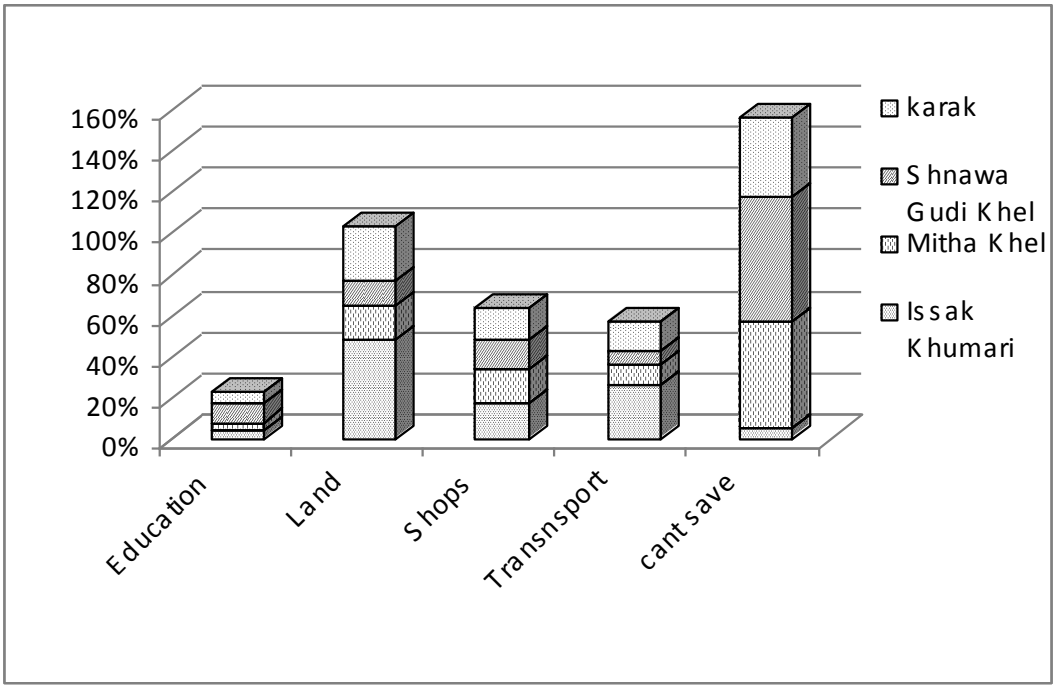
In terms of investments of savings bulk of the respondents had invested their savings in land and agriculture. This investment went mainly to purchase new land and only a small fraction was spent on enhancing land productivity or conservation through land leveling or agricultural inputs or purchase of agricultural machinery. Some households have also invested in small shops. Many households have bought taxis and other transport vehicles while few have invested their savings in opening schools and tuition centers. Hence besides meager investment in land leveling or conservation the only other way in which remittances have contributed is by reducing some dependency on land through the creation of off farm employment.

Fig 7.4: Karak District: Investment of Remittance in Different Sectors



Some variation can be seen in different ecological regions as in Issak Khumari the highest share was of investment in land and agriculture followed by transport business while in Shnawa the share of education is more significant. Fraction of the remittances is invested in land and agriculture by both emigrants of Shnawa and Mitha Khel.

Fig 7.6: Karak District: Investment of Remittances in Different Sectors in Sample Areas



Unlike international migrants, internal migrants to other parts of Pakistan from Karak have a fairly high literacy rate. Many of them hold graduate, postgraduate and professional degrees and hence have been able to secure professional and managerial jobs, while others with a higher secondary education have joined the armed forces or entry level clerical jobs. The earnings of internal or out migrants from Karak vary greatly, from Rs 6,000 (US$ 70) per month to about Rs 45,000 (US$ 500) compared to those of International migrants ranging from 30,000 to 120,000 Pakistani rupees. The low earnings by out migrants to other parts of Pakistan means any remittance from them to the district primarily goes to meeting household expenses.

7.6 CONCLUSION

Higher participation in off farm activities leads to higher household income, improved socio economic conditions and better soil nutrient balances, but it also leads to reduced labor intensity in farming. Therefore it is a threat to crop production and soil erosion. Declined agricultural productivity and non availability of alternative options at origin have pushed many people of Karak to migrate. Its economy is now more dependent on the remittance earned by the male population working in different nonfarm sectors (mainly international migrants) compared to agricultural sector.

Major portion of the remittance is used for household consumption particularly in poorer households. Almost 40% of these were not able to save anything as remittance is largely used for household consumption in these poor households. Rest of the families do save some amount and invest it in various forms. The major mode of investment is land and agriculture. Isaak has the highest share in this respect. Normally people prefer to purchase agricultural land and also use more farm inputs to improve the yield and productivity. Many people have also invested their savings in transportation business and have opened shops in local markets. Construction of new houses and digging wells is also very common in these families. In this way some off farm opportunities have been generated for local people. In summary, besides meager investment in land leveling or conservation the only other way in which remittances have contributed to land conservation is by reducing some dependency on land through the creation of off farm employment.

Family structure has direct relation with labor availability for farm sectors as in joint family system labor lost is compensated by other male family members. In Shnawa Gudi Khel due to large family size this problem can be easily tackled. In Issak Khumari due to high frequency of nuclear family system the problem of labor shortage has emerged which may contribute to desertification in land that is being left idle for this reason.

Due to large number of international migrants significant socio-economic changes have occurred both in individual households as well in the community. These changes have transformed the resource use and management strategies. As those left behind did not had the required skills and power to enforce the traditional norms and use the limited resources in rational ways, therefore agricultural resources are in jeopardy. As such many land and natural resource issues emerged in the farm sector throughout the study area.

CHAPTER – 8

CONCLUSION

This chapter sums up the main findings of the study. It has been divided into three sections. First section identifies the major problems and issues related to land and second part of the chapter is about the main factors contributing towards these problems. Third part analyse the adjustment mechanisms adopted by local inhabitants and their sustainability as follows:

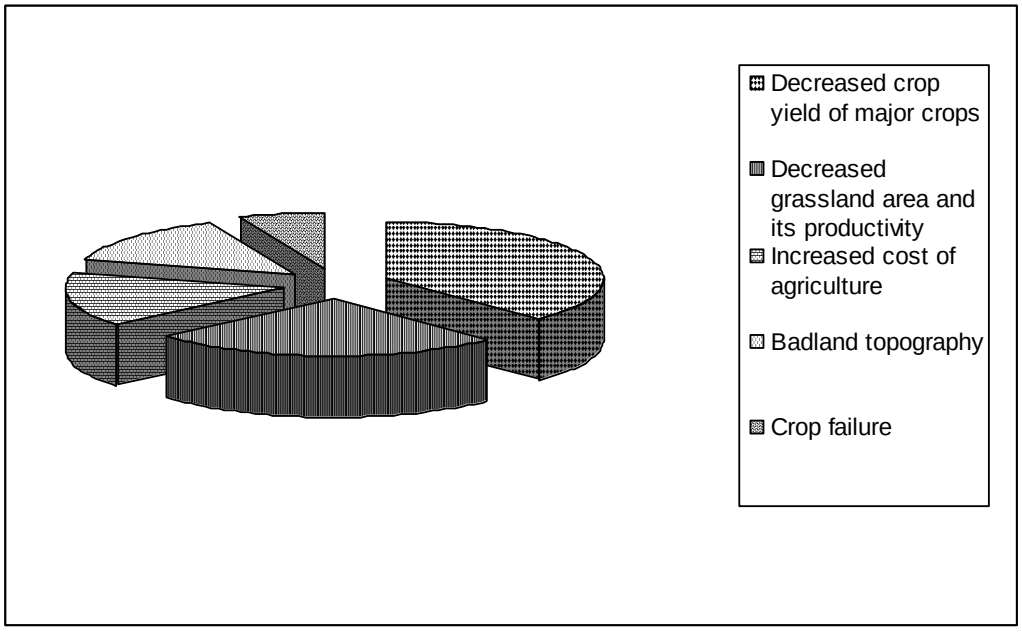
- Major issues of land or problems that have contributed towards desertification in different geo-ecological zones in the district,
- Key factors, both physical and anthropogenic, that have triggered these problems/issues,
- Creative adjustment mechanisms or strategies adopted by the local inhabitants and their sustainability.

Based on the above findings few remedial measures for sustainable land management and development were identified.

8.1 MAJOR ISSUES/PROBLEMS OF LAND

Desertification and land degradation is the most important problem of Karak District. This is happening through loss of land productivity, erosion and salinization. Cultivation of crops is one of the dominant land uses on private land, while communal land or *shamilat* is predominantly used as rangeland in the district. Problems, prospects and potentialities of these land uses are different but highly interlinked to desertification and land degradation. Important issues related to desertification of cropland include declining yield, and crop failure has been increasing the cost of agriculture. Rangeland is also being subjected to degradation through extraction of natural vegetation for domestic and commercial purpose and overgrazing. In addition the land in many parts of the study area has been dissected by water erosion resulting in badland topography. Major problems indicating desertification in the study area are presented in figure 8.1 and discussed in the following section.

Fig 8.1: Karak District: Indicators of Desertification in Karak District



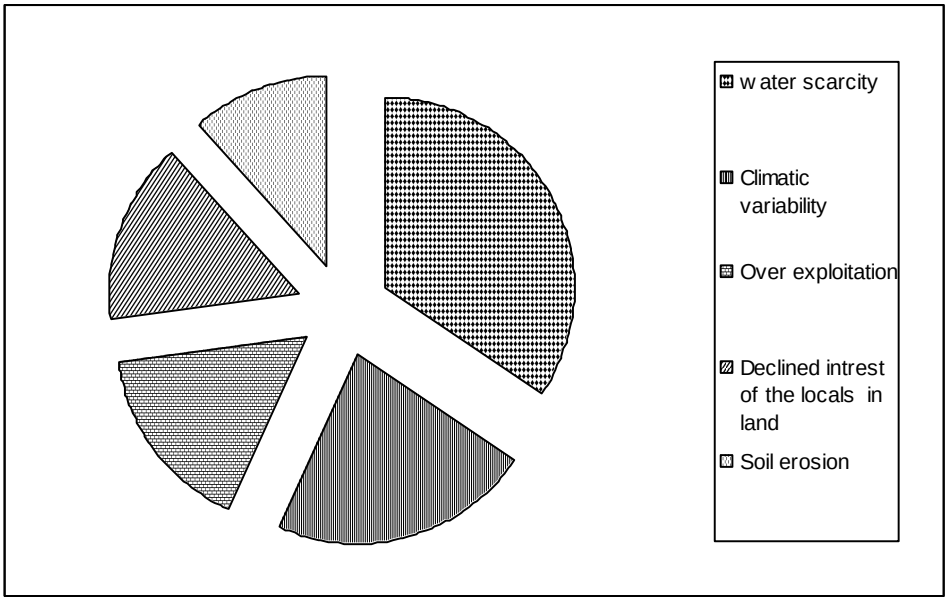
Yield of major crops like gram, millet and maize has decreased significantly in the study area in recent years. Declining productivity is a common problem but more noticeable in Shnawa Gudi Khel located in dry farming and rangeland region. Crop failure in the region is also a common problem faced by the local people. This usually results in food insecurity as in most cases even seed recovery is not possible. Cereal crops in such situation are usually utilized as fodder for livestock. Although, yield of wheat has increased somewhat but cost of agriculture has also increased due to rising prices of inputs such as improved seeds, chemical fertilizers and other farm inputs. Cost of irrigation has also increased due to rising price of electricity. In addition, electric power load shedding is another important issue in the study area.

