IUCN Pakistan Programme

Northern Areas Strategy for Sustainable Development

Background Paper

Rangelands and Livestock

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Published by: IUCN, Northern Areas Programme.

IUCN
The World Conservation Union

Citation: Dr. Abdul Ghaffar Khan, 2003.
NASSD Background Paper: Rangelands and Livestock.
IUCN Pakistan, Northern Areas Progamme, Gilgit. viii+47 pp.

Series editor: Hamid Sarfraz

ISBN: 969-8141-56-1

Cover & layout design: Azhar Saeed, ECK Group, IUCN Pakistan

Printed by: Rosette Printers, Karachi

Available from: IUCN-The World Conservation Union
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Fax: 05811-55 799
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LIST OF ACRONYMS

AKRSP	Aga Khan Rural Support Programme
AKDN	Aga Khan Development Network
AKCSP	Aga Khan Cultural Services, Pakistan
AKHS	Aga Khan Health Services
AKPBS	Aga Khan Planning and Building Services
BACIP	Building and Construction Improvement Programme
GoP	Government of Pakistan
IG	Interest Group
LB&RDD	Local Bodies and Rural Development Department
P&DD	Planning and Development Department
NAPWD	Northern Areas Public Works Department
NACS	Northern Areas Conservation Strategy
NA	Northern Areas
NAA	Northern Areas Administration
NGO	Non-Government Organisation
WASEP	Water and Sanitation Extension Programme
WSHHSP	Water Sanitation Hygiene and Health Studies Project

FOREWORD

The Northern Areas have a unique and critical role to play in the sustainable development of Pakistan. Although they span a relatively small geographical area, the Northern Areas serve as a vital catchment for the Indus River, upon which a majority of Pakistan's irrigated agriculture and hydroelectricity depends. The Northern Areas also contain the nation's most important natural forests, extensive mineral reserves, and a wealth of biodiversity. Dramatic scenery, some of the world's highest mountains, and a rich cultural and archaeological heritage make the Northern Areas one of the most visited tourist destinations in the country.

Over the last several decades, however, many of the Northern Areas' natural resources have come under increasing pressure, as a result of a growing human population and the opening of the Karakoram Highway. At the same time, it has become increasingly recognised that the isolated nature of many of the region's communities, coupled with the Northern Areas' high-altitude and fragile environment, poses special constraints and challenges to development. Perhaps more so than in any other part of Pakistan, there is a need in the Northern Areas to ensure that social and environmental considerations are fully integrated into the development process.

In response to these concerns, the Northern Areas Administration began the preparation of a Northern Areas Strategy for Sustainable Development in 1999, with the financial assistance of the Swiss Agency for Development and Cooperation, and the Norwegian Agency for Development Cooperation; technical support has been provided by IUCN–The World Conservation Union. The Strategy addresses a broad range of social, economic and environmental issues, and seeks to provide a comprehensive policy framework for the sustainable development of the region. It responds directly to the provisions and recommendations of the National Conservation Strategy, adopted by the Government of Pakistan in 1992.

In parallel, *The State of the Environment and Development in the Northern Areas* summarises in a single volume the key information gathered during the preparation of the NASSD. It is the first report of its kind to be produced for the Northern Areas, which provides a succinct, up-to-date and readily accessible analysis of the status of the most important environment and development sectors in the Northern Areas, including information on major trends and issues, the responses taken by both government and civil society to date, and strategic options for the future. It also provides a baseline against which future change can be measured and establishes the context and foundations for the Northern Areas Strategy for Sustainable Development.

During early consultations at the tehsil level, and with key governmental and non-governmental organizations 16 areas of intervention were identified as being critical for the NASSD. These include sectors like: water; agriculture; forestry; biodiversity; rangelands and livestock; the private sector; energy; urban

environment; and cultural heritage and sustainable tourism. In addition, some crosscutting themes were identified as crucial to each sector, including population, poverty and environment; communication for sustainable development; environmental education; NGOs; gender, environment and development; environmental health; and governance.

To address the needs of each of these areas, basic information was gathered through consultations and literature reviews. This data was analysed through background papers commissioned on each of the sectors and themes identified. The draft of each paper was shared with the larger community of stakeholders of the NASSD as well as experts in the relevant field of knowledge.

The papers follow a similar format: analysis of the current situation; issues; past and present initiatives in the sectors and thematic areas along with the lessons learnt; stakeholders; and recommended policy and action measures. The authors have also addressed cross-sectoral linkages and environmental concerns for the sake of more integration in planning for sustainable development.

There were constraints to developing these Background Papers and in some cases these hurdles were only partially overcome. These included the fragmented and scattered nature of information, the prevalent culture of not sharing information, contradictory and unreliable data, lack of thinking on cross-sectoral linkages and integrated planning, and lack of expertise in developing linkages with the environment.

Parts of the information of the papers were then incorporated into the State of the Environment and Development (SoED) and the main strategy, i.e., NASSD. However, since the Papers contain a wealth of extremely useful information, a decision was taken to produce a series of NASSD Background Papers.

Considering the need and importance of timely sharing information with the stakeholders, these papers are being produced without extensive editing. The authors have sole responsibility for the views expressed and data presented.

1. INTRODUCTION

1.1. Location, Geographical Area and Landholdings

Northern areas of Pakistan lie at the extreme north of the country (between 35-37°N and 72-75°E) where it borders the Xinjiang province of China. Chitral lies to its west and Kalam, Kohistan and Kaghan Valleys to the South. The newly independent republic of Tajikistan is only a handshake away. To its east lie the occupied territories of Ladakh and Kashmir. Northern area is one of the most rugged in the world where four mountain ranges, The Himalayan, Karakoram, Hindu Kush and Pamir meet. Most elevations in the area are at least 1500m above the sea level and more than half is above 4500m. The area contains 19 peaks higher than 7600m.

The northern area has a total geographical area of 72,496 km2. Land use is dominated by mountains (34% of area), rangelands (52%) with a small area of natural forest (4%). Less than 1% of the land is cultivated, about one percent of land is cultivable waste and 8% uncultivated waste (Table 1).

Table 1: Land Use of Northern Areas

Land Use	Area (million ha)	Percentage
Mountains	2.440	34
Forests	0.313	4
Rangelands	3.760	52
Cultivated area	0.054	1
Cultivable waste	0.060	1
Uncultivated waste	0.618	8
Total	7.245	100

Source: Census of Agriculture 1990, FAO, 1992

These areas are spread over 72,496 km2 populated by about one million people with population density as 14 person/square kilometre. The average household size is 7.2 persons. People with an average of 0.12 million hectare of agricultural land are living in about 650 villages, which are very widely scattered (NAS, 1996). The major inhabited land lies between 1100-2200 m (Whiteman, 1985; Dost, 1995 and 1997).

Presently, the Northern Areas are divided into five administrative districts of Gilgit, Skardu, Diamir, Ghizar and Ghanche. The Himalayas, the Karakoram, Pamir and the Hindu Kush mostly cover the area. K-2, Nanga Parbat, Gashbrum-1, 2, Broad peak and numerous world ranking peaks majestically stand above the heights. Outside the Archie world's largest glacier, Siachin is located here. Mighty Indus flows out of these to irrigate the entire country. Karakoram highway is the main communication link, joins China with Pakistan and also connects Northern Areas with the rest of the country.

1.1.1. Climate, Environment and Livelihood

Northern Areas are with 19 mountain peaks higher than 7,600m above sea level and more than half the land above 4,500 m. The Indus River and its early tributaries run through these mountains in narrow steep sided valleys and there are great ecological variations at short distances. Soil, rainfall and temperature vary with topography, elevation and other aspects, shaping both the natural and the man made environment. Below 3,000 m, precipitation is minimal, rarely exceeding 200 mm annually, but there is a strong gradient with altitude and at 6,000 m, the snow falls equivalent to 2,000 mm per year. Temperatures in the valley bottoms can vary from extremes of 35 to 40oC in summer and from -5 to -20oC in winter.

The mountain ecosystems tend to be relatively unstable, non-resilient, and of low inherent productivity. These areas can also be subjected to sudden mudslides and rock falls which frequently block roads and irrigation channels. Within this fragile environment, there are varieties of ecological niches upon which people base their livelihood.

Despite this physical challenging environment, the population of the Northern Areas exceeds 1million with an annual increase of about 5%. The local economy depends to a great extent, on subsistence agriculture. Crop production relies on irrigation using a system of channels that divert water from springs and streams fed by melt water from the high mountains. The need for irrigation curtails the proportion of land that can be cultivated and has led to the development of well-defined villages on the valley floors. The limits to cultivate land area mean that the average land holdings are generally insufficient to support the local population. This necessitates seasonal migration of male family members to the plains of Pakistan, where labour opportunities are more plentiful. A significant proportion of household income is, however, derived locally and livestock are central to the local agricultural economy.

The vast majority of households keep livestock for a range of purposes: milk, meat, wool, hair, dung production, as gifts for religious purposes, for traction and as capital investment. For many households, livestock products remain mostly within the household although some households use livestock as a source of cash income (ICIMOD, 2001).

A typical family's livelihood is based mainly on the farm, various livestock, common pasture and forest, and economic activities unrelated to the farm. Most of the people follow farming practices evolved through generations of trial and error. Cultivated land managed by the family close to the house averages only 0.76ha, of which one-fifth in under tree crops of apricot, apple, walnut, willow and poplar, and four-fifths is used for annual crop for food and forage. Spring wheat of local varieties is the dominant food crop and, where double cropping is possible, maize and vegetables follow wheat. In the transitional zone areas around 2300m, barley and maize replace wheat, and at the limit of cultivation close to 3,300m, only barley, peas, turnips and potatoes are grown. Leguminous forage crops include deep-rooted perennial alfalfa are grown on screens and lower slopes below irrigation channels and clover on fields within the village.

1.1.2. Agro-Ecological and Cropping Zones

The cropping areas can be clearly related to the ecological zones on the basis of altitude.

1.1.2.1. Double Cropping Zone

This zone is confined to valleys in the southern and central areas where altitudes are less than 2000m (1200-1800m) above sea level. The growing season is long enough for a double crop, late autumn sown wheat followed by early summer sowing of maize. Wheat and barley are sown in late winter and early spring followed by early sowing of maize.

1.1.2.2. Transitional Cropping Zone

These areas are located between 2000m and 2300m in eastern and northern side and are confined to middle and higher valleys of Indus River, where the growing season is not long enough for two crops.

1.1.2.3. Single Cropping Zone

The area is restricted to the upper limits of the valley where the altitude is greater than 3300m. The growing season is less than 5 months and only a single crop of either maize or wheat can be grown.

1.1.3. Livestock and Rangeland Interaction

Because of low rainfall, shortage of irrigated land, small farms and a reduction in the growing season with altitude, there is a shortage of fodder. From May to October the animals are grazing within the summer pastures. Depending upon the altitude, the critical periods of shortages are from January to April. Since, the physical features of the Northern Areas suggest about 52% rangeland and 4% forest therefore, these favour for the production of livestock. However, relatively greater number of livestock as compared to the availability of feed from the grazing area has negatively affected the rangeland. This inadequacy of range bio mass coupled with low agricultural crop residues and fodder production has also make the situation of feed availability bad. Moreover, pressure on rangeland from grazing animals has created a negative impact on the rangeland and thus the range is degraded and if this trend continues more degradation may occur and denudation of the rangeland is likely to happen.

1.2. Rangelands of Northern Areas

Rangelands are ecosystems that play critical ecological roles, which include feed resources, habitat for wildlife, source of biodiversity and pollution buffer. Rangelands are primary resource base available to rural people and are vital for local economics. Furthermore, they are major and most economical source of forage for livestock, particularly for sheep and goats. They are defined as the land on which the native vegetation is predominately grasses, grass like plants, forbs and shrubs. Productivity and vegetation of rangelands depend upon many factors such as types of soil, relative elevation and climatic variations. Moreover, quality of forage availability from rangelands can also vary depending upon plant species, phonologically stage of plants and general climatic attributes.

According to Mohammad (1989), rangelands in Pakistan occupy 45.2 million ha, which is about 51.4% of the total land surface of country. Rangelands of Northern Areas occupy 2.1 million ha, which constitute about 29.8% of the total rangelands of the Northern Areas. The details of the rangelands of Pakistan are given in Table 2.