Apart from agricultural land, in the study area rangeland is also heavily degraded both in terms of area and productivity. Over exploitation of natural vegetation for various purposes has resulted in reduced productivity of rangeland. Vegetation cover of the area has also deteriorated in quality. Consequently many plant species particularly grasses and herbs are now extinct and other are under heavy pressure. Hills of the district have lost their tree cover, trees have become stunt and biomass production has reduced drastically.

8.2 MAIN CAUSES OF LAND DEGRADATION AND DESERTIFICATION

Problems and issues related to land degradation and desertification discussed in the previous section have resulted due to various causes both natural and anthropogenic. Natural causes include water scarcity, climatic variability, topography, soil erosion and salinity. Declining interest of people in agriculture, over exploitation of vegetation and expansion of agriculture on marginal land are important anthropogenic factors causing land degradation (see fig 8.2). Additionally occasional flash floods also bring heavy amount of water which cause damage to property, crops and life of the locals. Run-off from local torrents or *nullahs* also damages the fields. As a result there is a visible disruption and damage to agriculture as well as livestock productivity in the area.

Fig 8.2: Karak District: Perception of Respondents (%) about Common Causes of Desertification



8.2.1 Natural Factors

Results of the survey conducted for this research revealed that climatic variability for the last 30 years has increased in the study area. It has played a vital role in increasing the intensity of existing problems related to land degradation and reduced productivity. Rainfall amount and frequency has also become more variable and erratic. Previously winter rains were common, which were extremely helpful in providing water to winter crops like wheat. Reduced winter

rain, poses a major problem for growing wheat, the most important food crop of the area, substantially reducing its yield. Winter rains were also important from ecological point of view as low evaporation rate during that time allowed higher amount of seepage and replenishment of ground water.

Timing of the rains have also changed, previously December and January were wet months providing required moisture to winter crops, while April, the month of harvest was predominantly dry. Shift in rainfall regime has also taken place whereby towards spring. December and January now receive little amount of rainfall increasing the need for irrigation, while April receives more rain creating a problem to ripening crops delaying harvest and also damaging grains.

Important change has been noticed in the spell duration of rains which in the past stretched for as long as a week allowing higher infiltration. Now although rainy days and total amount of rains has increased but short spells do not allow enough infiltration, reducing ground water recharge. This is very important as rainfall in the district is the only mean of ground water recharge. In contrast to winter, short spell summer rains have become more frequent and violent. These higher intensity rains normally lead to flash floods. Temperature in these months remain very high increasing the evaporation rate and hence again reducing the ground water infiltration rate and recharge.

Another very important climatic factor hampering the agricultural productivity is high velocity of dry winds, which more often develop into local dust storms. These winds pose the biggest threat to gram productivity, which has reduced considerably due to these winds. In summers these winds also cause damage to vegetation by increasing the evapo-transpiration rate and amplifying aridity. Third climatic factor with significant impact on the crop production is hailstorm. During late spring and early autumn (March, April/ September, October) thunderstorms are common, with short spells of torrential rains often associated with hailstones.

Beside rainfall variability, frequent droughts have also resulted in drying up of local ponds, springs and torrents. Water table in most of the areas has dropped significantly in the last three decades as well, increasing both economic and ecological cost of water abstraction. In fact, water scarcity is a common problem throughout the district which affects both crop

production and livestock herding.

Besides increasing cost, extraction of ground water below fresh water zone has resulted in abstraction of salt water and increased soil salinity. This is a major problem faced by the farmers of Mitha Khel located in irrigated agricultural region where relatively more land is irrigated. Some villages in the region like Tarkha Koi are faced with severe water/soil salinity problem leading to land abandonment. This problem was rarely reported in other two regions. Moreover, torrents originating from hills when flooded pass through salt range carry large amount of salt to the central and western plains. When water gets evaporated due to high temperature salt gets deposited on land and soil salinity occurs in the area.

Soil erosion is also an active process in some parts of the study area. Large parts of the district are naturally prone to soil erosion due to topography, soil type and climatic conditions. In these areas extensive gully formation has resulted in the development of bad land topography. North eastern side of the district receives higher amount of rainfall in summer which often results in flash floods in mountains as well as in lower plain areas. Even in southern arid region the local torrents frequently overflow. Therefore, field wash through sheet erosion has become a major problem in the district. Fields have to be leveled many times a year which is a laborious and expensive task. Moreover, wind is also an active agent of soil erosion in the southern sandy region. Loss of fertile top soil by wind erosion increases the demand for chemical fertilizer to enhance productivity.

8.2.2 Anthropogenic Factors

Meager income derived from agriculture as compared to off-farm activities as well as harsh environment with high risk of crop failure are the important factors discouraging people' s involvement in agriculture. Further it is taboo that agriculture is pursued by illiterate and less educated people. Increasing education is therefore, an indirect cause of reduced farm labor contributing to decline in farm productivity. Moreover, comparative affluence of migrant friends and relatives enhances the desire in younger generation to seek off farm employment. Elders of the study area were of the view that with efforts and dedication the land can be turned to productive fields but the younger generation has become easy going and looks for more return with less effort. Hence the current trend is towards off- farm jobs.

Increasing lack of interest in land and trend of out migration for participation in off farm employment has negatively affected the resource utilization and management mechanisms in the area.

The land productivity is also on the decline because increasing human and livestock population is exerting high pressure on meager cultivable land resources. As a result in recent years, expansion of agriculture, in most areas of the district has taken place on marginal lands. Such land requires substantial labor for land preparation and maintenance as well as considerable farm inputs to gain production. This land is also subject to quick exhaustion and after a few harvests its productivity decreases significantly. Expansion of agriculture in some areas of the district has also negatively affected the natural vegetation cover of communal lands, which previously provided food to the livestock. These have been cleared to make room for crop cultivation. Loss of natural vegetation from rangelands also exerts pressure on cultivated land as it increases the need to grow fodder crop to feed the livestock. Lack of vegetation on hill slopes also results in increased soil erosion due to flash floods as well as winds.

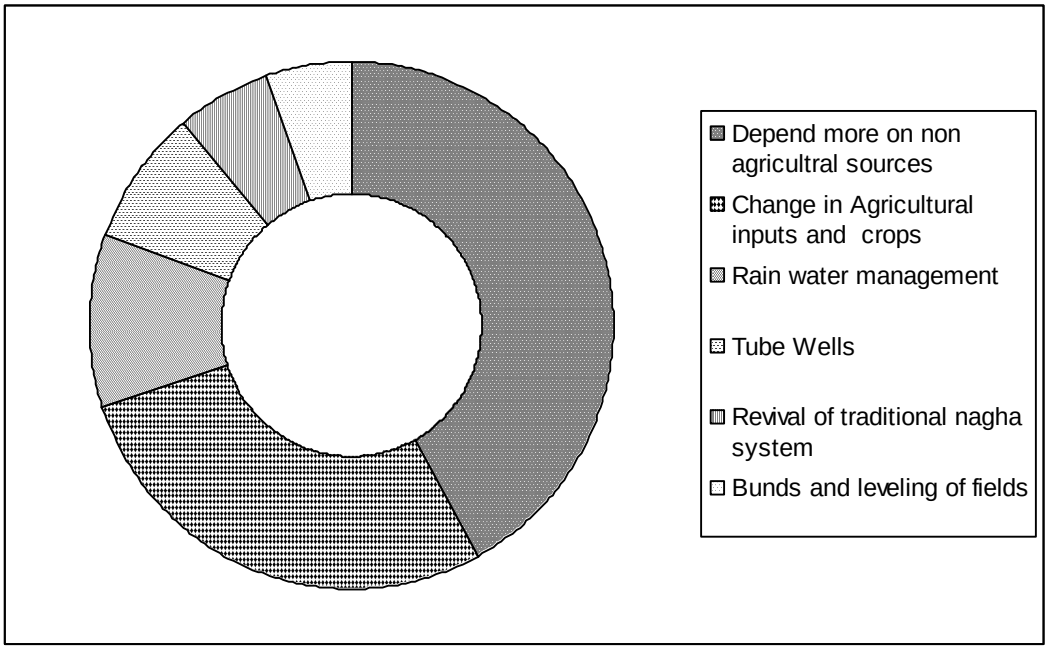
Hence two factors attributed to degradation of natural vegetation and decreased productivity of rangeland are increased population pressure and weakened role of social organizations both leading to over use and mismanagement of rangeland resources.

Although declining land productivity is common throughout the district but slight variation was noticed in different ecological regions. In the southern part of the district, the dry farming zone, water scarcity and sandy nature of soil are major constraints leading to declining yields and hence reduced crop production. Need for more inputs have increased the cost of agriculture which restricts the poor farmer’s capacity to cultivate the entire farmland. While In northeastern part of the district due to degraded vegetation cover and higher intensity rainfall land degradation through soil erosion is a major cause of declining land productivity. Soil salinity is more reflective in central irrigated region that is leading to abandonment of cultivated land in that area.

8.3 ADJUSTMENT MECHANISMS/ADAPTIVE STRATEGIES

The indigenous communities have always adopted their lives to respond to environmental problems particularly desertification. This study has attempted to look into the strategies adopted by local people as a control measures and to evaluate their effectiveness in the district. These include diversion of economic activities, changes in traditional agriculture (farm and livestock) practices and revival of local level norms/rules of resource management. Besides, tube wells construction and rain water management are also important strategies adopted by local farmers.

Fig 8.3: Karak District: Major Strategies Adopted by Local Inhabitant to Combat Desertification



Source: Field survey 2010

8.3.1 Enhancement of Off- Farm Activities as an Adaptive Strategy

Diversion of economy is one of the most important strategies adopted by majority of the inhabitants. Because of declining grain production, food demand of the households cannot be met for the whole year. The annual harvest lasts only for six months although in many cases grains produced last for only three to four months. In such a situation dependence is from market purchases hence the need for off farm income becomes obvious. As a result substantial numbers of residents rely on off-farm activities to compliment the subsistence

agriculture.

Opportunities for non-agriculture economic activities are limited in the district. Therefore, large numbers of local young male population have migrated to other parts of the country as well as abroad. Those working in different parts of the country are mostly employed in governmental jobs or recruited in armed forces. Income of a single out-migrant is comparatively small and the amount sent by him is usually not enough to cover the whole household expenditures, therefore, from majority of households more than one person are working in nonfarm sector outside the district.

During the last three decades international migration has also increased from the area. At least one person had migrated abroad from 34% of the total households surveyed in this study. Out of these, 30 households (19%) had sent more than one person for work abroad. Issak Khumari had the highest share in international migration, where significant development in agriculture has been made with these remittances. Beside land and agriculture some households had also invested it in transportation and other small scale business in local markets. Thus remittances have opened avenues for off farm employment for people locally.

Beside these positive changes brought by migrants many negative changes have also been attributed to them. The most important negative change brought by emigration was the erosion of social fabric that helped in sustainable use of natural resources in the area. Previously traditional rules for the use of natural resources were followed very strictly by the community. There were clear (although unwritten) distributions of responsibilities among locals for various tasks. Most important tasks were diversion of flood water and management of rain water, regulating the utilization and management of grazing lands, resolving the conflicts among different tribes and safety/ security issues in the area, These practices were on the decline with time primarily due to reduced dependence on natural resources as a result of off farm employment, increased income, and reduced manpower because of outmigration. However, erosion of the traditional values of the society had noticeable adverse impacts on natural resources and environment. One such impact was enhanced flash floods due to de-vegetation of the hill slopes. To control this problem, since 1994, the local community has revived the system of closing the rangeland and forests (n*agha*) for grazing and for cutting of firewood for two days (Friday and Wednesday) in a week to reduce the pressure on natural

vegetation. In addition, driving of camels to the rangeland for bringing fire wood and grasses are also banned in the area as a safeguard to mass removal of grasses and wood. Free grazing of livestock in the rangeland as well as in the surroundings of the villages is also being discouraged by invoking temporary confiscation. Other traditional values and norms governing the management of natural resources are also being revived along with collective action by the people for the overall benefit of the society.

Being age and sex selective, migration has also resulted in labor shortages as those who have migrated are young males leaving women and elders of the families behind. As a result a lot of land is now being left fallow due to labor shortage. It has also a profound impact on the livestock sector where shortage of appropriate labor has resulted in the reduction of herd size as well as its changing composition, whereby large animals such as cows and bulls are being replaced by goat and sheep. Large number of goats is one of the major concerns in regard of SLM.

Increased participation of local inhabitant in nonfarm activities has also brought noticeable change in gender roles and women empowerment. Women's increased access to money and their changed role as head of household has made them more confident. In many women headed households land is cultivated through tenants and reciprocal labor sharing is being replaced by paid labor. Women's access to education has also affected the traditional skills as now girls are more interested in vocational education such as computing, art work by machines etc.

A second important adaptive measure against desertification was changes brought in the agriculture practices in the district. This includes increased investment in agriculture development, introduction of new crops, reducing herd size and change in herd composition Indigenous and traditional methods have been replaced by technological/ mechanical agricultural practices in order to get more food from fragile land. Application of chemical fertilizers, improved seeds, and irrigation are more important in this regard. Irrigated land in district Karak has increased from 2% to more than 11% of the total cultivated land in last ten years (GoP, 1998 and 2007). This is the result of individual investment like tube wells, efforts made by different organization through providing help in rain water harvesting and public irrigation schemes i.e. Construction of small dams and check dams primarily against soil erosion.

New crop varieties like groundnuts[5], vegetables, and on very small scale, cotton, sugarcane and rice have brought new hopes for the farmers as these are not only profitable, but are also helping in providing nutrition and healthy food to the local people. Groundnut is a cover crop which is one of the agronomical measures against desertification while cotton and rice are experimentally grown on saline soil to reduce salinity on the advice of agriculture department.

A change in livestock type is also a response to the reduced land productivity. Traditionally cattle, goat, sheep, camels and donkeys were well represented in herd composition. Now due to various factors like degradation of rangeland, out migration of male, availability of farm machinery/ transport, in the region change in herd composition is noticed. Small ruminant milk animals and goats are more common while camels and donkeys have decreased significantly. In cattle cows are still very common but bulls have decreased in number. Herd size has also decreased in most of the households to reduce pressure on rangeland resources.

8.3.2 Adaptive Strategies on Farmlands

In response to decreasing vegetation cover on hill slope the inhabitants have carried out extensive plantation on their farms and fields. Besides economic benefits, these plantations are playing significant in desertification control by protecting soil in the area. Increased vegetation cover has also promoted bee culture for harvesting honey, which has become an additional source of farm income.

In order to cope with water scarcity, tube wells are being constructed. Although it has increased the water availability but has considerably enhanced the environmental risks as the area has very low recharge capacity compared to the rate of extraction of water. In addition to underground water extraction, storage of surface water has also helped in combating desertification. To reduce the adverse effects of torrential rains, the inhabitants of the study area have constructed diversions and *bunds* to check water speed and its erosive capacity. Moreover these small water reservoirs are also used for irrigation on limited scale and as recreation points that are visited by wildlife/birds. Additionally theses provide water points to

[5] Karak is among major groundnut growing district of Pakistan (See map 8 Annex 9)

local livestock.

Extra income from these sources also led to complacency towards management of land whereby implementation of traditional rules and norms set to strictly limit utilization of such resources as water, land, and natural vegetation were ignored. The ensuing reduction in productivity and such adverse consequences as enhanced frequency and intensity of flash floods and dust storms made the inhabitants realize the importance of ecological management of natural resources through traditional norms and values. These rules and values are being revived and changes are being introduced in current practices to make the economic activities sustainable. This is a good omen and hopefully would serve as a safeguard against desertification of land in future.

In order to help the inhabitants in their efforts, however, future research on the topics listed below could be helpful:

- Calculation of soil erosion rate (wind and water) in different ecological zones and identification of their control mechanisms
- Identification of suitable vegetation types (trees and crops) for different geo-ecological zones
- Identification and development of sustainable rain water harvesting techniques
- Cost benefit analysis of migration (out migration and emigration)
- Identification of alternate off farm income generating activities (type and location)

REFERENCES

Abdul Ghafar. (1997). Examining the rural landscape change an integrated approach of maps, aerial photographs and geographical information system. Paper presented at the Ninth all Pakistan Geographical Conference Islamabad/ Rawalpindi, Pakistan. (6-8th December 1997).

Abraham, M. E. and Villalba, R. (2008). Society, Desertification and climate change in the Argentinean Chilean Central Andes Region Mountainous regions: Laboratories for Adaptation (IHDP Update): 31-35.

Adnan, M. and Hölscher, D. (2010). Medicinal Plant Abundance in Degraded and Reforested Sites in Northwest Pakistan. In *Mountain Research and Development*, 30(1): 25-32.

Ahmad, F. and Kazmi, S. J. H. (2003). Role of local bodies in implementing the United Nations Convention to Combat Desertification in Pakistan. In *Pakistan Journal of Geography*, 13(1&2): 73-79.

Akhtar-Schuster, M.; Thomas, R.J.; Stringer, L.C.; Chasek, P. and Seely, M. (2011). Improving the Enabling Environment to Combat Land Degradation: Institutional, Financial, Legal and Science-Policy Challenges and Solutions. In *Land Degradation and Development*, 22: 299–312.

Arif, G.M. (2010). Recruitment of Pakistani Workers for Overseas Employment: Mechanisms, exploitation and vulnerabilities. Islamabad: Pakistan Institute of Development Economics

Ashraf, M. M. (1993). Role of vegetation in arresting debris flow and erosion control progressive farming. In *Science Vision*, 13(1): 17-20.

Asian Developing Bank. (2010). Combating Desertification in Asia http://www.adb.org/environment/desertification.asp (Last accessed 5th March 2011)

Azhar, A. H.; Rafiq, M. and Alam. M.M. (2006). Groundwater Control Assessment of Drainage Projects in Pakistan. In Pakistan Journal of Water Resources, 10(1): 1-9.

Bajracharya, B.; Kabir Uddin.; Chettri, N.; Shrestha, B. and Siddiqui, A.S. (2010). Understanding Land Cover Change Using a Harmonized Classification System in the Himalaya. A Case Study From Sagarmatha National Park, Nepal. In *Mountain Research and Development*, 30(2):143-156.

Barani Area Development Project. (1992). Project report of District Karak and Kohat.

Barrows, H. H. (1923). Geography as Human Ecology. In *Annals of American Geographers*, 13: 1-14.

Barth, H. K. (1977). Types of semiarid Ecosystems: Stress and Stress Potential with Special Reference to Sahelian areas of the Gourrwa, Mali. In *Applied Geography and Development*, 10: 59-80.

Berkes, F. and Folke, C. (1993). A Systems Perspective on the Interrelationships between Natural, Human-Made and Cultural Capital. In *Ecological Economics*, 5: 1-8.

Bewket, W. (2002). Land Cover Dynamics since the 1950, Chemoga Watershed, Blue Nile Basin, Ethopia. In *Mountain Research and Development*, 22: 263-269.

Blaikie, P. and Brookfield, H. (1987). Land Degradation and Society. Methuen, London and New York. Pp: 1-26.

Blum, W. E. H.; Kresse, K. and Meier, W. (1985). Landsat Imagery for the Assessment of Soil Erosion in Large Mountain Watersheds. In *Applied Geography and Development*, 26: 46-56.

Bovill, D. W. (1921). The Encroachment of the Sahara on the Sudan. In *Journal of the African Society*, 20: 259–269.

Brookfield, H. (1999). Environmental Damage: Distinguishing Human from Geophysical Causes. In *Environmental Hazards*, 1: 3-11.

Brown, O. (2008). *Migration and climate change*, IOM Migration Research Series No 31. Geneva: International Organization for Migration

Bruntland, G.H. (1987). Our Common Future: World Commission on Environment and Development. Oxford Press.