Table 2: The Distribution of Rangelands in Pakistan (in million ha)

Province	Total land	Rangeland	% of Rangeland
Punjab	20.63	8.2	39.7
Sindh	14.00	7.8	55.3
NWFP	10.12	6.1	59.9
Balochistan	34.72	27.4	78.9
Northern Areas	7.04	2.1	29.8
Azad Kashmir	1.33	0.6	45.1
Total	87.98	45.2	51.4

According to the livestock census of Northern Area (Pakistan), 1996, the population of sheep and goats has increased substantially from 0.88 million in 1976 to 1.56 million in 1996, with an annual growth rate of 3.56%. This increase has resulted pressure on rangelands. Since, the animal production systems in rangelands operate on low input basis and the problem of pressure on grazing land is further increased by the animals brought for grazing by the nomads from the down country. This is particular to the ranges of Deosai plateau between Astore and Skardu and Punial and Ishkoman. Therefore, increase in grazing pressure will become worse over the period of time. The decline in vegetation cover due to grazing pressure will accelerate erosion and desertification of rangelands.

Northern Areas of Pakistan are located out of the monsoon rain shadow. The natural environment is harsh and with alternating temperatures which are low in winter and high in summer. It is estimated that except in alpine pasture (1.68 million ha) in Northern Areas where dry matter bio mass production is about 1500 kg/ha that is within the normal range, however, most of the other rangelands produce significantly less dry matter biomass, which is nearly 100-500 kg/ha. The estimated annual forage dry matter (DM) production from rangelands of the Northern Areas is given in Table 3.

Table 3: Estimated Annual Forage Production from Rangelands

Rangeland	Area	Current production		Improvement potential	
		DM	Total DM	DM	Total DM
	(mha)	(t/ha)	(mt)	(t/ha)	(mt)
Alpine pastures	1. 68	1. 50	2.52	2.50	4.20
Trans-Himalayan Grazing lands	3.50	0.60	2.10	2.00	7.00
Himalayan forest Grazing lands	0.67	0.60	0.40	3.00	2.01

Source: Mohammad, 1989.

The population of sheep and goats has increased substantially from 0.88 million in 1976 to 1.56 million in 1996. Rangelands being the major source of feed particularly for sheep and goats in Northern Areas are subjected to misuse and due to centuries of over grazing, the productivity of rangelands has been adversely affected. The details of the grazing areas in Pakistan are presented in Table 4.

To elaborate the livestock stocking rate situation in Northern Areas, the total livestock population was converted into animal unit and the stocking rate calculated keeping in view the area under rangelands. Total animal unit present in Northern Areas are 0.72 million where the rangelands are 3.76 million. Therefore,

the stocking rate is 5.2 ha/animal unit. FAO (1987) has reported that a critical stocking rate should be of 16 ha/animal unit for low potential range. The above calculation leads to the conclusion that the current stocking rate is about 3 times more than reported by FAO and the rangelands are burdened and over grazed. This situation is leading towards depletion of rangelands in terms of bio mass production, soil erosion and degradation. Moreover, this overstocking of animals does not allow them to produce as per their inherent production capacity.

Table 4: Grazing areas of Pakistan

Province	Geographic	Area sown to crop	Balance for grazing	% of Pasture
	Area in"000 ha"			
Punjab	20,629	10,398	10,231	50
Sindh	14,098	3,170	10,928	78
NWFP	10,178	1,519	8,660	85
Balochistan	34,734	476	34,258	99
Northern Areas	7,027	41	6,986	99
Azad Kashmir	1,330	171	1,159	87
Pakistan	87,996	15,775	72,222	82

Source: Land Utilization Statistics of Pakistan 1984-1985.

There are three range areas in Northern Areas of Pakistan, which are as follows:

- Alpine pastures
- Trans-Himalayan grazing lands
- Himalayan forest grazing lands

The details regarding type of ranges, their area and distribution are given in Table 5.

Table 5: Range Areas of Northern Areas

Area	Extent (mha)	Distribution
Alpine Pastures	1.68	Northern Mountains, altitude above 3500 m.
Trans-Himalayan Grazing lands	3.50	Hindu Kush Region
Himalayan Forest Grazing lands	0.67	Western Himalayas

Source: Mohammad, 1989.

1.2.1. Description of Range Areas

The description of each type of range areas are described in the proceeding paragraphs.

1.2.1.1. Alpine Pastures

These include areas from district of Gilgit, Diamir, Chilas and Skardu of Northern Areas and areas from districts of Hazara, Swat, Dir, Chitral and Malakand. Alpine pastures are characterized by short, cool growing seasons and long, cool winter. Slow growing perennial, herbaceous and shrubby vascular plants and extensive mats of cryptograms (mosses, lichen, etc.) mostly dominate the vegetation. Much of the landscape of the alpine pastures is rugged and broken with rocky, snow capped peaks, spectacular cliffs and slopes. However, there are also many large areas,

gently rolling to almost flat topography. The forage production from various range types in alpine and sub alpine zones is given in Table 6.

Table 6: Forage Production from various Range types in alpine and sub alpine zone

Range Types	Forage Yield (DM kg/ha)
Meadows	1,240
Shrub meadows	2,660
Shrub	2,400
Kail/Fir forage range	1,270
Birch range	Not sampled
Shrub – grassland	2,300
Grasslands	2,300

Source: Mohammad, 1989.

The main limiting factor for proper forage production is low temperature during many months of the year. The average forage production recorded was 700 kg/ha. Alpine meadows contain luxuriant ground flora. These alpine meadows have the greatest value as grazing lands. Trees are conspicuous by their absence in this type. Vegetation consists of perennial forbs and grasses belonging to the genera Poe, Festuca, Stipa and Agropyron. The average carrying capacity of a well-managed area is considered to be about 5 ha per animal unit. Alpine forests are subjected to heavy grazing during summer. No planned grazing system is followed. Crop production, livestock rearing and forestry are major land uses. Maize, rice, wheat and barley are important cereal crops. Native flora of alpine pastures is given below:

Tree/Shrubs: *Juniperus communis, Rosa webbiana, Berberis lycium, Berberis spp, Cotoneaster spp.*

Grasses: *Phleum alpinum, Agrostis gigantea, Trisetum spp. Poa spp. Agropyron dentatum, Agropyron caninum, Festuca ovina, Alopecurus gigantea, Dactylis glomerata, Pennisetum lanatum, p. filaccidum, Clamagrostis pseudopharag mites, Oryzopsis spp, Carex spp.*

Forbs: *Plantago ovata, Plantago major, P. lanceolata, Trifolium pratense, T. repens, Fragaria Wesca, Medicago spp, Potentilla spp. Rumex nepalensis, Polygonum alpinum, Anaphalis contorta, Thymus serphyllum, Astragalus spp, Taraxicum officinalis, Iris hookriana, Nepata spicata, Saxifraga iacquemon tiana.*

Medicinal Plants: *Aconitum heterophyllum, Aconitum chasmanthum, A. laeve, Saussurea lappa, Rehum emodii and Podophyllum hexandrum (Karki and William, 1999).*

1.2.1.2. Trans-Himalayan Grazing lands

These grazing lands spread over northern mountains in Dir, Chitral, Swat, Gilgit, Chilas and Skardu districts. This region constitutes a series of high mountain ranges of Karakoram, Hindu Kush and Pamir. The altitude varies from 1500m to 8600 m and includes 19 peaks over 7000m, such as K2, Nanga Parbat, Rakaposhi and Trichmir. The area has rugged, steep and dissected slopes and narrow valleys, subject to active geologic erosion. The terrain is a naturally unstable, landslide and rock falls are very common.

The climate of the area is that of a mountain desert with bitterly cold winters and hot dry summers. The climatic variation in the area is greatly influenced by altitudinal differences. Lower altitude (below 2300m) experience marked diurnal as well as seasonal temperature variations and scanty precipitation. The areas between 2300 and 3300m receive sufficient snow and enjoy a temperate climate. Areas above 3300m are very cold with a limiting growing season. Most of the areas are beyond the reach of summer monsoon rainfall. Average rainfall in the valleys is 100-300mm most of which occurs during winter and early spring.

Crop production, livestock rearing and forestry are major land use in this area. Maize, rice, wheat and barley are important cereal crops. Double cropping is practiced up to 2300m while above that altitude only single-short duration crops can be raised. Orchards of apricot, apple and mulberry are important components of the farming system. According to Shiekh and Khan (1982), these areas are subjected to heavy pressure by livestock as well as shortage of fuel wood. Alpine pastures are in good condition but due to environmental limitations, the growth period is short. Low lying ranges are in fair to good condition. Ahmad and Qadir (1976) conducted physiological studies along Gilgit to Gupis. The following range plants are found in these areas:

Tree/Shrubs: *Juniperus macropoda, Quercus ilex, Pinus gerardiana, Cedrus deodara, Pinus wallichiana, Fraxinus xanthoxyloides, Artemisia maritima, A. sacrorum, Indigofera spp. Ephedra spp, Daphne oleoides, Sophora spp, Cotoneaster spp., Parrotia jacquemontiana, Salix spp., Jasminum spp., Sorbaria tomentosa, Caragana spp.*

Grasses: *Chrysopogon spp., Cymbopogon spp, Dichanthium annulatum, Pennisetum orientale, Aristida spp., Oryzopsis spp., Dactylis glomerata, Poa spp, Bromus inermis, Agropyron dentatum, A. caninum, Agrostis spp., Rottboellia exaltata, Phacelurus speciosus, Eragraostis spp.*

Forbs: Iris spp., *Tulips spp., Polygonum spp., Sambucus ebulus, Lotus comiculatus, Medicago spp., Plantago lanceolata, Lathyrus spp., Thgmus serphyllum, Nepata spicata, Viola spp., Taraxicum officinalis, Ferns, etc.*

Medicinal Plants: *Ephedra nebrodensis, Artemisia maritima, Carum bulbocastanum, Thymus and Ferula, Juglans regia, Pinus gerardiana and Zizyphus sativa.*

1.2.1.3. Himalayan Forest Grazing Lands

Himalayan forest grazing lands cover Siran, Kaghan, Neelam and Jhelum Valleys. These areas can be ecologically divided into moist temperate and subtropical humid zones. The wet temperate zone occurs between 2000m to the timberline. Kail, deodar, spruce and fir forests are abundant in this zone. Most of the areas in this zone receive more than 1000 mm during the monsoon, which creates heavy soil erosion, as the topography is steep and disturbed by unscientific cropping. In this area summers are cool but winters are very cold.

Forestry, cropping and livestock grazing are the major land uses. Maize, rice and wheat are the major crops. Apple orchards cover a large area. Bluepine and chirpine forests cover an extensive area throughout the tract. Grazing is done in forests and

along water channels and on cropped areas. Important plants in the Himalayan forest grazing lands are listed below:

Trees: *Pinus wallichiana, Picea smithiana, Taxus baccata, Cedrus deodra, Quercus incana, Q. dilatata, Q. semicarpifolia, Juglans regia, Aesculus indica, Acer pictum, A. caesium, Populus alba, P. ciliata, Pyrus spp.*

Shrubs: *Vibernum nervosum, Indigofera spp., Rosa webbiana, Salix spp., Cotoneaster spp., Pistacia spp., Berberis lycium, Prunus cornata, Rhododendron arboreum, Sarcococca saligna, Rubus spp., Desmodium spp., Strobilanthus spp.*

Grasses: *Dactylis glomerata, Agropyron dentatum, Phacelurus speciosus, Rottboellic exalatata, Alopecurus gigantea, Pennisetum flaccidum, Oryzopsis spp., Poa spp. Stipa sibirica, Bromus inermis, Bothriochloa paseudoischaemum, Chrysopogon echineulatus, Themeda anathera.*

Forbs: *Plantago ovata, P. major, P. lanceolata, Senecio spp., Rumex nepalensis, Astragalus spp., Trifolium repens. T. pratense, Lotus corniculantus, Fragaria vesica, Medicago spp., Geranium collinum, G. nepalensis, Thymus serphyllum, Polygonum aviculare, P. parencoides, Phlomis bracteosa, Taraxicum officinalis.*

Medicinal Plants: *Zizyphus vulgaris, Punica granatum, Berberis lycium, Skimmia laureola, Viola serpens, Dioscorea spp., Valeriana wallichii, Atropa acuminata, Colchicum luteum, Asparagus racemosus, Mentha piperita.*

1.3. Livestock of Northern Areas

Northern Areas being an arid region, predominantly has a range based livestock production system and sustainable lively hood for people particularly living in the rural areas. Cattle, goats and sheep are better adapted to Northern Areas and greatly outnumber buffalo and camels.