Burton, I and Kates, R. W. (1964a).The Perception of Natural Hazards in Resource Management. In *Natural Resource Journal*, 3: 412-41.

Burton, I.; Kates, R. W. and White, G.F (1968). The Human Ecology of Extreme Geophysical Events, Natural Hazard Research Working Paper No 1, Department of Geography, University of Toronto, Toronto.

Buzdar, N. (1988). Property Rights, Social Organization and Resource Management in Northern Pakistan. Honolulu. (= Environment and Policy Institute East West Center Working Paper 5)

Caroe, O. (1973). The Pathan, Union Book Stall, M.A. Jinnah Road Karachi.

Carson, R. L. (1962). Silent Spring. Boston: Mifflin.

Cerdà, A. (1997). Soil Erosion after Land Abandonment in a Semiarid Environment of South-eastern Spain. In *Arid Land Research and Management*, 11 (2): 163 – 176.

CGIAR. (2009). Climate, Agriculture and Food Security: A Strategy for Change.

Charney, J.; Stone, P.H. and. Quirk. W.J. (1975). Drought in the Sahara: A Biophysical Feedback Mechanism. In *Science*, 187, 434-435.

Chaudhry, Q.Z. and Rasu, G. (2004). Agro-Climatic Classification of Pakistan. In *Science Vision*, 9 (1-2): 59-66

Chidumayo, E.N. (1989b). Land Use, Deforestation and Reforestation in the Zambian Copperbelt. In *Land Degradation and Rehabilitation*, 1: 209-216.

Chikozho, C. (2010). Applied Social Research and Action Priorities for Adaptation to Climate Change and Rainfall Variability in the Rain Fed Agricultural Sector of Zimbabwe. In *Physics and Chemistry of the Earth*, 35(13-14): 780-790. Retrieved from http://www.sciencedirect.com/science/article/pii/S147470651000135X#secx11 (Last accessed 12 July 2010)

Child, D.R.; Byington E.K. and Hansen, H.H. (1985). Goats in the mixed hardwoods in the South eastern United States. In: F.H. Baker and R.K. Jones (Eds): Multispecies Grazing.(= Winrock International Institute for Agricultural Development, Morrilton, AK) : 149–158.

Collin, D.C. (1932). The Problems of the North West Frontier, Curzen Press London.

Commoner, B. (1972a): The Closing Circle: Man Nature and Technology. New York, Knopf.

Critchley, W. (1999). Harnessing Traditional Knowledge for Better Land Husbandry in Kabale District, Uganda. In *Mountain Research and Development* 19 (3) :261-272

Daily, G. C. (1995). Restoring values to the world's degraded lands. *Science, New Series*, 269(5222): 350-354.

Danfeng, S.; Dawson, R. and Baoguo, L. (2006). Agricultural Causes of Desertification Risk in Minqin, China. In *Journal of Environmental Management*, 79 (4): 348-356. Retrieved from http://www.sciencedirect.com/science/article/pii/S0301479705002537 (accessed 30th August 2011)

DeFries, R. and Rosenzweig, C. (2010). Toward a Whole-Landscape Approach for Sustainable Land Use in the Tropics. In Science, 107: 19627-19632. Retrieved from http://www.pnas.org/content/107/46/19627 (Last accessed 6th September 2011)

Desprats, J. F.; Delpont, G. and Lagos, M. (2000). Combating Desertification in the Central Cordillera of Chile: Mapping Soil Vulnerability to Erosion Using Remote Sensing and GIS (online) *The Land*, 4(1), 15-28.

Diaz, S. (2001). Does the Biodiversity Matter to Terrestrial Ecosystem Processes and Services? Pp 216, (166). In Challenges of a changing earth: proceeding of the Global

Change Open Science Conference, Amsterdam, Neatherland, 10-13 July 2001; Will Steffen, Jill Jager, David J Carson and Clare Bradshaw (ed.). Berlin; Heidelberg; New York; Barscelona; Hong Kong; London; Milan; Paris; Tokyo: Springer, 2002 (Global Change- the IGBP series).

Dregne, H. E. and Chou. N-T. (1992). Global Desertification Dimensions and Costs. In *Degradation and Restoration of Arid Lands*, Lubbock: Texas Tech. University. Retrieved from http://www.ciesin.columbia.edu/docs/002-186/002-186.html (Last accessed May 2010)

Edward, B. B.; Sanchez, P.; Thomas, R. and Wagner, A. (1997). The Economic Determinants of Land Degradation in Developing Countries [and Discussion], Philosophical Transactions. In *Biological Sciences*, 352(1356): 891-899. Retrieved from http://links.jstor.org/sici?sici=0962-8436%2819970729%29352%3A1356%3C891%3ATEDOLD%3E2.0.CO%3B2-J (Last accessed March 2009)

Ehlers, E. (1982). Man and Environmental-Problems in Rural Iran. In *Applied Geography & Development*, 19: 126-138.

Ehlers, E. (1996). Population Growth, Resource Management and Well Adapted Land Use in the Bagrot/Karakoram. In *Applied Geography & Development*, 48: 7-28.

Ehlers, E. (1997). Traditional Environmental Knowledge and Consciousness and the Problem of Sustained Agricultural Development. In *Applied Geography & Development*, 49: 79-95.

Ehlers, E. (2000b). Sustainability- Indigenous Systems and Traditional Land Uses. The northern areas of Pakistan as an example. In Dittmann, A. (Ed): Mountain Societies in Transition. Contribution to the Cultural Geography of the Karakorum. Koln. (= culture area Karakorum Scientific Studies 6): 37-63.

Ehrlich, P. R. (1968). The Population Bomb. New York. Balllantine.

Elwell, H. A. (1985). An Assessment of Soil Erosion in Zimbabwe. Zimbabwe. In *Science*, 19: 27-31.

Eswaran, H.; Lal, R. and Reich, P.F. (2001). Land Degradation: An overview. In: Bridges, E.M.; Hannam, I.D.; Oldeman, L.R.; Pening de Vries, F.W.T.; Scherr, S.J. and Sompatpanit, S. (eds.). Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification, Khon Kaen, Thailand. Oxford Press, New Delhi, India. Retrieved from

http://soils.usda.gov/use/worldsoils/papers/land-degradation-overview.html (last accessed 12th July 2009)

FAO, (1996). Agro-Ecological Zoning: Guidelines. Chapter-2. Retrieved from http://www.fao.org/docrep/W2962E/w2962e-02.htm#TopOfPage (last accessed 12th July 2011)

FAO. (n.d). Overview of Land Desertification Issues and Activities in the People's Republic of China. Retrieved from http://www.fao.org/docrep/W7539E/w7539e03.htm (Last accessed on 28.January,2010)

Farooqi, A. (2006). Injudicious Agricultural Practices are Source of Breeding Environmental Problems in Pakistan. The Rural Citizen: Governance, culture and Wellbeing in the 21st Century. Retrieved from www.ruralfuturesconference.org/2006/Farooqi.pdf (Last accessed March 2009)

Fazlur-Rahman (2007). Persistence and Transformation in the Eastern Hindu Kush: A Study of Resource Management Systems in Mehlp Valley, Chitral, North Pakistan. Bonn. Bonner Geographische Abhandlungen 118.

Gazetteer of Kohat District. (1883-4). Reprinted by Spinzar Publications in 1990, Lahore.

Geist, H. J. and Lambin, E. F. (2004). Dynamic Causal Patterns of Desertification. In *Bio-Science*, 54(9): 817-829. Retrieved from http://www.bioone.org/doi/abs/10.1641/0006-3568(2004)054%5B0817:DCPOD%5D2.0.CO%3B2 (Last accessed on 10th January, 2006)

Glantz, M.H. and Orlovsky, N. (1983). Desertification: A Review of the Concept, Desertification Control Bulletin, 9:15-22.

GoNWFP and IUCN Pakistan, (2007). Natural Resource Management for Improved Livelihoods in Northern Pakistan. IUCN Pakistan, Peshawar, Pakistan.

GoNWFP. (1991). Bureau of Statistics, Planning and Development Department, Peshawar.

GoNWFP. (1994). Changhoze Dam Project: Feasibility Report, Irrigation Department Small Dams Directorate, Peshawar.

GoNWFP. (1997). NWFP Development Statistics 1997. Bureau of Statistics, Planning, Environment and Development Department Peshawar. Table 99 Page 201 (for 1986 data)

GoNWFP. (2007). Bureau of Statistics, Planning and Development Department, Peshawar.

Goodwins, B. (1969). Life Among the Pathans (Khattaks), Reprinted by Owl Printing Company Essak, UK in 1975.

GoP & IUCN. (1992). Pakistan National Conservation Strategy, Environment and Urban Division Islamabad Pakistan.

GoP (1988a). Environmental Profile of Pakistan, Environment and Urban Affairs Division Islamabad Pakistan.

GoP (2001). District Census Report of Karak 1998. (Report number 97)

GoP (2002). National Action Programme to Combat Desertification.

GoP (2004). Evaluation, Reclamation and Management of Saline-Sodic Soils in Kohat Division

GoP (2005). Medium Term Development Framework (2005-2010). Planning Commission, Government of Pakistan. Islamabad.

GoP (2011). Economic Survey of Pakistan (2010-2011). Ministry of Finance Islamabad. http://www.finance.gov.pk/survey_1011.html (last accessed 1st July 2011)

GoP. (1973). Soil Survey Bannu Basin.

GoP. (1988b). District Census of Rural Settlement, Karak, 1: 17-33.

GoP. (1998). NWFP Livestock Census 1996. Vol. II, Part I. Agricultural Census Organization Statistics Division, Government of Pakistan. Lahore. Table 1 Page1

GoP. (2000). National Report of Pakistan on the Implementation of United Nations Convention to Combat Desertification (UNCCD), Ministry of Environment, Local Government and Rural Development, Government of Pakistan, Islamabad

GoP. (2006). NWFP Livestock Census 2006. Agricultural Census Organization Statistics Division, Government of Pakistan Lahore. Table 1 Page1.

GoP. (2007). Soil Survey Pakistan.

Gordon, I.J. and Illius, A.W. (1992). Foraging strategy: from monoculture to mosaic. In: A.W. Speedy, Editor, *Progress in sheep and goat research*, CAB International, Wallingford: 153–177.

Graef, F.; Gaiser, T.; Herrmann, L. and Frick, T. (2001). Improved Targeting of Soil and Water Conservation Measures with the Soter Database in Niger. In *The Land* 5(3): 213-224.

Grainger, A. (2009b). The role of science in implementing international environmental agreements: the case of desertification. In Land Degradation & Development, 20: 410–430.

Grey, L. C. (1999). Is Land Being Degraded? A Multi-Scale Investigation of Landscape Change in South Western Brukina Faso. In *Land Degradation and Development*, 10(4), 329-343.

Hans, H. (1974). Irrigation in Kenya. In *Applied Geography & Development*, 4, 75-88.

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

Hasibullah, (2009). Environmental Challenges and Opportunities for the Developing Countries. In *Science Vision*, 15. (1): 1-13.

Heinz, E. (1986). The Effects of Environmental Factors and Use Alternatives upon the Species Diversity and Regeneration of Tropical Rain Forests. In *Applied Geography & Development*, 28: 19-36.

Herrmann S.M. and Hutchinson C. F. (2005). The Changing Contexts of the Desertification Debate. In *Journal of Arid Environments*, 63(3): 538-555. Retrieved from http://www.sciencedirect.com/science/article/pii/S0140196305000492 (Last accessed 10th December 2009).

Hillel, D. and Rosenzweig, C. (2002). Desertification in Relation to Climate Variability and Change. In Advances in Agronomy. D.I. Sparks, (Ed). Academic Press: 1-38. Retrieved from http://pubs.giss.nasa.gov/abs/hi02000x.html (Last accessed 30th August 2008)

Hillel, D. and Rosenzweig, C. (201*0).* In Handbook of Climate Change and Agroecosystems: Impacts, Adaptation, and Mitigation. (Ed). Hillel, D. & Rosenzwei*g*, C. ICP Series on Climate Change Impacts, Adaptation, and Mitigation Vol. *1* (London: Imperial College Press). Retrieved fro*m* http://pubs.giss.nasa.gov/abs/hi07100z.html (Last accessed 12 July 2010)

Hoermann, B.; Banerjee, S. and Kollmair, M. (2010). Labour Migration for Development in the Western Hindu Kush-Himalayas Kathmandu: ICIMOD

Hussain, J. L.; Najeeb ur Rehman, Hamayun, M.; Shah, T.; Nisar, M.; Bano, T; Shinwari, Z.K. and Lee,I.J. (2009). Proximate and nutrient analysis of selected vegetable species: A case study of Karak region, Pakistan *African Journal of Biotechnology*, 8(12): 2725-2729.

IFAD, (2009). Sending Money Home to Africa. Remittance Markets, Enabling Environment and Prospects. Rome: International Fund for Agricultural Development

IFAP, (2006). The Role of Farmers in Combating Desertification and Land Degradation. Retrieved from http://www.ifap.org/en/about/documents/PolicyDesertificationbackground.pdf (Last accessed 23rd October 2008)

Iffat, T. (2005). Women's Role in Household Income Generation by Using Natural Resources of Rangeland in Semiarid Mountainous Region of Pakistan: A Case Study of Karak district. University of Peshawar, Peshawar.

Iffat, T. (2006, 2007). Women's Role in Use and Management of Rangeland Resources in Semiarid Mountains: A Case Study from Karak district, North Pakistan. Paper presented at International Conference, The Sustainable Slopping lands and Watershed management: Linking research to Strengthen upland policies and practices. , Luang Prabang, Lao PDR. (12-15 December 2006).

Iffat, T. And Fazlur-Rahman. (2010). The Analysis of Rangeland Resources and Their Utilization in Karak District, Khyber Pakhtunkhwa, Pakistan. In *Pakistan Journal of Geography*, 20 (1&2): 85-94.

Iffat. T.; Fazlur-Rahman and Khan, A. (2009). Gender Role in the Use of Rangeland Resources in Semi-Arid Region: A Case Study of Karak District, North West Frontier Province (NWFP) Pakistan. . In *The Journal of Humanity and Social Sciences*, University of Peshawar XVII (1): 36-48.

Iqbal, M.M.; Goheer, M.A. and Khan, M. (2009). Climate Change Aspersions on Food Security of Pakistan. In Science Vision Vol.15 No.1: 15-24.

IUCN Pakistan (16 June 2011). IUCN Pakistan celebrated the World Day to Combat Desertification. International news release, Karachi. Retrieved from http://iucn.org/about/union/secretariat/offices/asia/asia_where_work/pakistan/?7688/IUCN-Pakistan-celebrated-the-World-Day-to-Combat-Desertification (Last accessed 30th June 2011)

IUCN. (1996). Sarhad Provincial Conservation Strategy

Jie, C.; Jing-zhang, C.; Man-zhL, T. and Zi-tong, G. (2002). Soil degradation: a global problem endangering sustainable development. In Journal o f Geographical Sciences 12, 2: 243-252. Retrieved from http://www.springerlink.com/content/c47520g3551r3138/fulltext.pdf (Last accessed 13th June 2011)

Jiggins, J. (1994). Changing the Boundaries. Women-Cantered Perspectives on Population and the Environment. Washington, D.C: Island Press.

Jurgen, K. (1997). Land Degradation in Namibia North of the Tropic of Capricorn: An Outline of the Problem. In *Applied Geography & Development*, 50: 21-37.

Kahlown, M.A.and Gill, M. A. (2004). Managing Saline-Sodic Groundwater In The Indus Basin: In *Science Vision*, 9. (1-2): 1-10

Kaoneka, A.R.S. and Solberg, B. (1994). Forestry related land use in the West Usambara Mountains, Tanzania. *Agriculture Ecosystem and Environment*, 49 (2): 207-215.

Kazi, Q. A. (2009). Environmental Degradation in the Mountainous Regions of Pakistan. In *Science Vision*, 15 (1): 25-32.

Khan, A.A.; Khan, K. and Chaudhry, S.M. (2010). Ecosystem Services and Human Wellbeing in Cholistan Desert Pakistan. In *Pakistan Journal of Geography*, 20 (1&2): 51-74.

Khan Abdul Ghaffar (2004). The Characterization of the Agro Ecological Context in Which FAnGR (Farm Animal Genetic Resource) Are Found: Technical Report on, Development and Application of Decision Support Tools To Conserve and Sustainably Use Genetic Diversity in Indigenous Livestock and Wild Relatives, Islamabad, Pakistan. http://www.fangrasia.org/admin/admin_content/files/3673.pdf (Last accessed December 2010)

Khan, N.M.; Ahmad, B.; Latif, M. and Sato, Y. (2004). Application of "Saltmod" To Evaluate Preventive Measures against Hydro-Salinization in Agricultural Rural Areas (A Case Study of Faisalabad, Pakistan). In *Science Vision*, 9 (1-2):111-117.

Khan,.K.F. (2000). Geography of Pakistan, Oxford Press, Karachi.

Kuang, C. W. (2010). Method That Turns Wastelands Green [Electronic Version], Retrieved from http://www.fastcompany.com/1655491/plan-to-turn-deserts-green-wins-2010-buckminster-fuller-challenge (Last accessed December 2010)

Kuhnen, F. (1992). Sustainability, Regional Development and Marginal Locations. In *Applied Geography and Development*, 39: 101-105.

Lestrelin, G. (2006, 2007). Local Knowledge and Land Degradation: A participatory case study in the uplands of the Lao PDR. Paper Presented at the Sustainable Slopping Lands and Watershed Management: Linking Research to Strengthen Upland Policies and Practices. Luang Prabang, Loa PDR.

Lestrelin, G.; Giordano, M. and Keohavong, B. (2005). When Conservation leads to land degradation: Lessons from Ban Lak Sip, Laos. Colombo: IWMI.

Lubchenco, J. (1998). Entering the Century of the Environment: A New Social Contract for Science. Science, New Series, 279: 491-497.

Lugo, A.E. (1992). Tree plantation for Rehabilitating Damaged Lands in the Tropics. In: M.K. Wali (Editor), Environmental Rehabilitation, 2, SPB Academic Publishing. The Hague: 247- 255.

Malik, J. S. and Nazli, H. (1998). Rural Poverty and Land Degradation: A Review of the Current State of Knowledge, *The Pakistan Development Review*, Pakistan Institute of Development Economics, 37(4): 1053-1070.

Mannava,V.K.; Sivakumar and Ndegwa, N. (Eds.) (2007). Climate and Land Degradation. In Environmental Science and Engineering. (Ed). Allan R. U.; Forstner and W. Salomons, Spingers, New York.

Mathieu, R.; Cervelle, B.; Rémy, D. and Pouget, M. (2007). Field-based andSpectral Indicators for Soil Erosion Mapping in Semiarid Mediterranean Environments (Coastal Cordillera of central Chile). Earth Surf. Process. Landforms 32: 13–31. [Published online 9 June 2006 in Wiley Inter Science]. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/esp.1343/pdf (Last accessed May 2009 and September 2011)

Maydell, H.V. (1985). Forestry in Areas with Marginal Site Conditions. In *Applied Geography & Development*, 26: 57-70.

Mbegu, A.C. (1996). The Problems of Soil Conservation and Rehabilitation: Lessons from the HADO project. Pp.147-157. In: Christiansson, C. and Kikula, I.S. (Eds). Changing Environments: Research on Man-Land Interrelations in Semi-Arid Tanzania. Sida'sRegional Soil Conservation unit, Nairobi Kenya

MEA. (2005). Millennium Ecosystem Assessment: Ecosystem and Human Well-being: Desertification Synthesis. Retrieved from http://www.eco-web.com/editorial/060715.html (Last accessed 23rd October 2008)

Mitchell, B. (1989). Geography and Resource Analysis. UK: Longman, Group Limited.

Mitchell, B. (Ed.). (1991). Resource Management and Development: Addressing Conflict and Uncertainty. Toronto: Oxford University Press.

Mitchell, J. K. (1974a). Natural Hazard Research. In, Manner, I. R. and Mikesell, M.W. (Ed). Perspectives on Environment, Publication No 13, Washington, D.C.

Nafees, M; Khan, H and Jan, M.R. (2009). Circulatory Land Tenure and its Social and Ecological Impacts: A Case Study of Village Allahdhandheri in North Pakistan. In *Mountain Research and Development*. 29: 59-66

NAS, R. A. (1992). The Royal Society and the National Academy of Sciences on Population Growth and Sustainability. In *Population and Development Review* 18(2): 375-378.

Nasir, A.1.; Uchida, K. and Ashraf, M. (2006). Estimation of Soil Erosion by Using RUSLE and GIS for Small Mountainous Watersheds in Pakistan: In *Pakistan Journal of Water Resources*, 10 (1): 11-21.

Nizami, A.; Malik, F. and Kamal.F.D. (Ed.) (2006). Dry land management: A Perspective for Livelihood Improvement in Rural Areas. Experiences from Pakistan. Islamabad.