1.3.1. Livestock Resources: Population Size and Distribution

In Northern Areas, the livestock resources consists of cattle, some buffaloes, sheep, goats and camels. Furthermore, there are also pack animals such as horses, donkeys and mules. Domestic poultry is also present in these areas. These animals are basically reared for a range of purposes: milk, meat, wool, hair, eggs, dung and for traction. Many farmers use livestock as source of cash income. Cattle, goats and sheep are predominant livestock, but there are also significant numbers of buffaloes, donkeys, yaks, and horses, as well as small numbers of camels and mules. The livestock census of 1996 estimated that there were over two million number of livestock in Northern Areas. If the poultry is excluded, then the livestock number falls to 1.7 million livestock (Table 7).

The per annum growth rate for cattle, buffalo, sheep, goats, camels, horses, donkeys and mules were 4.52, 5.46, 3.06, 4.31, 24.37, 0.71, 0.25, 20.39 and 5.57 percent, respectively during the period from 1976-96.

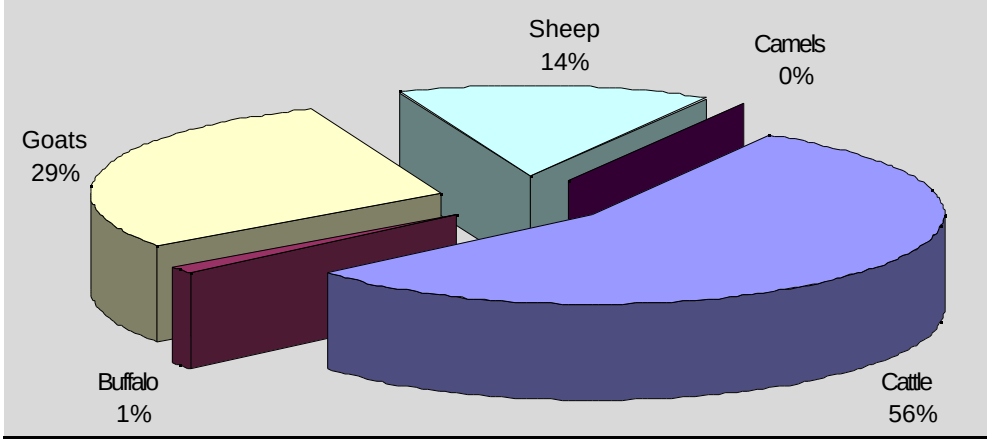
Livestock population of the Northern Areas for the year 1996 was converted into the animal units. A careful perusal of the animal unit of different livestock species indicated

Table 7: Livestock Populations (in 000) of Northern Areas (1996)		
Species	**Population**	**Animal Units**
Cattle	397,957	398.00
Buffalo	6,208	9.42
Goats	1,047,285	209.40
Sheep	518,052	103.60
Camels	141	0.21
Horses	7,903	8.00
Donkeys	21,483	17.19
Yaks	15,098	15.00
Mules	955	7.64
Domestic Poultry	609,344	-
Total	2,379,928	1524.82

Source: Livestock Census, 1996.

that there are maximum population of cattle followed by goats and sheep in the Northern Areas. The percentage of ruminants animal units are presented in Figure 1.

Figure 1: Ruminants as Animal Units (Percentage)

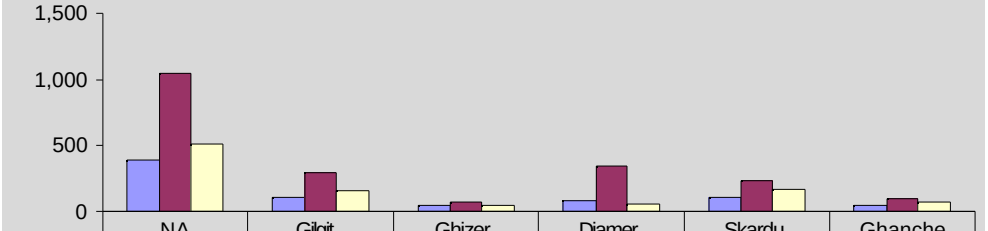


Source: Agricultural Census Organization, 1998.

1.3.1.1. Distribution of Livestock

The distribution of livestock in different districts of Northern Area is shown in Figure 2.

Figure 2: Distribution of livestock in the Northern Areas, by district (in thousands)



	NA	Gilgit	Ghizer	Diamer	Skardu	Ghanche
Cattle	398	114	51	83	107	44
Goats	1,047	289	77	349	239	93
Sheep	518	162	44	60	177	75

Source: Agricultural Census Organization, 1998.

The distribution of large and small ruminants varies considerably in different districts of Northern Areas. The largest population of cattle is in Gilgit and Skardu districts. However, buffaloes are highest in Diamir. The highest population of goats is in Diamir followed by Gilgit and Skardu, whereas sheep are highest in the district of Skardu and Gilgit. The higher number of goats in these districts is due to the prevailing suitable climatic conditions and the preference by the graziers.

1.3.1.2. Breeds of Small Ruminants

1.3.1.2.1 Sheep Breeds of Northern Areas and their Characteristics

There are three major breeds of sheep available in the Northern Areas and their names and characteristics are presented in Table 8.

Table 8: Sheep Breeds of Northern Areas and their Characteristics

Breed	Habitat	Adult Weight (kg)	Purpose	Production Characteristics
Baltistani	Baltistan District	Male=27.6 Female=24.8	Mutton, milk, wool and manure	Short tailed Milk Yield 0.8L/day Dressing %=48.0
Gojal	Hunza Valley	Male=38.5 Female=33.8	Mutton, milk, wool and manure	Fat tailed Milk Yield 0.76L/day Mutton Quality Fair Dressing %=60.0
Kohai Ghizar	Kohai Ghizar Mountain	Male=36.5 Female=32.6	Mutton, wool and manure	Rudimentary fat tail Mutton Quality fair Dressing %=55.0
Kail	Azad Kashmir	Male=40 Female=35	Mutton and Milk	Thin tailed Milk Yield 0.6L/day Mutton Quality Good Dressing %=45.0

Source: Sheep and Goats in Pakistan, FAO Animal Production and Health Paper 56, Food and Agriculture Organization of the United Nations Rome, 1985.

Among the available breeds of Northern Areas, the most promising breed in terms of adult weight is Gojal having highest male and female weights. This breed is used both for meat and milk purposes. To improve the efficiency of sheep breeds of Northern Areas, breeding programs based on selection and cross breeding should be planned and implemented. Selection and production of superior quality rams and their distribution to the farming community will help to upgrade the existing genetic potential of farmers flock. However, cross breeding program should be carefully planned and only the needed suitable production traits should be introduced. For example Kail breed of sheep from AJK has reasonably good adult body weight and reasonable daily milk yield. This sheep is also well suited for pasture grazing and can be a potential breed for crossbreeding in Northern Areas. A successful cross breeding program of local sheep with exotic rambolliat ram in Abottabad district, NWFP can be a good option for crossbreeding program in Northern Areas.

1.3.1.2.2 Goat Breeds of Northern Areas and their Characteristics

There are four major breeds of goats available in the Northern Areas and their names and characteristics are presented in Table 9.

Table 9: Goat Breeds of Northern Areas and their Characteristics

Breed	Habitat	Adult Weight (kg)	Purpose	Production Characteristics
Baltistani	Baltistan District	Male=28.8 Female=25.6	Milk, Mutton, Hair and Manure	Milk Yield 1.1 L/day Dressing %=49.0
Jara Khiel	Chilas/ Diamir District	Male=51.5 Female=42.0	Milk, Mutton, Hair and Manure	Milk Yield 1.39 L/day Dressing %=56.0 Mutton Quality good
Kohai Ghizar	Kohai Ghizar Mountain (Gilgit-Yasin)	Male=41.0 Female=35.6	Milk, Mutton, Hair and Manure	Milk Yield 0.97 L/day Dressing %=50.0 Mutton Quality fair
Piamir	Khunjerab, Upper Hunza Valley	Male=40.5 Female=36.0	Milk, Mutton, Hair and Manure	Milk Yield 0.80L/day Dressing %=58.0 Mutton Quality fair

Source: Sheep and Goats in Pakistan, FAO Animal Production and Health Paper 56, Food and Agriculture Organization of the United Nations Rome, 1985.

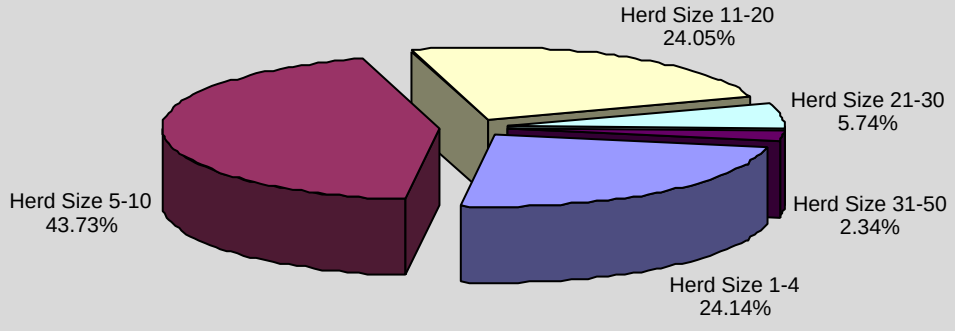
Among these goat breeds, Jara Khiel posses best characteristics regarding adult body weight, dressing percentage and daily milk production. To upgrade the goat production performance, selection of the superior animals should be adopted as a continuous phenomenon. Animal Husbandry Department of the Northern Areas should introduce a nucleus herd of potential goat breed (Jara Khiel) for the production of superior bucks. These superior bucks can onward be distributed among the farming community to increase the flock production efficiency.

1.3.1.3. Breed Characteristics and Flock Size

1.3.1.3.1 Cattle

The indigenous cattle of Northern Area are mainly of non-descript breeds. They have become dwarfed in the process of acclimation with the environment including

Figure 3: Cattle herd size in the Northern Areas



Source: Agricultural Census Organization, 1998.

low input: low output scenario. Local cattle are relatively small, typically weighing between 200 and 220 kilograms. On an average they produce 1.5 litres of milk per cow per day (Wardeh, 1989) to 3-4 litre of milk per cow per day (Debord, 1989). Another report suggested an average milk yield of about 1.0 litre of milk per cow per day in Chitral (Mulk, 1981). Animals reach maturity between the ages of three to four years, depending on their nutritional status. Herd size is generally small, and rarely exceeds 20 animals (Figure 3).

Female animals are maintained for milk, which is consumed fresh during the winter and converted into ghee and cheese during the summer. Milk yields are approximately 300 kilograms per lactation; the calving interval is more than 24 months. As there is considerable competition between the households and calves for milk, young animals are generally undernourished and the sexual maturity of females is delayed, mainly as a result of insufficient protein intake. Male animals are seldom castrated and are used for traction and breeding; bull production exclusively for breeding is unusual.

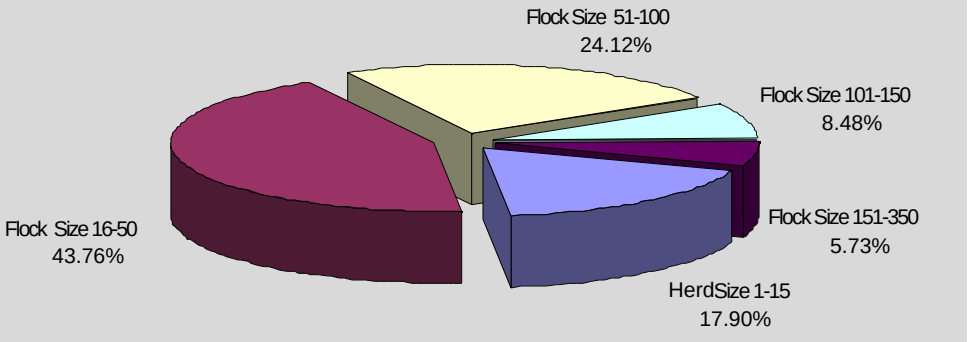
The actual genetic potential for milk, meat and reproductive performance has not yet been established by livestock researchers. However, it is believed that improved nutrition and management could lead to significant improvements.

At higher altitudes, cattle are replaced by yaks. Yaks are cross-bred with cattle to produce a hybrid (known as a zo), which is highly prized for draught purposes. The males are sterile but the females produce more milk than cattle (400 litres per lactation, with higher fat content).

1.3.1.3.2 Goats

Goats are the most numerous livestock species, and are used to produce milk, meat and hair. Flock sizes rarely exceed 150 animals. Most common flock size ranges 16-50 goats followed by flock size ranging 51-100 goats (Figure 4).

Figure 4: Goat flock sizes in the Northern Areas



Source: Agricultural Census Organization, 1998.

Average daily milk production ranges between 0.8 to 1.0 litre, which is approximately 60 litre during the course of 80-100 days lactation period. Generally, mature body weights vary considerably, typically ranging from 20 to 30 kilograms for male and slightly less for females; however, potential weights of up to 45 kilograms can be achieved with proper feeding and management.

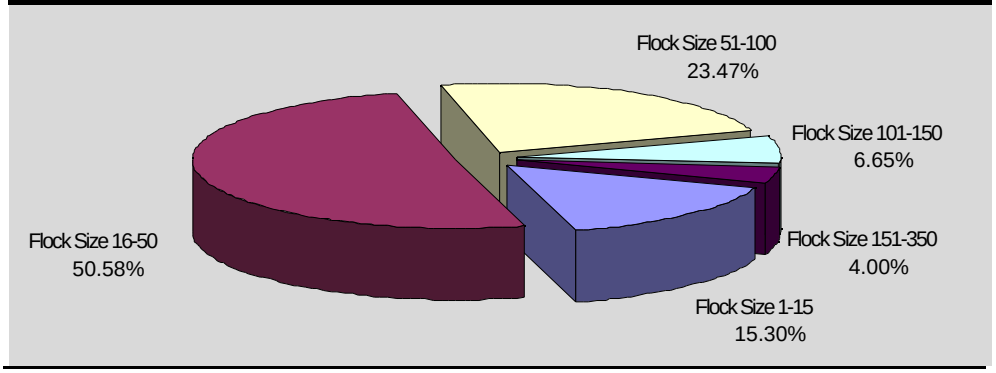
Goat management is generally poor, and neonatal mortality is high. First year death rates are reported to be as high as 33 percent, the principal causes of death are malnutrition and low temperatures, combined with parasitic infestation and clostridial diseases. Deaths in adults are reported to be approximately 25 per cent.

Kidding is an annual event, which takes place in February and March, and occasionally in September. Twinning is reported in only ten per cent of the kids dropped. In these two months there is a severe winter that is coupled with high deficiency of available feed resources. Resultantly, the goat suffer from mal nutrition and cannot produce enough milk. Consequently, the kids cannot get required quantity of milk and thus suffer with nutritional deficiencies and develop low immune system that leads to high kid mortality.

1.3.1.3.3 Sheep

There are three major breeds of sheep in the Northern Areas. Sheep are reared for the production of meat and coarse wool. Most common flock size ranges 16-50 sheep followed by flock size range 51-100 sheep (Figure 5).

Figure 5: Percentage of Sheep by Flock Size



Source: Agricultural Census Organization, 1998.

Their reproductive and meat production indices are similar to those for goats, as are their mortality rates. Twinning is reported in ten per cent of the lambing in the double-cropped zone.

1.3.2. Feed Resources

Nutritional inadequacy has been identified as a principal limiting factor for low livestock productivity in Northern Areas. Lack of sufficient feed resources particularly the quality fodder during the winter season is mainly responsible for reduction in body weight of adult animals and death loses in newly born lambs and kids. The major feed resources are pasture, and fodder in summer and crop residues, particularly maize stover, grass hay and tree lopping during winter. The feed budget situation in northern area is depicted in Table 10.

Table 10: Estimated Livestock Feed Budget for NA

	Estimated Total Availability (tons)	Estimated Total Requirement (tons)	Deficit (%)
Total Digestible Nutrient	490,000	710,000	31
Digestible Protein	42,000	77,000	45

Source: Archer, 1994

The estimates indicated that there is a severe deficiency of digestible protein and total digestible nutrients to the tune of 45 and 31 percent, respectively. This deficiency has resulted into low production performance of both small and large ruminants

Table 11: Contribution of Feed Resources for TDN and DCP in Northern Areas

Feed Resources	TDN		DCP	
	million tons	%	million tons	%
Crop residue	0.132	26.9	0.016	38.1
Range	0.300	61.2	0.021	50.0
Grazing	0.062	12.7	0.005	11.9
Total	0.490	100.00	0.042	100.0

Archer (1994) described that there are basically three feed resources such as crop residues, range land biomass and grazing on the side of water channel and fallow lands. Among these crop residues alone contributes around 50% of the digestible crude protein (DCP) and more than 60% of the total digestible nutrients (TDN).

Because of the small landholdings and the limited availability of irrigation water, only a relatively small area is planted for fodder. Farmers employ a variety of strategies to meet fodder requirements, but crop residues and stubble grazing remain the mainstay of winter nutritional support. Traditional feed resources and feeding practices in Northern Areas are summarized as below.

- Summer grazing in high altitude, alpine pastures is exploited to the maximum;
- Excluding alpine grazing, 70 per cent of the NA livestock feed resources is derived from maize stover and wheat straw; seven per cent is obtained from Lucerne hay;
- Farmers deliberately select tall growing wheat and maize varieties, which produce relatively low grain yields but large amounts of straw and stover crop residues are carefully conserved and stored, often on roofs or in trees;
- Cereals are sown at two to three times the recommended seeding rates. This permits thinning for green fodder and increases straw production;
- High quality leguminous fodders are grown on small areas of land. Shaftal (Trifoliurn resupinatum) is grown for green feed during the spring and Lucerne (Medicago sativa) is grown to produce hay as winter feed;
- Multi-purpose trees, such as willow (Salix spp.), mulberry (Morus spp.) and Russian olive (Elaeagnus spp.), are planted on field edges and marginal land. Their leaves and shoots provide supplementary fodder in winter. In some areas, leaves are dried and stored for winter use.

Fodder situation in northern areas indicate a fodder deficiency from November to March, when the season for the main summer fodder crop (maize) is over and the traditional winter fodders such as shaftal (TrifoIium resupinaturn) and Lucerne (Medicago sativa) are still dormant. The seasonal availability of feed resources for livestock in Northern Areas is presented in Table 12.

With the exception of some farmers in the double-cropped areas, who may have access to fodder produced elsewhere, most farmers do not procure additional feed supplies. The shortfall is made up almost entirely by summer grazing. However, many animals are poorly fed during the summer months and enter the winter in poor

Table 12: Seasonal Calendar of Feed Availability in NA

Fodder Resources	J	F	M	A	M	J	J	A	S	O	N	D
Green Fodders:												
Grasses					X	X	X	X	X			
Bersemm/Lucern/Shaftal	X	X	X	X							X	X
Barley or Oat				X	X							
Maize									X	X		
Fodder trees				X	X	X	X	X	X	X	X	
Grazing in Rangelands/G Forests				X	X	X	X	X	X	X	X	
Dry Fodders:												
Hay	X	X	X								X	X
Maize Stover	X	X	X								X	X
Concentrates:												
Cake (only to milking animals)	X	X	X	X	X	X	X	X	X	X	X	X
Period of severe Feed Shortage	X	X									X	X

condition. As a result, many animals experience a nutritional shortfall throughout the year. A significant proportion of the NA livestock - particularly lactating cows and goats are deficient in protein, energy, trace elements and vitamins.

Double-cropped areas tend to generate larger amounts of crop residue and are thus able to support a greater number of cattle. Single-cropped farms tend to maintain larger flocks of sheep and goats and fewer cattle; this is primarily because the absence of a winter crop permits free grazing (for which the smaller animals are well suited), and because the lower availability of crop residues renders the maintenance of larger animals untenable. The opportunities for producing sufficient fodder on single- cropped farms are limited to the residues available from just one annual crop, and animals on this farm type are often poorly served nutritionally.

Winter feed derived from mature maize stayer and dried grass is high in fibre but low in digestible energy and protein. Maize and grass are harvested late, when fibre content and quantity are at their highest; this is a deliberate strategy linked to the NA scarcity of forage and the long tradition of under-feeding. Farmers know that fibrous feed slows down digestion, thus enabling livestock to over-winter on less fodder. Many animals, however, are physically unable to consume sufficient quantities to satisfy their needs and lose considerable bodyweight during the course of winter.

1.3.3. Livestock Production and Management Systems

There are three principal types of livestock production and management systems in the Northern Areas: pastoral; transhumant; and sedentary. However, in and around big cities commercial system at house hold level has recently being introduced mainly to supply fresh milk to the urban population.

The numbers of large and small ruminants under various production system are presented in Table13.

1.3.3.1. Pastoral System

According to the 1996 livestock census, there were 15779 large and small ruminants under the pastoral system in the Northern Areas. These ruminants are reared in a

Table 13: Ruminants Under Various Production Systems in Northern Areas			
Species	**Stall Feeding**	**Grazing**	**Both**
Large Ruminants	14,559	1,702	299,703
Cattle	14,559 (4.6%)	1,601 (.5%)	299,175 (94.89%)
Buffaloes	-	101 (16.05%)	528 (83.95%)
Small Ruminants	15,144	14,077	1,126,582
Sheep	3,710 (.8%)	3,849 (.8%)	450,573 (98.83%)
Goats	11,434 (1.64%)	10,228 (1.47%)	676,009 (96.89%)
Total	29,703	15,779	1,426,285

Source: Livestock Census, 1996, Northern Areas
Note: Ruminants population given in this table exclude Dimmer District.

nomadic system of animal husbandry, characterized by a continuous search for pasture and the year-round movement of cattle, sheep and goats. Only 0.5 % cattle, 0.8% sheep and 1.47% goats, out of their total population comes under the pastoral system. True pastoralists do not own any land nor do they engage in farming activities.

Livestock move between the alpine and sub-alpine pastures. They typically spend four to five months in the alpine pastures, and the remainder of the year at lower ranges. Non-local pastoralists pay communal landowners for the rights to graze their animals for specific periods.

1.3.3.2. Transhumant System

A vast majority of the Northern Area ruminants (0.143 million) are managed under the transhumant system of animal husbandry. Majority of the ruminants such as 95% cattle, 99% sheep and 97% goats are kept under this production system. In this system, farmers maintain their principal home at lower altitudes, where they live for approximately seven months of the year. During the cold winters, livestock are kept indoors and fed on a diet of maize stover, wheat straw and hay. In the summer, the animals are taken up into the mountains to graze, first on the sub-alpine pastures, and finally on the alpine pastures.

The movement to and from the mountains typically takes place in a series of well-defined stages. In late April or early May, a part of the household treks to the edge of the conifer forests, where a second house is located. Here they stay for three to four weeks, before moving to a third house located within the forest itself. After a further stay of three to four weeks, both livestock and people move to the high alpine pastures, where they remain for a period of up to two months. The return journey begins with the first snowfall in late September.

There is a variant to this transhumant production system in which the livestock owner remains in the village but hires a shepherd during the summer months to take the flocks to the mountain pastures. Each shepherd is typically responsible for 15 to 40 cattle, 100 to 200 goats/sheep, or a mixture of both cattle and sheep/goats.

1.3.3.3. Sedentary System

In this system, the animals are kept on the farm throughout the year. Only one to five percent of the total population of the ruminants in Northern Areas are reported

to be stall fed. Under this system, cattle; sheep and goats are allowed to graze on gentle slopes and in the fields following the harvest. Animals are also grazed on community lands and fallow fields. Maize stover, hay and grasses are the principal source of stall feeding. In some villages, maize stover, green grass and wheat straw are sold/exchanged among the farmers.

1.3.3.4. Commercial Production System

Commercial dairy farms do not exist in the Northern Areas. However, a few, non-farm households maintain small numbers of cows and buffaloes (one to five animals) in the urban areas, in order to supply fresh milk to residents and tea shops of the area.

1.3.4. Animal Health

Large ruminants are usually affected by foot and mouth, haemorrhagic septicaemia, black quarter and rinderpest diseases in Northern Areas. Diseases affecting sheep and goat in Northern Areas fall into three categories according to casual organism, namely bacteria, viral and parasitic.

The major diseases affecting sheep and goat in Northern Areas are described as follows:

1.3.4.1. Bacterial Diseases

Abortion, Metritis, Listeriosis, Malignant Oedema, Mastitis, Lamb Dysentery, Tetanus, Pasteurellosis and Enterotoxaemia.

1.3.4.2. Viral Diseases

Foot and mouth, Pox.