Nüsser, M. (2002). Pastoral Utilization and Land Cover Change: A Case Study from the Sanqebethu Valley, Eastern Lesotho. In *Erdkunde*, 56: 207-221.

Nyangito, M. M.; Musimba, N. K. R., and Nyariki D. M. (2008). Range Use and Dynamics in the Agro Pastoral System of Southeastern Kenya. In *African Journal of Environmental Science and Technology*, 2 (8): 222-230. Retrieved from http://www.academicjournals.org/AJest (Last accessed 7th July 2010)

Oldeman, L. R.; Hakkeling, R. T. A., and Sombroek, W. G. (1990). World Map of the Status of Human-Induced Soil Degradation. An Explanatory. International Soil Reference and Information Centre, Wageningen, Netherlands.

Osman-Elasha, B.; Goutbi, N.; Spanger-Siegfried, E.; Dougherty, B.; Hanafi, A.; Zakieldeen, S.; Sanjak, A.; Atti, A.H. and Elhassan, M.H. (2006). Adaptation Strategies to Increase Human Resilience against Climate Variability and Change: Lessons from the Arid Regions of Sudan. AIACC Working Paper No. 42. Retrieved from http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP42_Osman.pdf (Last accessed March 2010).

OTA, (1982). Impacts of Technology on U.S. Cropland and Rangeland Productivity. Washington, DC: Office of Technology, U.S. Congress.

Otterman, J. (1977). Anthropogenic Impact on the Albedo of the Earth. Climatic Change.

Pickup. G. (1998). Desertification and Climate Change—the Australian Perspective. In *Clim Res*, 11: 51–63. Retrieved from http://www.int-res.com/articles/cr/11/c011p051.pdf (Last accessed 3rd September 2011).

Pimentel, D. (1993). World Soil Erosion and Conservation, Cambridge University Press.

Pimentel, D.; Harvey, C.; Resosudarmo, P.; Sinclair, K.; Kurz, D.; McNair, M.; Crist, S.; Shpritz, L.; Fitton, L.; Saffouri, R. and Blair. R. (1995). Environmental and Economic Costs of Soil Erosion and Conservation Benefits. In *Science*, 267: 1117-1123.

Plataforma, S.I.N.C. (2009). Perennial Vegetation: An Indicator of Desertification In Spain. In *ScienceDaily*. Retrieved from http://www.sciencedaily.com/releases/2009/09/090904071953.htm (Last accessed 9th September 2011)

Reed, M. S.; Dougill, A.J. and Taylor, M.J. (2007). Integrating Local and Scientific Knowledge for Adaptation to Land Degradation: Kalal Rangeland Management Options. In *Land degradation and Development*, 18: 249-268.

Reij, C.; Tappan, G.; Belemvire, A. (2005). Changing Land Management Practices and Vegetation on the Central Plateau of Burkina Faso (1968–2002). In *Journal of Arid Environments*, 63(3): 642-659. Retrieved from http://www.sciencedirect.com/science/article/pii/S0140196305000546 (Last accessed 10th December 2009).

Reynolds, J.F.; Smith, S.D.M.; Lambin, E.F.; Turner, B.L.; Mortimore, M.; Batterbury, S.P.J.; Downing, T.E.; Dowlatabadi, H.; Fernandez, R.J.; Herrick, J.E.; Huber-Sannwald, E.; Jiang, H.; Leemans, R.; Lynam, T.; Maestre, F.T.; Ayarza, M.; Walker, B. (2007). Global Desertification: Building a Science for Dry-Land Development. In *Science,* 316: 847–851.

Rhoades, R.E. and Thompson, S.I. (1975). Adoptive Strategies in Alpine Environments: Beyond Ecological Particularism. In *American Ethnologist,* 2(3): 535-551.

Saizen, I. ;Maekawa, A. and Yamamura, N. (2010). Spatial Analysis of Time-Series Changes in Livestock Distribution by Detection of Local Spatial Associations in Mongolia. In *Applied Geography,* 30, (4):639-649.

Santini, M.; Caccamo,G ;Laurenti, A.;Noce, S. and Valentin, R. (2010). A multi-Component GIS Framework for Desertification Risk Assessment by an Integrated Index. In *Applied Geography*, 30(3): 394-415. Retrieved from http://www.sciencedirect.com/science/article/pii/S0143622809000769#sec1 (Last accessed 30th August 2011)

Seeger, M. and Ries, J. B. (2008). Soil Degradation and Soil Surface Process Intensities on Abandoned Fields in Mediterranean Mountain Environments. In *Land Degradation & Development*, 19: 488–501.

Shakir, M.A.; Jamil, S.; Wasi, H.; Arshad, M. and Bano,A. (2011). Pakistan Agriculture in Changing Climate: An Overview. Paper presented at National Conference on Sustainable Agriculture in Changing Climate. July 7-9 2011 at Peshawar Univesity (Baragali Sumer Campus) Abbotabad. Pakistan Agricultural Scientists Forum.

Sher, H.; Ahmad, A.; Eleyemen, M.; Fazl-i-Hadi, S. and Sher, H. (2010). Impact of Nomadic Grazing on Medicinal Plants Diversity in Miandam, Swat-Pakistan (Preliminary results): In *International Journal of Biodiversity and Conservation,* 2(6): 146-154.

Singh, S. P. (1998). Chronic Disturbance, a Principal of Environmental Degradation in Developing Countries. *Environmental Conservation*, 25, (1): 1-2. http://www.foreignpolicybulletinmonitor.com/action/displayIssue?jid=ENC&volumeId=25&seriesId=0&issueId=01 (Last accessed 23rd October 2008)

Smith, S. D.M. and Reynolds, J.F. (2002). Desertification: A new Paradigm for an Old Problem. In Global Desertification: Do Humans Cause Deserts? Reynolds, J.F., Smith, S.D.M (eds). Dahlem Workshop Report 88. Dahlem University Press: Berlin, 403–424.

Stebbing, E. P. (1953). The Creeping Desert in Sudan and Elsewhere in Africa: 15-13 Degrees of Latitude, (Sudan) Khartoum. McCorquodale.

Stöber, G. and Herbers, H. (2000). Animal Husbandry in Domestic Economies: Organization, Legal Aspects and Present Changes of Combined Mountain Agriculture in Yasin. In Ehlers, E and Kreutzmann, H (Eds): High Mountain Pastoralism in Northern Pakistan. Stuttgart. (= Erdkundliches Wissen 132): 37-58.

Tang.H , Chen. Y and LI. X. (2008). Driving Mechanisms of Desertification Process in the Horqin Sandy Land- a Case Study in Zhalute Banner, Inner Mongolia of China. Front. *Environ, Sci. Engin*, 2(4): 487–493.

The News. (2009). Wildcat oil well in NWFP to start production soon Sunday, September 13, 2009. (Editorial by Riaz Khan Daudzai)

Thomas R.J. (2008). Addressing Land Degradation and Climate Change in Dry-land Agro-ecosystems Through Sustainable Land Management. In *Journal of Environmental Monitoring*, 10: 595–603.

Tröger, S. (2002). Sustainability in the Context of Natural and Social Environment: An Actor-oriented Interpretation from South-west Tanzania. *Erdkunde*, 56(2): 170-183.

Troeh, F. R.; Hobbs, J.A and Donahue, R.L. (1991). Soil and Water Conservation (2nd Ed.). Englewood Cliffs: NJ: Prentice Hall.

Tschopp, R.; Aseffa,A.; Schelling, A. and Zinsstag, J. (2010). Farmers' Perceptions of Livestock, Agriculture, and Natural Resources in the Rural Ethiopian Highlands. In *Mountain Research and Development*, 30(4):381-390.

Tulachan, P. M.; Saleem, M. A. M.; Maki-Hokkonen, J. and Partap, T. (2000). Contribution of Livestock to Mountain Livelihoods: Research and Development Issues (on- line). Chinese Academy of Sciences (CAS). Retrieved from http://books.icimod.org/index.php/search/author/321 (Last accessed march 2010).

Udall, S. L. (1963). The Quiet Crises. New York. Holt, Rinehart and Winston.

UNCCD. (1998): The Social and Economic Impact of Desertification in Several Asian Countries: Inventory Study. Geneva.

UNCCD. (2006). United Nations Convention to Combat Desertification. Retrieved from http://www.unccd.int/ and

http://www.globaleducation.edna.edu.au/globaled/go/cache/offonce/pid/2006 (Last March 2010)

UNCED. (1992): Agenda 21: Programme of Action for Sustainable Development. Rio de Janeiro, United Nations.

UNDP. (2009). Overcoming Barriers: Human Mobility and Development, Human Development Report 2009. New York: United Nations Development Programme

UNEP. (1992). World Atlas of Desertification, London, Arnold.

UNFPA. (1991). Population and the Environment: The Challenges Ahead.

United Nations Conference on Desertification - UNCOD. (1977). Desertification: Its Causes and Consequences. Compiled and edited by the Secretariat of the United Nations Conference on Desertification, Nairobi, Kenya, 29 August to 9 September, 1977, Pergamon Press. Oxford.

Vallentine, J.F. (2001). Grazing management, Academic Press, San Diego.

Vernooy, R. (2008). Learning together. Integrating Social and Gender Analysis into Natural Resource Management Research. In Mountain Forum Bulletin: 3-5.

Verstraete, M. M.; Brink, A. B.; Scholes. R. J.; Beniston, M., and Smith M. S. (2008). Climate Change and Desertification: Where Do We Stand, Where Do We Go? In *Global and Planetary Change,* 64: 105–110.

Verstraete, M. M.; Hutchinson, C. F.; Grainger, A.; Stafford Smith, S. M.; Scholes, R. J.; Reynolds,J. F.; Barbosa, P.; Le´on, A. and. Mbow, C. (2011). Towards a Global Dry-lands Observing System: Observational Requirements and Institutional Solutions. In *Land Degradation and Development,*22: 198-213

Verstraete, M.M. (1986). Defining desertification: A Review. Climatic Change, 9: 5–18.

Vogt, J. V.; Safriel, U.; Von Maltitz, G.; Sokona, Y.; Zougmore, R.; Bastin, G. and Hill, J.(2011). Monitoring and Assessment of Land Degradation and Desertification: Towards New Conceptual and Integrated Approaches. In *Land Degradation and Development,* 22: 150–165.

Walker, H. H. (1984). Problem of the Organization of Irrigation Projects. A System Orientated Study of Irrigation Projects in Developing Countries. In *Applied Geography and Development,* l4: 20-45.