1.3.4.3. Parasitical Diseases

Gid, Liver Fluke, Mange, Parasitic Gastroenteritis and Gillar.

1.3.4.4. Miscellaneous Diseases

Bloat, Impaction of Rumen, Foot Rot, Pneumonia, Goiter, Bronchitis, Grass Tetany and poisoning. The seasonal occurrence of common animal diseases in Northern Areas are presented in Table 14.

Normally both sick and healthy animals are kept together and in case of communicable diseases, this lead to the rapid spread of disease. In 1994, for example, the Northern Areas was affected a severe outbreak of rinderpest, which led to the deaths of some 35,000 head of cattle. By 1996, an intensive vaccination program appeared to have brought the outbreak under control.

Vaccination against the most common endemic diseases is undertaken by the Department of Animal Husbandry on a limited scale. However, vaccination tends to be done primarily in the immediate area of DoAH facilities or in response to disease outbreaks. Animal diseases appear to have increased with the opening of the Karakoram Highway and the transport of slaughtered animals from the southern parts of Pakistan. Newcastle Disease, for example, has become a major problem for poultry development, although the Northern Areas were formerly free of this disease.

Table 14: Seasonal Occurrence of Common Animal Diseases in NA													
Name of Disease	**Animals Affected**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Foot and Mouth Disease (FMD)	C, B, G, S						X	X					
Hemorrhagic Septicaemia (HS)	C, B, G	X	X				X	X	X			X	X
Black Quarter (BQ)	C, B	X	X				X	X				X	X
Pleuropneumonia	G, C, S	X	X										X
Pox	G, S	X											X
Enterotoxaemia	G, C			X	X								
Anthrax	C, S, G	X	X	X	X	X	X	X	X	X	X	X	X
New Castle Disease (Rani Khet)	P	X	X	X	X	X	X	X	X	X	X	X	X
Infectious Coryza	P	X	X									X	X
Fowl pox	P	X	X	X	X	X	X	X	X	X	X	X	X
Common outbreak period		X	X				X	X	X			X	X

Note: C = Cattle, B = Buffalo, G = Goat, S = Sheep, P= Poultry

AKRSP has made consistent efforts to train the livestock community representatives for vaccination of the livestock and also has provided them with the para-veterinary kits.

1.4. Cultivated Fodder Production

In Northern Areas, about 90,466 ha is the total cropped area out of which 16,267 ha which is about 9.8% area is mainly under fodder production. The major winter crops are wheat, barley, shaftal, Lucerne and vegetables whereas summer crops are maize, potatoes, millet and pulses. The details of fodders cultivated in various districts are given Table 15.

Table 15: Area Under Fodder Crop Production (ha) in Various Districts of NA			
Districts	**Cropped Area**	**Fodder Area**	**Area under Fodder Production**
	(ha)	**(ha)**	%
Northern Areas	90466	16267	19.8
Gilgit	20493	1368	6.7
Ghizar	14901	2530	17.0
Diamir	15687	1047	6.7
Skardu	19881	1932	9.7
Ghanche	19504	9394	48.2

Source: Statistical Abstract of Northern Areas, 1999

Lack of quantity and quality fodder especially during winter is the major factor that limits animal production. The animals in the Northern Areas have to graze over large distances on high pastures to obtain their summer forage. During winter, all animals principally have to rely on crop residues and cultivated fodder which is available in less quantity, hence, the livestock production is very low and the animals are weak by spring. Therefore, there is a considerable need for high quality fodder if maximum production (milk, meat) is to be obtained from existing and genetically improved animals.

Because of very limited land holdings and extreme weather conditions, fodder crop cultivation is practiced on small areas. Traditionally there is a fodder deficit from November to March, when the main summer fodder crop season (maize) is over and the traditional winter fodder, especially Shaftal (Trifolium resupinatum) and Lucerne (Medicago sativa) are still dormant during the freezing temperature. Also, livestock from high pastures start coming down to the valley bottoms, therefore the lack of sufficient quantity and quality of fodder seriously hampers livestock productivity. Due to limited land holdings, farmers also practice a highly integrated and subsistence type of farming system that is not very flexible. The majority of farmers who have livestock also have fruit trees: an integrated approach that should complement rather than complete is required. Fodder legumes such as Shaftal (Trifolium resupinatum), Alfalfa or Lucerne (Medicago sativa), Berseem (Trifolium alexandrinum), Vetch (Vicia sativa), Cowpeas (Vigna unguiculata) etc. can be grown in association with fruit trees, providing fodder for livestock as well as improving soil fertility through biological nitrogen fixation.

1.4.1. Traditional Forage Resources and Production Practices

In Northern Areas, traditionally livestock drives 70% of their feed resources from maize stover and wheat straw whereas 7% is obtained from Lucerne haw in winter. Farmers of these areas are aware of the need for maximum quantity as well as quality of fodder, and have therefore, evolved the following practices:

The farmers have compromised for grain production by tall wheat and maize varieties with a low harvest index but a lot of straw and stover. Crop residues are carefully conserved and stored often on roofs or in trees.

Sowing cereals at two or three times than the recommended seed rates to permit thinning for green fodder and to increase straw production.

High quality leguminous fodders such as Shaftal (Trifolium resupinatum) are grown on small areas for green feed during spring and Lucerne (Medicago sativa) for hay as winter-feed.

Multipurpose trees Willow (Salix spp.), Mulberry (Morus spp.) and Russian Olive (Elaeagnus spp.) are planted on field edges and marginal land, their leaves and shoot provides supplementary fodder in winter. In some areas leaves are dried and stored for winter use.

Summer grazing at high altitude in alpine pasture is exploited to the maximum.

About 70% to 80% of the available non-alpine feed is straw and stover and its quality is low, especially in term of protein. The nutritional value can be improved by urea treatment of straw and by feeding some concentrates to milking animals.

1.5. Medicinal Plants of Northern Areas

There are between 35,000 and 70,000 plant species, which have been used at one time or another for medicinal purpose in the world. At least 6500 species are used in Asia as home remedies. Nearly 6000 species of flowering plants reported to be

occurring in Pakistan and Azad Kashmir, a very large number is found in Northern Areas and the North Western parts of Pakistan. Most of these plants are known to posses' medicinal and economic values or local people in the rural areas have known properties and their uses for the past several hundred years. It is reported that more than 1500 plant species with medicinal properties have been used in Pakistan. Approximately 400 to 600 medicinal plants are more frequently used in herbal preparation and while several species, which are common in certain areas are known to be used locally in traditional preparation. However, these have not been scientifically investigated for wider use. There is a great potential in effectively utilizing these valuable plant resources to improve the primary health care system of the rural communities especially in the northern mountainous region of the country. Similarly, there are opportunities for rural and tribal people to harness the economic potential of these plants through a sustainable system of utilization. Commercially exploited medicinal plants species found in different zones of Northern Areas are described below:

1.5.1. Alpine and High Altitude Areas

Several important species of medicinal plants found in moist alpine and sub-alpine Himalayan meadows, which are confined to the north-eastern regions of the country. However, due to increasing human and livestock population, these habitats are being subjected to over increasing pressure and several areas are displaying signs of degradation as indicated by decreasing species diversity and increasing number of unpalatable species as well as soil erosion. Most of the alpine medicinal plants are slow growing perennial species, which require several years of vegetative growth for reproduction by seeds. Further, due to the fact that in many cases under ground rhizomes are being used for medicinal purpose, reproduction by vegetation propagation is also limited. Some important endangered medicinal species of this zone are Podophyllum hexandrum, Aconitum heterophyllum, A.Chasmanthum, A.Laeve, Sanssures costus, Pierorhiza kurrooa, Rheum emodii and Corydalis spp.

The common species of plants used as medicine by the local communities and as well as in other areas are described below:

Aconitum heterophyllum
A perennial herb found under shade of western Himalayan belt. Major use in primary health care is pain relief, a tonic, astringent, stomachic, anti-periodic and anti-puritic.

A. chasmanthum
Roots are used as tonic and astringent.

Picrohiza spp.
It is a perennial herb with a narrow distribution in the region. Root is used as hepato protective and also used in fever, asthma, dyspepsia and as tonic.

Podophyllum hexandrum
It is a rhizomatous perennial herb. Roots are used for their resin content. Mostly use as purgative and other uses in primary health care are hepato-stimulant, allopathic anti-cancer drug.

Saussurea lostos

It is a rhizomatous perennial herb with aromatic roots. It has a short growing period. Mostly used in the treatment of respiratory problems, treatment of blood, liver and kidney ailments, dysentery, arthritis and as a tonic.

1.5.2. Temperate Mountain Forest

It is a second major ecological zone, coniferous forest Zone of Himalayan Mountains where medicinal plants are found in abundance. However, during the 100 years, these forests have been subjected to major structural changes leading to a decrease of about 50% of the potential forest area. The decreases in the forest cover, combined with major change in community structure have also been responsible for the decline in medicinal plant populations resulting from disturbances of habitats. Some of the more common species collected from these forests include Atropa acuminata, Angelica glauca, Artemisia spp, Glycyrrhiza glabra, Ephedra spp, Mentha piperita and Rheum spp. The root bark of the Juglans regia is extensively collected from these natural forests with annual consumption rates of between 50 to 100 tones. Extraction of the young roots of this species not only damages the trees but also disturbs the surrounding soil and vegetation.

Cedrus deodara

It is a large, evergreen tree. Its wood juice is used as carminative and diuretic.

Rheum australe

It is a perennial herb, the root of which is widely used as tonic, astringent and purgative.

Juglan regia

Root bark used as an antihelmintic, leaves as an astringent, fruit to cure rheumatism and also used for curing teeth and swollen gums.

1.6. Wildlife of Northern Areas

Pakistan has a variety of habitat with a rich and varied wildlife fauna. There are some 600 species of birds more than 160 species of mammals and dozen of reptiles. However, since late 1800, most of wildlife population has declined drastically. Currently, about 20 species of birds, 31 species of mammals and 5 species of birds have been enlisted as endangered species. The causes for this decline in wildlife population have been identified human-related and include encroachment by human population, degradation of habitat, beyond controlled hunting and sometime illegal export. Major cause in the decline of the large species of oriental faunal origin in mountainous regions has been reported by Muhammad and Anwar (1993) and Anwar and Ahmed (1995) as increased competition between wildlife and domestic ungulates for available range bio mass. This competitive situation has been analysed and will be stated later on in this chapter. Wildlife species of different regions of Northern Areas are described in the following of paragraphs.

1.6.1. Cold High Peak Desert Mountains

In this regions wildlife include Himalayan ibex (Capra ibex sibirica), baral (Pseudois nayaurs), snow leopard (Panthera unica), alpine weased (Mustela

altaica), bobak marmot (Marmota bobak), Lynx (Felis lyrix), snow pigeon (Columbia leuconota) and himalayan snow cock (Tetraogallus himalayensis) etc.

1.6.2. Alpine Meadows

The alpine vegetation consists of scrub forming quite dense cover composed of mostly deciduous species and with small leaves including some evergreen Juniper, Rhododendron, Ephedra and Salix etc. There is also a rich herbaceous growth mainly perennial including a number of palatable grasses. The major wildlife species are Himalayan ibex, Snow leopard, Red bear, long tailed Marmot, Snow pigeon and Snow partridge etc.

1.6.3. Sub-alpine Forests

These forests form the upper most forest habitat in the Himalayas. The trees are of moderate size and ground field layers are well developed. Major plants species are Betula spp. Sorbus, Salix, Juniferus and Poa. Important wild life species include Snow leopard, Musk deer, Stone marten, Royle's pika. Snow pigeon, Western tragopon, Monal pheasant and Chukar (Alecloris chukar), etc.

1.6.4. Alpine dry forest

Important plant species of this area include Juniperus macropoda, Pistacia Quercus ibex, Pinus spp. Artemisia maritima, Ephedra spp. Berberis spp. Major wildlife species are Markhor, Royle's pika, stone Marten, chukar, Western tragopon, and Koklas pheasant etc.

1.7. Wildlife Ruminant Population and Feed Resources

The population of ruminant wildlife species of Northern Areas and their district wise distribution is given in Table 16.