Wang, X.; Chen, F. and Dong, Z. (2006).The Relative Role of Climatic and Human Factors in Desertification in Semiarid China. In *Global Environmental Change*, 16 (1):48-57. Retrieved from http://www.sciencedirect.com/science/article/pii/S0959378005000476 (Last accessed 9th September 2011)

WAPDA, (1983). Technical Report on Groundwater Resources in Domail Plain Bannu and Karak Districts, NWFP Report number iv-1.

WAPDA, (1988). Hydrology and Groundwater Resources of the North-West Frontier Province Pakistan, Peshawar.

WAPDA, (2004). 3rd National Seminar on Drainage in Pakistan NWFP Agricultural University Peshawar 1.

Warraen, A. (2002). Land Degradation is Contextual. In *Land Degradation and Development*, 13: 449-459.

Warren, A.; and Agnew, C. (1988). An Assessment of Desertification and Land Degradation in Arid and Semi-Arid Areas [Electronic Version], Retrieved from (http://www.ciesin.org/docs/002-315/permit.html (Last accessed 20th November 2008)

White, G.F. (1973). Natural Hazard Research: 193-216. In Chorley, R.J. (ed), Direction in geography, Methuen, London.

White, G.F. (Ed.). (1974a). Natural Hazard Research: Concepts, Methods and Policy Implications. Oxford University Press New York.

White, G.F. and Hass, J.E. (1975). Assessment of Research on Natural Hazard. MIT Press Cambridge.

Whitehead, E.E.; Hutchinson, C.F.; Timmermann, B.N., and Varady, R.G. (eds). (1988). Arid Lands Today and Tomorrow. Westview Press: Boulder, CO.

Whyte, A. V. T. (Ed.). (1986). From Hazard Perception to Human Ecology, 2. Chicago Press Chicago.

Winslow, M.; Shapiro, B.I.; Thomas, R.; and Shetty, S.V.R. (2004). Desertification, Drought, Poverty and Agriculture: Research Lessons and Opportunities. Aleppo, Syria, Patancheru, India; and Rome, Italy. Retrieved from http://www.iwmi.cgiar.org/Assessment/files/Synthesis/Land%20Degradation/DDPAARLO_text.pdf (Last accessed 20th November 2010)

Worldwatch Institute. (1992). State of the World. Washington, DC: Worldwatch Institute.

WRI. (1994). World Resources 1994-95. Washington, DC: World Resources Institute.

WRI. (1998). World Resources 1998-99. Washington, DC: World Resources Institute.

WWF. (1993). Sustainable Use of Natural Resources, Concepts, Issues and Criteria. Paper presented at the Annual WWF conference, Gland Switzerland.

Zahidullah andAhmad, A.(2011). Invasive Alien Species (Ias): A Threat to Sustainable Agriculture under Changing Climatic Conditions. Paper presented at National Conference on Sustainable Agriculture in Changing Climate. July 7-9 2011 at Peshawar Univesity (Baragali Sumer Campus) Abbotabad. Pakistan Agricultural Scientists Forum.

Zhang, K.; Yu, Z; Li, X.; Zhou, W. and Zhang, D. (2007). Land use change and land degradation in China from 1991 to 2001. In *Land Degradation and Development*, 18: 209-2119.

Zia, M. S.; Tariq, M.; Mirza B. B.; and Aslam. M. (2003). Land and Environmental Degradation and Its Amelioration for Sustainable Agriculture in Pakistan. In *Science Vision*, 9 (1-2): 1-5.

Zia, M.S.; Mahmood, T.; Baig, B. M. and Aslam, M. (2004). Land and Environmental Degradation and Its Amelioration for Sustainable Agriculture in Pakistan. In *Science Vision*, 9 (1-2): 1-5.

Zia-ul-Hassan, S. and Arshad, M. (2006). Land Degradation in Pakistan: A serious Threat to Environments and Economic Sustainability. Retrieved from http://eco-web.com/editorial/060715.html (Last accessed 24th August 2010)

ANNEX – 1

Village Name _____ Questionnaire No:
Respondent Name:_____ Age _____. Education: _____
Total persons living in this house.

Relationship with Respondent	Age	Sex	Marital status	Education	Occupation	Income	Place of work

How many people of your family are working abroad?
Where?----------since how long?----------type of job
After how long they visit home?----------approximate amount sent/ year
Where do you spend that money?
Where do you invest that money?
What are the good and bad affects of these people on local community?

How this has changed the women role (responsibilities/ workload)

Agriculture;
Land resource; Farm size. ----------. Rain-fed. ----------. Irrigated. ----------
Irrigation type
Share in communal land----------
Tenure: Owner cultivator: Tenant: Lease out/owner: Tenant/owner: Lease out:
Type of crops

Season	Crops Grown	
	Now	30 years back
Rabi		
Kharif		
Any other		
Most Common		

Any change noticed in agricultural practices or agricultural resource depletion during your life time?

Change in agricultural practices.

Issues of land: Soil erosion, Water scarcity, Soil Salinity, Water logging, Any other. If yes then
Indicators

Causes
Coping Strategies

Agricultural inputs	Now		30 years back	
	Type	Amount	Type	Amount
Fertilizers				
Irrigation				
Seeds				
Mechanization.				

Agricultural outputs

Crops types	Production / yield	
	Current	30 years back

Live stock

Type	Number.		Use.		Income.	
	Present	30years back	Present	30years back	Present	30years back
Cow						
Bull						
Donkey						
Camel						
Goat						
Sheep						
Buffalos						
Others						

Where do you keep your livestock?
1. Cattle post- 2. Lands 3. Inside house
Feeding method (tick):
A; grazing in rangeland: Yes No: If yes: a. Daily: b. weekly: c. seasonally: d. any other:
B; stall-feeding: Yes No: If yes a. cultivate fodder b. buy grass and fodder c. any other

2:Source and type of Energy

Purpose of Use	Type (1 very importnt--3 least importnt)	Source (buy or collect)
Cooking		
Heating		

If fuel-wood do you buy it? YesNo
If yes, from where: Locals Non locals
2.2 The price you pay is, 1. increasing 2. decreasing 3. constant
2.3 If collecting, how much time is spent, and distance you cover to collect the fuel-wood 1. increased 2. decreased 3. stayed the same
2.4 Would you say that you face fuel-wood shortage? 1. Yes 2 No (If no, Go to 3)
2.5 If yes, Causes?

Coping strategies

3 Other natural resources /or rangeland products you harvest from the rangeland are:

Type of resource	Increasing	Decreasing	Remained constant
Grasses/hay			
Medicinal herbs			
Wild fruits/ vegetables			
Construction material			
Salt			
Honey			
Dung cakes			
Wild life			
Any other			

3.1 What in your opinion are the reasons for rangeland resources decrease?

3.2 What in your opinion are the reasons for rangeland resources increase?

Plantation. Plantation has increased or decreased
Trees increased. Type Location
Trees decreased. Type Location

Why?

Impacts
Have you noticed any decrease or increase in water resources?

Type of resource	Increasing	Decreasing	Remained constant
Rainfall			
Local bund(Gandi)			
Water table depth			
Any other			

ANNEX – 2

Questionnaire for whole village.

Name of the village. ----------
Patwar circle. ----------
Distance from main road. ----------
Distance from hill. ----------
Population.
Total land.
Total houses.
Main economic activity of the people.
Migration.
Second economic activity.
Main resources of the village.
Cultivable land. ----------.
Rangeland.
Industries.
Facilities.
Health. ----------. Schools boys---------. Girls ----------. Water. Drinking-------. Irrigation. ----------. Distance of Veterinary hospital. ----------. Market----------.
Do you have any social intuitions in your village for resource management? Please name them and describe the function and role.
Who run them and how?
Do people cooperate? If not why?
Who have right to use the resource?
How often?
3.3 What are the indigenous and introduced/technical management systems that were/are used to manage rangeland products, and how effective are they?

Indigenous Management Systems (past practices)

Effectiveness 1. Effective 2. Moderately effective 3. Ineffective
Technical Management Systems

Effectiveness 1. Effective 2. Moderately effective 3. Ineffective

3.4 Are you aware of any policy that deals with natural resources / rangeland products management in your area?
1. Yes 2. No (go to 3.5)
If yes which policies, and how successful are they in addressing the problem of rangeland product depletion?

Success in addressing the rangeland product depletion?
1. Very successful 2. successful 3. moderately successful 4. unsuccessful
3.5 Are you aware of any programme / project that deal with natural resources / rangeland products management in your area? 1. Yes 2. No (go to3.6)
If yes, which project and how successful is it in addressing the problem of rangeland product depletion?

Success in addressing the rangeland product depletion?
1. Very successful, 2.successful 3. moderately successful 4. unsuccessful
3.6 Are you aware of any local institutions or committees that deal with rangeland product management in your village?

1. Yes 2. No (go to 3.7)
If yes, name them, their functions, and how you are/were involved with them

Involvement of indigenous people

3.7 Are you aware of any institution (Government or NGO) in your village/district that deals with management in your village? i) Yes ii) No (go to 3.8)
If yes, name them and their function or role on rangeland product management issues.

Function/Role of the institution

3.8 Have you ever had any training (workshop, seminar) in rangeland product management issues?
i) Yes ii) No (Go to 3.11)
3.9 If yes, what was it about? Please specify.

_____

3.10 Do you think the training has helped you in managing rangeland products better?
1. Yes 2. No (Go to 3.11)
If yes, in what ways?