Table 16: Population of Ruminant Wildlife of NA and their District wise Distribution

Common Name	Scientific Name	NA	Gilgit	Ghizar	Diamir	Skardu
Marcopolo sheep	Ovis ammonpolin	900	900	-	-	-
Blue sheep	Ovis pseudoisnayur	35	35	-	-	-
Urial	Ovis orientatis	1,050	90	-	-	960
Musk deer	Machus machiferus	853	4	-	180	669
Ibex	Capra ibex berica	8,479	1,531	1,078	1,000	4,870
Markhore	Capra falconeri	2,800	1,004	36	1,300	460
Total Population		14,117	3,546	1,114	2,480	6,959

Source: Statistical Abstract of Northern Areas, IUCN, 1999.

Since, wildlife ruminants are inhabitant of the rangelands ad thus assumes to have direct competition with domesticated ruminants particularly sheep and goats for forage consumption. The total number of wildlife ruminants in northern areas is about 14,117. These species include 900 heads of Marcopolo sheep (Ovis ammonpolin), 35 heads of blue sheep (Ovis pseudoisnayur), 1050 urial (Ovis orientatis), 853 Musk deer (Machus machiferus), 8479 Ibex (Capra ibex berica) and 2800 Markhore (Capra falconeri).

In Northern Areas main threats to wild life habitats include deforestation, agriculture, mineral extraction and settlement. It was previously perceived that in NA, ruminant wildlife are in direct competition with domesticated ruminants such as sheep and goats. However, if we take the population of domesticated small ruminant vis-à-vis the wildlife of NA into account, it reveals that percentage of wildlife compared to small ruminants is only 0.92%. This very negligible population of wildlife has no threat for competing with small ruminant for forage utilization from grazing lands.

1.8. Multipurpose Trees and Shrubs

The multipurpose trees and shrubs are making a significant contribution to agricultural systems by providing a variety of useful products including valuable forage and wood. Leguminous plants, which may be large and small trees or shrubs are an important component of the cellulose and high protein fodder resources available for use by livestock and wildlife.

Tree foliage is being increasingly recognized as a potentially high quality feed resource for ruminants, particularly to supply crude protein. This is especially true in harsh, arid and extreme climate where trees provide more edible bio mass than pasture and this bio mass remains green and high in protein, even when pastures dry off (Leng, 1997). In Northern Areas, livestock are reared mainly on rangeland pasture/natural pasture and January through April there is a critical shortage of feed for livestock. In this situation, tree foliage seems to be a good source of protein as fresh or in dry form.

Naturally and commonly available trees in Northern Areas are given under rangelands. However, trees and shrubs, which can be used in animal feeding are summarized as under:

Pistacia species
Pistacia is a medium sized tree and is valuable member of the coniferous forest. The uses of this tree include nuts, wood for furniture, fodder and medicine.

Pinus geiardiana
Pinus geiardiana is native to Northern Areas; however, it is also found in other mountainous regions of Pakistan. The seeds are grazed by the animals and also collected for human use.

Juglans regia (Walnut)
This tree is native to Pakistan and is found in Northern Areas and also in mountainous areas. The major uses of this plant includes fruits, wood for furniture, fodder and as medicine (anthelmintic, astringent and for rhematism). Walnut oil cake is an excellent feed for animals containing vitamins A, B1 and B2. However, poorly stored cake can be spoiled through rancidity and develop bad taste and it's longer use can adversely effect the health of the animals.

Queicus dilata
This is a native species and is evergreen tree found in Himalayan mountainous area, which also includes Northern Areas. The shoots with leaves are extensively

lopped as fodder for sheep and goats. The nutritional value of the leaves is moderate.

Queicus incana
This is a native tree and found in Northern Areas. The leaves of this tree are palatable but should not be as sole feed for long periods as this may cause constipation. The nutritional value of the leaves is almost equal to grass.

1.8.1. Shrubs

There are two major shrubs found in Northern Areas, which are grazed by the animals. The brief description of these plants are given as under:

Artemesia species
This is a fast growing rootstock perennial but sometimes acting as annual shrub. Germination occurs in June and July and it flowers in August through November. Mainly it is used as fodder and its nutritional value is described as good.

Indigotera species
This is perennial creeping shrub with a strong root system. This can be cultivated with grasses and is either grazed or cut and carry as fodder. The animals like this shrub. However, there are some species of this shrub, which are toxic and can cause health problems.

1.8.2. Multi Purpose Trees as Fodder

In Pakistan particularly in Northern Areas, research on the use of multipurpose trees as ruminant feed is totally neglected. The literature needs to be surfaced for details and baring minor differences there are chances that we come up with a MPTS supplementation strategy for livestock in such areas. The problem is to determine the nutritive value of our indigenous feedstuffs and their quantity fed to the area and then to assess the optimal level of MPTS in feeding calendar. AKRSP and forest department if northern area haves introduced some tree species like Ailanthus spp., Robinia spp., Poplar, Willow, Elaeagnus, Mulberry and Salix in northern area and found then suitable for this area. These species are also quite encouraging when planted on the boundaries of the cultivated fields and around the houses.

Robinia psendoacacia
Robinia is indigenous to North America. In Pakistan, it has been successfully established in Tarbela and Mangla watersheds, Kaghan and Naeelam Valleys. Plantation has also been raised along with Karakoram highway, Gilgit and other parts of Northern Areas. It has a rapid growth rate and a useful fast growing tree in the chirpine zone of Pakistan. It fixes nitrogen and its foliage and seeds are used as fodder for livestock particularly in winter season. The major uses include fodder, fuel, erosion control, shade, apiculture and fence posts.

Populus
Growth is relatively fast. Most of the species are native to Europe, China and Himalayan region including Pakistan, India and Nepal. It can be propagated by cuttings made from 1-year-old wood preferably from stool or pollards (AKRSP, 1987). Leaves are used for winter livestock feeding in the Northern Areas. It has

moderate nutritional value as fodder. Firewood quality is poor. It is used for furniture, packing material, matches and poles.

Elaeagnus angustifolia (Russian Olive)
It is a medium size deciduous tree whose leaves drop late. Elaeagnus is native to Southern Europe, Western and Central Asia and the Himalayas region. In Pakistan, it is extensively cultivated along with the water courses in Gilgit, Skardu and Chitral. It grows up to 3000m. It is a slow growing tree. It is planted for fodder and fruit and is lopped for fuel. Leaves are dried and used as hay for winter livestock feed. Fruit berries are edible and often used for making jam and jellies.

Morus alba (Mulberry)
It is a medium sized deciduous tree, which is both wild and cultivated. It is native to Pakistan, China, Central Asia and Afghanistan. It is planted in the Northern Areas especially in Gilgit up to 3200m. It grows very fast Mulberry leaves yield a good quality fodder, which are dried as hay and fed to livestock during winter feed scarcity period. Its dried fruit is also used as feed. It is also important as silk warms feed. Its wood is used for furniture's and sporting goods but not good as firewood.

Ailanthus altissima
The tree is native to China and Japan. It has been successfully cultivated through out the world. It has become naturalized in Pakistan and can be found almost everywhere. Cultivated in Gilgit and on Karakoram high way. It is a fast growing tree that grows to a height of 3 to 4 m in a period of 5 months. It is a very aggressive tree that will do well on very harsh sites. It is used for livestock feeding, particularly during winter.

Salix acmophylla (Willow)
It is a small deciduous tree up to 9m tall with a diameter of 50 to 70 cm. The tree is native to parts of the Middle East, and this sub-continent. In Pakistan it is found in

Table 17: Seasonal proximate composition and cell wall constituents of various fodder tree leaves (% DM)

Species		DM%	CP	NDF	ADF	Hemi-cellulose	ADL	Ash
Salix	Spring	54.5	12.5	33.9	22.3	11.6	5.3	7.7
	Winter	55.1	9.8	34.5	21.9	12.6	4.2	10.9
Robinia	Spring	61.9	23.9	37.7	24.5	13.2	6.4	9.8
	Winter	57.8	14.5	44.2	27.9	16.4	8.8	6.9
Mulberry	Spring	64.9	17.6	26.0	22.8	3.2	5.4	14.5
	Winter	60.9	13.7	28.0	22.2	6.0	5.6	11.4
Elaeagnus	Spring	65.6	14.9	37.5	21.0	16.5	2.5	7.1
	Winter	46.7	13.9	31.0	20.8	10.2	5.8	11.8
Populus	Spring	56.8	11.3	32.6	23.9	8.7	7.9	8.5
	Winter	49.2	10.0	30.5	26.0	7.2	4.1	10.7
Ailanthus	Spring	65.3	27.2	22.3	17.9	4.4	4.8	9.4
	Winter	66.3	10.5	26.0	18.3	7.7	2.6	13.5
Mean + SE	Spring	61.5+1.9	17.9+2.0	31.7+2.5	22.1+0.9	9.6+2.1	5.4+0.7	9.5+1.1
	Winter	56.0+2.9	12.0+0.9	32.4+2.6	22.4+1.3	10.0+1.6	5.2+0.9	10.9+0.9

Source: Azim et al., 2002.

Northern Areas besides other mountainous areas. It is relatively fast growing. This is a very desirable tree for use in farm forestry programs especially on wet sites. Its leaves are used as fodder. It is also a good tree to control erosion.

The nutritional profile of the leaves of Salix, Robinia, Mulberry, Elaeagnus, Populus and Ailanthus is presented in Table 17.

An experiment was conducted to evaluate the potential of four forage tree leaves as winter feed when supplemented with concentrate feed. The result of this experiment are presented in Table 18.

Table 18: Effect of Various Treeleaves-based rations on the Feed Intake and Digestibility Pattern in Goats

Parameters	Rations			
	Salix	Robinia	Mulberry	Eleaganus
Nutrient Intake g/day				
Dry Matter	1526.75 ^{a}	1438.50 ^{b}	129.600 ^{c}	1450.75 ^{b}
Crude Protein	260.68 ^{a}	222.75 ^{a}	199.75 ^{b}	216.75 ^{a}
Crude Fibre	241.68 ^{a}	228.00 ^{b}	225.00 ^{b}	246.50 ^{a}
Digestibility (%)				
Dry Matter	61.72 ^{a}	46.31^{c}	53.86 ^{b}	59.51 ^{a}
Crude Protein	64.59 ^{a}	55.71 ^{c}	62.16 ^{ab}	61.19 ^{b}
Nitrogen retention (g/d)	10.50 ^{a}	9.92 ^{c}	10.30 ^{bc}	1.45 ^{b}

Note: Values with different subscripts in the same row differ significantly (P<0.05)

This study suggested that supplementation of the leaves foliage with concentrate feed can support moderate feed intake and performance of the animal during winter season.

2. ISSUES AND TRENDS

2.1. Key Issues and Constraints

2.1.1. Shortage of Cultivated Fodder

The quantitative and qualitative shortage of fodder is the principal constraint to livestock production in the Northern Areas; the situation is particularly acute during late winter and early spring, when crop residues from the previous season have been largely exhausted. However, during this period the animals are in advance pregnancy or in early lactation and thus require more nutritional inputs. This situation is exacerbated by the absence of research and development programs aimed at developing improved varieties of fodder and forage for the NAs different agro-climatic zones; similarly, there are insufficient facilities for the production of quality fodder seed.

2.1.2. Poor Animal Nutrition

Lack of feed resources particularly the quality fodder leads to under-nourishment, which, in turn, is a major factor contributing to low milk, meat and wool production. The most recent livestock census suggests that the proportion of lactating cows has decreased from 74 per cent to 67 per cent. Similarly, the proportion of young sheep and goat stock has also declined significantly. This might be due to high infant kids and lambs mortality due to poor mothering ability of under fed mothers.

2.1.3. Poor Genetic Animal Resources

Genetic production characteristics of cow, sheep and goat breed of Northern Areas are defined as poor because their production of milk and meat is low. There has been no research and development program focusing on upgrading of the genetic potential of livestock either through selection or cross breeding. However, some sporadic efforts have been made by FAO and AKRSP to cross breed the local cattle with jersey bulls to increase the milk production of their progeny, but if along with cross breeding, other factors such as proper nutritional inputs and disease control is not practiced, these efforts might lead to no progress rather can worsen the existing situation. Therefore, research and development program should be carefully planned and executed to make the program effective and sustainable.

2.1.4. Inadequate Health Coverage

Under-nourishment also contributes to reduced disease resistance. Livestock diseases are common and widespread, and are another important factor contributing to low productivity. The provision of veterinary services, however, is constrained by a wide variety of factors, including: insufficient staff, equipment, drugs, and transportation; the seasonal movement of livestock; and the rugged and inaccessible mountain environment.

2.1.5. Lack of Human Resources

In Northern Areas, the Animal Husbandry Department is a part of Directorate of Agriculture. This department is largely engaged in vaccination and treatment practices. However, livestock production sub sector that includes nutrition, breeding and management is poorly equipped with trained man power. Due to lack of trained man power, the research and development programs in Northern Areas are not taken up in an organized manner. Moreover, appropriate strategies for livestock production have not been developed and carried out. Therefore, there is a strong need to initiate well integrated research and development program to upgrade the genetic resources of animals, develop appropriate and strategic nutritional technologies, livestock management and disease control. For all these functions and activities, veterinary man power has to be necessarily trained in the subjects related to above mentioned livestock prospects.

2.1.6. Rangeland Degradation

The growth in the NA livestock population over the last forty years has placed increasing pressure on the region's pastures and rangelands. Although there has been relatively little research on this subject to date, there are indications that the productivity and floral diversity of the NA's alpine pastures is decreasing. This requires proper applied research in the form of controlled grazing and management. Ever increasing pressure of over grazing by livestock in Northern Areas is evident from the calculation made by the author. Calculation leads to the conclusion that in 1976 there was 9.08 ha per animal unit that decreased to 2.47 ha per animal unit in 1996.

2.1.7. Competition with Wildlife

There is also evidence to suggest that the growth in livestock numbers is having a negative effect upon the NA's wildlife populations. Muhammad and Anwar (1993) for example, have reported that increased competition between wildlife and domestic ungulates for available range biomass is one of the causes of wildlife declines in Pakistan's mountainous regions.

2.2. Trends

2.2.1. A Relatively Static Livestock Population

Table 19 presents a summary of the NA's livestock population over the last two decades.

From these figures, it can be seen that the numbers of cattle, sheep and goats increased rapidly between 1976 and 1986, but there after remained relatively static; both cattle and sheep populations appear to be decline, while the goat population has exhibited only a modest increase. These trends suggest that livestock carrying capacity of the Northern Areas may now have been reached, and that further increases in livestock numbers may be difficult to achieve until the lack of feed and other constraints are addressed properly. The other correlating factor for relatively static livestock population during the last decade might be due to more opportunities for off farm activities.

Table 19: Growth Trend of Livestock Population (000 heads) in Northern Areas						
Species	**1976***	**1986***	**± % per year**	**1996****	**± % per year**	**± % per year (1976-96)**
Cattle	209	408	+9.52	398	-0.24	+4.52
Buffalo	3	1	-6.66	6.28	+52.8	+5.46
Sheep	321	643	+10.03	518	-1.94	+3.06
Goats	562	939	+6.71	1047	+1.15	+4.31
Camels	(24)	(90)	+27.5	(141)	+5.66	+24.37
Horses	7	4	+4.28	8	+10.00	+0.72
Asses	20	25	+2.5	21	-1.60	+0.25
Mules	(188)	(183)	-0.26	955	+42.01	+20.39
Domestic Poultry	288	359	+2.46	609	+6.96	+5.57

Source: * Agriculture statistics of Pakistan 1999-2000
** Livestock Census, 1996 and Statistical Abstract of Northern Areas, IUCN, August 2, 1999
Note: Figures in parenthesis ( ) are actual.

2.2.2. Declining Livestock/Human Ratios

In Northern Areas, human population has exceeded one million with an annual growth rate of 5.0%. But, the annual growth rates of large and small ruminant ranged between 3.0-5.4% during the last twenty years. However, if we take the growth rates of ruminants only for last decade into account, these are much less than the previous decades. This clearly indicates that there is a declining trend in livestock/human ratio. Currently, the animal/human ratio is about 1.75 animal units per human being.

2.2.3. Increased Grazing Pressure

Ever increasing pressure of over grazing by livestock in Northern Areas is evident from the calculation made by the author. Calculation leads to the conclusion that in 1976 there was 9.08 ha per animal unit that decreased to 2.47 ha per animal unit in 1996. The above given facts clearly establish that there is a decline in the grazing area for livestock.

3. CONSEQUENCES OF INACTION

If current trends continue, livestock production will not be able to keep pace with the growth in the human population. This will have significant implications for the Northern Areas. Not only the amount of milk and meat available per person will decline, but also, the amount of cash generated per person as a result of livestock-related sales will decrease. To meet the shortfall of milk and meat, imports from other parts of Pakistan can be expected to increase, making the Northern Areas' food security increasingly dependent on external factors - and hence, increasingly vulnerable to disruption (e.g., blockages along the Karakoram Highway). As the dependence on cash economy grows, the proportion of milk and meat in the diets of the poorest can be expected to decrease. With the decrease in intake of livestock products; milk and meat in the diets of people, it can be expected that the incidence if mal nutrition, particularly in most vulnerable groups like children and nursing mothers will increase.

Unless more effective rangeland management strategies are put into place, rangeland degradation will also contribute to this cycle, albeit perhaps in a more insidious and less visible fashion. Declining pasture quality can be expected to lead to poorer livestock nutritional status; this, in turn, will contribute to lower productivity and reduced disease resistance. Wildlife populations and water catchment values are also likely to be negatively affected by rangeland deterioration.

It is, therefore, crucial to the sustainable development of the Northern Areas that efforts to enhance livestock production and improve rangeland management be intensified. The experience from other parts of the world shows that the deferral of effective rangeland management frequently results in such severe deterioration that major, systematic rehabilitation programmes are subsequently required to restore productivity.

4. PREVIOUS AND ONGOING INITIATIVES

4.1. Fodder Crops

4.1.1. Summer Fodder

A growing number of farmers are experimenting with new summer fodder crops, including the sweet sorghum hybrid. The S.S. hybrid produces yields that are four to five times greater than those from local maize; it also provides five cuttings between May and November, thereby ensuring a supply of fodder throughout the summer. As a result of these traits, the S.S. hybrid has become increasingly popular among the farmers of the double-cropped areas.

4.1.2. Winter Fodder

Local shaftal is the traditional winter fodder crop in the Northern Areas, together with Lucerne and barley. However, the local varieties of both shaftal and Lucerne are winter-dormant; their growth is very slow, and the crops typically provide only two or three cuttings per season.

The fodder component of the FAO/UNDP project PAK/86/027 assessed a total of 72 Lucerne cultivars on the basis of their potential number of cuts and green forage yields, and selected seven for further evaluation. Winter-active Lucerne varieties (particularly Sundar) have been very successful. Although they suffer from frost damage at high altitudes (above 2,000 metres), they grow throughout the year and provide more than twice the yield of traditional land races (Table 20). The new varieties of Lucerne recover quickly after harvesting, and provide six to eight cuts per season. They also remain green in the critical December-January period, when traditional crops are usually dormant and there is a fodder deficiency. In some areas, berseom (a winter legume) has been introduced to replace shaftal. Berseem grows vigorously, provides early fodder in November produces five to six cuttings, and yields two to three times more than shaftal.

Table 20: Green and Dry Matter Yields (tons/ha) of Improved and Traditional Lucerne Cultivators (based on seven cuttings/year, between 1944-97)

Cultivators	Sites					
	Chilas		Gilgit		Skardu	
	Green Yield	Dry Yield	Green Yield	Dry Yield	Green Yield	Dry Yield
Sundar	165	50	174	52	90	26
Misa Sira	98	32	117	34	74	20
Pioneer	92	29	95	30	84	22
Sanora	90	27	84	24	73	20
Illunico	71	22	68	22	70	19
Type 8/9	100	32	96	30	74	21
Powea	58	19	61	19	68	17
Local	55	16	60	18	57	18
Average	91.13	23.38	94.38	28.62	73.25	20.38

4.1.2.1. Fodder Oats

Fodder oats cultivation has advanced significantly in the Northern Areas, as a result of extensive on-farm demonstrations carried out under the FAO/UNDP Project PAK/86/027 and seed multiplication by local farmers (Dost, 1995). Improved oat cultivars are a potentially valuable source of fodder for the Northern Areas, since they grow much earlier and more vigorously than other winter grown cereals.

Oats assessed during the FAO/UNDP project provided two cuttings between March and May (the traditional fodder deficit period). All the oat varieties/cultivars were shown to be superior to barley and rye, in terms of both green and dry matter yields.

Oats are excellent for mixed planting with berseem or Lucerne. If Lucerne is planted in rows at 30cm intervals, this permits inter-cultivation and seeding with oats in autumn, thereby maximising yields per unit area.

4.1.2.2. Improved Maize

Muhammad (1993) evaluated the performance of seven improved maize varieties and one local variety at different locations in the Northern Areas. He found that the improved maize varieties had superior yield of fodder, grain and stover at all three locations. However, the improved varieties matured 20 to 30 days later than the local maize; this would make it difficult to introduce the improved varieties into the traditional land-use system, since farmers typically allow livestock to graze freely on crop stubble by the middle of October.

4.1.3. Mixed Cropping

Because most of the farmers in the Northern Areas have very small land-holdings, it is important to find ways of maximizing fodder production without competing with the production of grain and fruit crops. Most farmers are forced to practice intensive cropping, and there is relatively little flexibility in the farming system. A number of trials, however, have suggested that mixed cropping (e.g., fodder legumes mixed with cereals; orchards inter-planted with legumes) has the potential to address these concerns whilst also maintaining soil fertility.

For example, in trials carried out by FAO/UNDP project, three fodder legumes (Lucerne, berseem and red clover) were grown on their own and also inter-cropped with oats. In all case, inter-cropping produced significantly greater yields of both green and dry matter (Table 21).

Table 21: Green and Dry Matter Yields of Various Legumes and Oats in Danyor (1994-97)

Treatment	Green Yield (tons/ha)	Dry Matter Yield (tons/ha)
Lucerne alone	70	18
Lucerne + oats	115	30
Berseem alone	80	17
Berseem + oats	135	30
Red clover alone	63	16
Red clover + oats	94	26

4.2. Cattle Cross Breeding

In Northern Areas, the local cattle are small in body size and their milk production is low. It was planned by the Animal Husbandry Department and the NGO's that to cater the needs of the population of Northern Areas, it is necessary to upgrade the genetic cattle resources for higher milk production. Therefore, the AKRSP and Animal Husbandry Department under FAO/UNDP assisted project have introduced cross breeding in Northern Areas. Through these projects, the above mentioned organizations made efforts to increase the milk production of local cattle through its genetic improvement program. In this program, the cross breeding of local cattle with genetically superior exotic bulls, particularly of Jersey breed was carried out and also the supply of exotic/cross bred cattle to the farmers on the basis of demand generated by the community organization. Cross bred cattle produced comparatively higher quantity of milk compared to local cattle. However, it was observed that cross bred cattle require intensive health care and higher nutritional inputs. More research and development programs need to be initiated with sharp focus on proper level of cross breeding, management and feeding strategies.

4.3. Feed Supplementation

In recent past, it has been observed that there is a growing trend for the use of supplementary feeding, particularly the commercial concentrates among the farming community of the Northern Areas. Now farmers are becoming more and more aware about the usefulness of supplementary feeding to harvest more milk. There are evidences that supplementary feeding specially with commercial concentrate for milking cattle is increasing particularly in the urban and peri urban areas. However, the supplementary feeding is going on without any planning and this issue needs to be addressed by the Animal Husbandry Department. The department should formulate the feed supplementation strategy in different ecological zones of Northern Areas.

Use of multi nutrient blocks that are comparatively a new type of feed in Pakistan has been introduced, particularly during winter season in Northern Areas. Multi nutrient block has special advantage as supplementary feeding and this is because of its high nutrients density coupled with their easy transportation and simple feeding and management. Multi nutrient block has special supplementary feeding value for range-livestock particularly when they are fed on poor quality crop residues and low quality range biomass.

5. KEY INSTITUTIONS

5.1. Public Sector Institutions

5.1.1. Department of Animal Husbandry

The Department of Animal Husbandry is the key government institution involved directly in livestock production and health. The department is headed by a Deputy Director, who is supported by one Assistant Director (Poultry) and one Research Officer at the regional level and three Assistant Directors at the district level. The Assistant Directors are responsible for overseeing the implementation of all livestock related activities at the district level, including those related to animal health, breeding and extension. These livestock related activities are basically carried out by the veterinary officers with the support of para veterinary staff. Principally, this department is engaged in animal health related activities with less focus on livestock production: nutrition, breeding and management. Few developmental projects had been carried out by the department, but the sustainability of the activities was lacking. There is an absolute absence of research and development program on livestock production and health in Northern Areas.