_____

3.11 What in your opinion are the three most important possible solutions to rangeland product depletion? Who do you think should initiate/facilitate them and what would be your role in these solutions?
Solution

Facilitator: *1. Individual 2. Community 3. Government 4. NGO*
Your role in implementing solutions

ANNEX – 3

Major projects related to Drainage, Salinity Control and Land Reclamation Undertaken by National Engineering Services Pakistan (NESPAK)

Project	Location	Client
Rahim Yar Khan Salinity Control and Reclamation Project (SCARP VI)	Pakistan	Water and Power Development Authority
Khushab Salinity Control and Reclamation Project	Pakistan	Water and Power Development Authority
Mardan SCARP Project	Pakistan	Water and Power Development Authority
Dera Ghazi Khan and Ghotki SCARP Project	Pakistan	Water and Power Development Authority
Water Logging Control in Muzaffargarh Canal Command	Pakistan	Irrigation & Power Deptt., Govt. of the Punjab
Fordwah Eastern Sadiqia Surface Drainage Project	Pakistan	Water & Power Development Authority
National Drainage Programme (Phase-I)	Pakistan	Water & Power Development Authority
Lower Indus Right Bank Irrigation and Drainage Project	Pakistan	Water & Power Development Authority/World Bank
Dera Ghazi Khan Integrated Drainage and Irrigation Project	Pakistan	Water & Power Development Authority
Lining of Distributaries and Minors in Punjab	Pakistan	Irrigation & Power Deptt., Govt. of the Punjab
Left Bank Out Fall Drain Stage-I	Pakistan	Water and Power Development Authority
National Drainage Programme	Pakistan	Water and Power Development Authority and Provincial Irrigation & Power Deptts.
Extension of Right Bank Out Fall Drain from Sehwan to Arabian Sea	Pakistan	Irrigation & Power Deptt., Govt. of Sindh
National Drainage Programme, NWFP	Pakistan	Irrigation & Power Deptt., Govt. of NWFP

Retrieved from
http://www.nespak.com.pk/projects/major.asp?Ar=4&sector=2
(Last accessed 25th September 2011)

ANNEX – 4

Climatic characteristics of district Karak (1999-2008)

	Mean monthly temperature		Mean monthly temperature	Average monthly rainfall	Mean monthly relative humidity		Mean monthly relative humidity
	max	Min			Max	Min	
January	18.5	4.3	11.4	29.4	77.36	36.87	57.1
February	21.3	7.8	14.55	29.54	78.05	42.00	60.02
March	27.4	12.4	19.9	36.39	75.61	33.45	54.5
April	34.1	18.9	26.5	21.18	64.31	33.62	48.98
May	38.3	20.9	29.6	28	57.27	23.40	40.33
June	40.3	26.4	33.35	68.47	62.92	33.38	48.15
July	34.1	26.8	30.45	130.02	77.61	42.02	59.81
August	36.4	23.5	29.95	106.84	81.11	44.31	62.71
September	35.1	23.7	29.4	58.73	80.04	39.82	60.4
October	32.6	16.1	21.3	6.48	72.07	33.55	52.81
November	23.7	9.9	16.8	4.95	70.21	35.26	52.73
December	19.6	6.7	13.15	13.38	71.96	30.68	51.32

Source: Processed from data obtained from AWAF Karak

ANNEX – 5

List of Natural Vegetation in Karak District

S. No.	Botanical Name	Local Name	Uses
1.	Nerium oleander	Gandechar	Fodder, Fuel wood
2.	Agave wightii	Azghakai	Medicinal herb
3.	Amaranthus viridas	Sarjmai	Medicinal herb
4.	*Calatropis procera*	Spalmai	Medicinal herb
5.	*Heliotrophium europeuea*	Shamakai	Fodder
6.	*Opuntia dillenii*	Zuqam	Medicinal herb
7.	*Pakinsonia aculeate*	Kabalai kikar	Fuel wood
8.	*Capparis dcidua*	Kirra	Fruit
9.	*Maytenus roylenia*	Manroo	Medicinal herb, Vegetable
10.	*Citrullus colocynthis*	Takha Hinduana	Medicinal herb, Vegetable
11.	*Euphorbia indica*	Mandaro (type)	Medicinal herb, Vegetable
12.	*Chrozophora tinctoria*	Barsandai	Vegetable
13.	*Otostigeae limbata*	Spin azgay	Medicinal herb
14.	*Salvia aegyptica*	Khar ghwag	Fodder
15.	*Salva macrofitina*	Khar ghwag	Fodder
16.	*Aloe vera*	Zargaia	Medicinal herb
17.	*Melia azedrech*	Tora bikanra	Fuel wood
18.	*Acacia nilotica*	Zair Kikar	Fuel wood
19.	*Acacia modesta*	Phalosa	Medicinal herb, fuel wood
20.	Prospis glandulosa	Anrezae kaker	Fuel wood
21.	*Albizia lebback*	Srikh	Medicinal herb
22.	*Phonix sylvestris*	Kajoor	Fruit, Raw material
23.	*Nanrrhopes richiana*	Maizare	Raw material, Fodder
24.	*Aristida adscensionis*	Wakha	Fodder
25.	*Symbopogon jawarancusa*	Sargare	Fuel wood
26.	*Sacchrum spontaneum*	Nare nal	Fodder
27.	*Zizipus numilarea*	Karkanda	Fodder
28.	*Zizipus muritiana*	Bera	Fodder, Fruit, Medicinal herb, Fuel wood
29.	*Zizipus oxyphylla*	Markhanay	Medicinal herb
30.	*Dodonea viscose*	Ghoraske	Medicinal herb
31.	Monoteca buxifolia	Gorgwara	Fruit

32.	*Datura stramulaceae*	Daltoora	Medicinal herb
33.	*Withiana coagulans*	Shepianga	Medicinal herb
34.	*Withiana somnifera*	Margounay	Medicinal herb
35.	*Tamarix aphylla*	*Ghaz*	Fuel wood, Fodder, Raw material
36.	*Vitex trifolia*	Marvanday	Medicinal herb
37.	*Peganum harmala*	Spelanai	Medicinal herb
38.	*Tribulus terristris*	Markondai	Fodder
39.	*Fagonia Arabica*	Azghakai	Medicinal herb, fuel wood
40.	*Carallong tuberculala NE Brow*	Pawanny	Vegetable
41.	*Chnopodum album linn*	Torsomay	Fodder
42.	*Menthe arresis linn*	Walana	Vegetable, Medicinal herb
43.	*Convolvulus arrensis linn*	Parwathe	Vegetable, Medicinal herb
44.	*Fagonia Arabica linn*	Spilsngzai	Medicinal herb
45.	*Ficus carica linn*	Inzar	Fodder, Fuel wood
46.	*Cynodon dactylon linn*	Pardwd	Fuel wood
47.	*Eucalyptus camoldulinsiecllecht*	Lachi	Fuel wood
48.	*Fumarid indica hausslin*	Soraka	Medicinal herb
49.	*Planlago lanccolata linn*	Spiegot	Medicinal herb
50.	Periphoca aphylla dene	Birard	Fuel wood, Fodder
51.	Ricinus communis linn	(Arand) Randa	Fuel wood, Medicinal herb
52.	Rhazyd stricta decine linn	Gandaray	Medicinal herb, Fuel wood
53.	Solanum sorattense burn	Maraghoni	Medicinal herb, Fuel wood
54.	Taraxacum officinali weber	Zairgulay	Medicinal herb
55.	Witharia coagulans dunal	Shapyanga	Medicinal herb
56.	Cyperus rotendrus	Deela	Fodder, Raw material
57.	Digitaria stricta roth	Shamookha	Fodder
58.	Portulaca deracea	Warkhary	Saag(Edible)
59.	Sacchanim spantanum	Sargrhi	Raw material
60.	Rimbrislylis dichomoma	Barware	Raw material

ANNEX – 6

Karak District: Land capability classification

Soil quality	(Area in %)		Description/ suitability
	1973	2007	
I: (Very good)	00.21	3.18	Can be used for cultivation, normally the irrigated land
II: (Moderate)	07.24	12.91	With normal precipitation give good returns.
III: (Poor dry farm land)	24.46	11.21	Efforts are needed to grow crops and fodder.
VI: (Fair grazing land)	05.37	0	Land with good quality and quantity of grasses
V: (Poor grazing land).	57.80	69.64	Used for grazing and fuel wood collection. Productivity highly dependent on rainfall.
IV: (Agriculturally un productive).	04.92	3.06	----------
TOTAL	100.00	100	

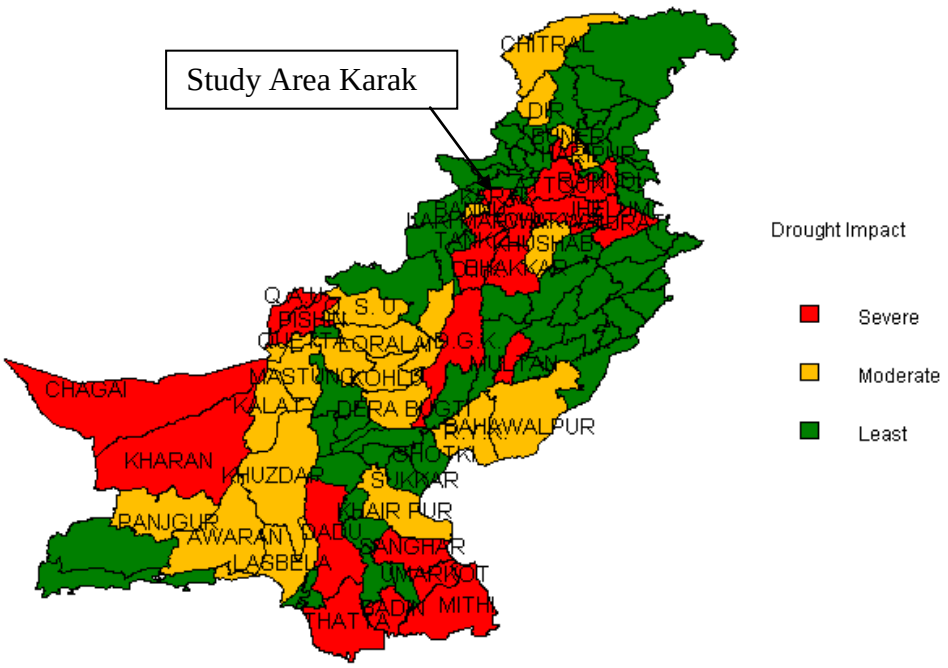
Source: Soil Survey of Pakistan (2007).

ANNEX – 7

Drought Affected Districts by Province - Government Classification

Balochistan		Sindh	**NWFP**		Punjab	
Severe	Moderate	Severe	**Severe**	Moderate	Severe	Moderate
Pishin Killa Abdulla Chagai Kharan	Quetta Kalat Mastung Loralai Killa Saifulla Panjgoor Dera Bugti Kohlu Lesbella Khuzdar Sibi Awaran Musakhail Barkhan	Badin Thatta Singha Tharparker Umar Kot Dadu	D.I Khan L. Marwat **Karak** Swabi	Bannu Chitral Shangla Low Dir Buner Haripur	Miawali Attock D.G. Khan Chakwal Jhelum Rawapindi Gujrat Bhakkar Cholistan	B/walpur Khushab Sheikupura
4	14	6	4	6	10	4

Source: FAO/WFP (11 July 2001): Special Report on Crop and Food Supply Assessment Mission For Pakistan. Retrieved from



ANNEX – 8

Map 9: Groundnut growing areas of Pakistan