5.1.2. Agriculture Department

Director of Agriculture Department is technically and administratively responsible to get the agriculture and livestock related activities implemented in Northern Areas. Deputy Director of Animal Husbandry is working under the overall administrative control of Director of Agriculture Department. However, there is a feeling among the technical staff of the Animal Husbandry Department that there should be a separate directorate headed by a full fledged director for this department.

5.1.3. Forest Department

The Forest Department maintains field staff in all five districts. The department is responsible for the management of the NApublic sector forests, the maintenance of several nurseries, and the provision of services related to farm forestry, soil conservation and watershed management. Forest Department does not have any officer having a special training in range management and development. Moreover, there is no specific long term project for range improvement and development while focusing on the livestock impact on range land degradation or otherwise.

5.1.4. Planning and Development Department

Planning and Development Department headed by a Secretary is responsible for the preparation of annual and five-year plans. It is responsible to evaluate the projects prior to the approval by the NA Council. It recommends allocation and distribution of financial resources to public sector institutions. It is also responsible to coordinate activities of the line departments especially under the integrated rural development projects.

5.2. International Organizations and NGOs

5.2.1. Aga Khan Rural Support Program (AKRSP)

The Aga Khan Rural Support Program (AKRSP), a non-profit, non-sectarian NGO, started its operation in Gilgit in 1982, with the objective of increasing the capacity of local people to identify and utilize opportunities to solve their own problems. The induced local capacity to plan and implement development program was intended to contribute to increased income and employment. Community Based Organizations (CBO's) are established by AKRSP that are being involved in activities related to rural development, environmental management, agro-range-livestock, education and health.

AKRSP persuaded a three pronged strategy for the improvement of livestock: reduction in animal loses due to diseases, improvement in animal nutrition and improvement in genetic base of livestock. The strategy was implemented by developing and applying appropriate and area specific interventions, organizing delivery of production inputs and training of village livestock specialists.

5.2.2. IUCN

IUCN contributed significantly in the preparation of the National Conservation Strategy (NCS) for Pakistan. The NCS includes section on water. IUCN is now actively engaged in the preparation of the Conservation Strategy for the Northern Areas. Furthermore, it is also involved in environmental issues related to water and agriculture.

Other international organizations involved in various activities for the Northern Areas of Pakistan are listed as under:

- World Wide Fund for Nature (WWF)
- International Fund for Agriculture Development financed project on "Natural Resource Management"
- World Health Organizations
- European Union financed Projects
- UNICEF

6. THE WAY AHEAD

The sustainable development of rangeland and livestock sector in the Northern Areas will require strategic interventions in two broad areas:

- Livestock productivity
- Range management

Improvements to livestock productivity will require better management of livestock production including feeding systems, breeding program, production of fodders and forages and health control. Interventions in the area of livestock breeding are likely to rely primarily on the introduction of improved breeds of both small and large ruminants, in order to meet the increasing demand for milk and meat. Improvements to range management will require the introduction of grazing controls, so that native range species are given sufficient time to recover between grazing intervals.

These areas will need to be addressed if the livestock sector is to fulfil its potential contribution to the sustainable development of the Northern Areas. However, the introduction of improved breeds is both capital-intensive and time consuming. In the short to medium-term, therefore, the core objective of the livestock and range sector should be to improve the management of existing livestock-range systems and expand the production of cultivated fodders, appropriate and strategic use of crop residues and multi purpose tree leaves. Moreover, strategic supplementation of feeding should be introduced for moderated milk producing and advance pregnant animals.

6.1. Livestock Productivity

6.1.1. Improve Fodder Cultivation

High priority should be accorded to increasing the amount of fodder produced by the NA's existing agricultural systems, particular on irrigated lands under the kuhl command system. Selected fodder varieties should provide multi-cut harvests, be high yielding and require relatively little water, in order to reduce competition with grain crops. Possible interventions include:

- Inter-cropping maize with leguminous fodders such as vetch (Vicia sativa);
- Growing fodder legumes such as Lucerne, red clover, berseem, shaftal and vetch in association with fruit trees, thereby providing fodder for livestock as well as improving soil fertility through biological nitrogen fixation;
- Expanding the area under improved varieties of Lucerne. Sundar has been especially promising;
- Promoting the use of Phalaris spp., red clover and prairie grass (Bromus wriloides) at higher altitudes.

In addition to fodder quantity, it will also be important to improve the nutritional quality of the fodder grown in the Northern Areas. One way in which this might be

achieved is by planting a mixture of compatible fodder crops. For example, leguminous dwarf fodder species such as berseem could be planted together with tall growing cereal fodders such as oats, rye grass or Brassica. Similarly, deep-rooted crops such as Lucerne could be mixed with shallow-rooted crops such as oats, rye, barley and Brassica.

The timing of fodder production is also crucial. Based on the results of the research that has already been carried out in the Northern Areas, it should now be possible to ensure the production of fodder on a year-round basis, and to avoid the traditional fodder shortfall that typically occurs in late winter and early spring. For example, to ensure a supply of fodder throughout the winter, berseem and winter-active Lucerne should be inter-cropped with oats in September/October.

Other steps that should be taken to enhance fodder and forage production in the Northern Areas include the following:

- Multi-purpose trees and shrubs should be introduced which are capable of providing both forage and other products. AKRSP, for example, has successfully promoted the use of several tree species within its programs, including Ailanthus spp., Robinia spp,, poplar, willow, Elaeagnus, mulberry and Salix the trees are typically planted along the boundaries of cultivated fields and in the vicinity of houses. In selecting trees arid shrubs for cultivation, however, great care will need to be taken to screen out potentially invasive species that might spread uncontrollably and damage both the NA's environment and economy;
- Forage crops and multi-purpose tree species should be planted along the sides of irrigation channels, where seepage is sufficient to support establishment;
- Fodder breeding and improvement programs should be established under KARINA, with
- Strong linkages to Northern Areas Department of Agriculture, AKRSP and Village Organizations;
- Strong linkages should be established with the National Fodders Research Program as well as the Fodders Research Institute in Punjab. The Northern Areas should also seek to become a partner in the National Uniform Yield Trials for fodders;
- Fodder testing, screening and demonstration facilities should be established in a wide range of agro-ecological conditions, and in close partnership with rural communities. In the future, these facilities could be used for the multiplication of certified fodder seed.

6.1.2. Livestock Breed Improvement

Livestock breed improvement will be a long-term effort. Among the measures that should be pursued are the following:

- The suitability of improved breeds of both large and small ruminants should be carefully assessed under a range of the NA's ecological conditions and agricultural systems. In undertaking this evaluation, it will be particularly important to take account of farmers' perspectives and priorities; for example, farmers may not desire improved breeds if these have significantly greater needs tar fodder, feed supplements, and vaccines;
- Existing artificial insemination facilities should be strengthened, and Village Organizations trained in their operation. Increasingly, the role of the

Department of Animal Husbandry should become that of a technical advisor, skills enhancer and facilitator;

- Existing breeds of large ruminants should be improved through the provision of stud bulls to Village Organizations. Similarly, quality rams and bucks should be introduced to enhance the production of meat and wool in sheep, and the production of milk and meat in goats. These steps should be combined with the provision of training to VO's in livestock breeding techniques
- A registry of progeny animals should be established for each district and the information made available to local communities as well as research and development institutions.

6.1.3. Promote the Use of Supplementary Feed

In order to improve the nutritional status of livestock, it will not only be necessary to enhance the production of fodder, but also, to promote the use of supplementary feed. However, before promoting the use of supplementary feeding, Animal Husbandry Department should prepare a strategic and cost effective supplementary feeding plan which might differ from farm to farm and in different ecological zones of Northern Areas. As the first step, facilities for the production of livestock feed and molasses blocks should be established at a number of locations in the Northern Areas. The size of the facilities should be carefully tailored to the needs of local communities; the facilities should also be carefully sited so as to minimize farmers' transport costs. Public sector staff and rural communities should receive training in livestock feeding and the provision of nutritionally-balanced diets.

6.1.4. Introduction of Feed Lot Fattening System

In Northern Areas, most of the livestock particularly small ruminants are reared under agro-range-livestock production system. Under this system most of the livestock drives their feed from resources like range biomass and crop residues with very low financial inputs. Sheep and goats are on the pasture when their kids and lambs reach to about 5-6 months age. At this age, these young ruminants are physiologically capable to gain faster weight gains and can be subjected to fattening by offering special feed and at the same time also taking advantage of available grazing. A careful fattening strategy can make this fattening cost affective and farmers can be economically benefited from this activity. At the same time, fattened animals can be sold for slaughtering and as a result grazing pressure on range lands can be decreased and simultaneously stored feed resources can be effectively utilized in winter. Animal Husbandry Department with the participation of livestock farming community should initiate fattening activity, however, before doing so the department should get their staff trained for the fattening technologies. In this regard Animal Nutrition Program, National Agricultural Research Centre has experienced man power and this facility can be used for training the departmental personnel.

6.1.5. Strengthen Veterinary Services

The NA's veterinary services require considerable strengthening. There is a need to enhance the supply of drugs and vaccines, to increase the number of trained staff, to purchase additional transport and equipment, and to improve extension services.

AKRSP has launched an innovative program to train para who have been selected by the local communities themselves; this program has shown considerable promise and should be expanded. Once the para have received their initial training, it will also be important to ensure that they are provided with a means to upgrade their skills and knowledge; this could perhaps be achieved by forging continuing education linkages with national institutions dealing with animal health and production.

6.1.6. Strengthen Livestock Research

A livestock research facility should be established within KARINA. The existing research staff should be strengthened through the recruitment of specialists with expertise in livestock health, nutrition and production. Priority research topics include the following:

- Small ruminant research, e.g., the improvement of sheep arid goats for milk and wool production;
- Small ruminant feed lot fattening for increased mutton production.
- Animal nutrition and management;
- The use of multi-purpose trees as ruminant feed;
- Integrated research on the reproductive physiology, epidemiology and management of dairy animals;
- Vaccine efficacy and durability;
- Epidemiological and diagnostic studies of livestock disease.

6.1.7. Range Management

Effective range managements likely to require a combination of interventions, including:

- The development of community-level, livestock organizations. The village organization concept introduced by AKRSP has been very successful at enhancing agricultural productivity within the kuhl command areas, and should now be extended to livestock owners and graziers. Community organization will be a basic prerequisite for the initiation of rangeland management activities;
- The introduction of rotational grazing schemes;
- The reduction of livestock grazing pressure on the NA's rangelands to more sustainable levels. A variety of measures should be explored, such as the introduction of rangeland grazing fees and the development of new, irrigated fodder resources close to settlement areas, in an effort to relieve pressure on the high alpine pastures;
- The initiation of rangeland rehabilitation program for degraded areas. These re-seeding, which in turn will require the establishment of rangeland and grassland reserves for the production of seed;
- Enhanced coordination between the forest department's range management initiatives and the agriculture department's livestock development activities. The cultures of these two institutions are very different, and their efforts are sometimes in conflict. It will be important to establish joint mechanisms to improve communications and coordination.

6.2. Recommendations

6.2.1. Recommendations for the Livestock Sector

6.2.1.1. Short-term Recommendations

- Selection of progeny animals should be initiated for both small and large ruminants within the available ecologies representing wide range of temperature and elevation conditions.
- Provision of incentives to the rural communities is essential for maintaining the progeny animals and development of mechanisms for the competitions among the communities to maintain the best progeny animals. A registry of progeny animals should be established under each district and information be made available to communities, research and development institutions.
- Strong linkages should be established with the National Fodders Research Programme of NARC and the Punjab's Fodders Research Institute to become a partner in the National Uniform Yield Trials for fodders;
- Fodders testing and demonstration facilities should be established in close partnership with the rural communities and to cover wide variability in terms of temperature, elevation and soil/water availability. These facilities can be used in future for the multiplication of certified seed of fodders. The responsibility of the R&D institutions would be for the production of basic seed, which can be provided to the Village Organizations for further multiplication for provision of certified seed to the farmers.
- Veterinary services available in the Northern Areas are not up to the desired standard, which need to strengthened. Furthermore, involvement of rural communities is essential for the provision of quality services to the farmers. In this regard, developing paraveterinary specialists among the organized communities has made beginning. Their skills and information needs have to be upgraded in the future to address new and emerging issues.

6.2.1.2. Medium Term Recommendations

- Improvement of the existing breeds of the large ruminants should be initiated through provision of progeny bulls to the village organizations and training for reproduction measures.
- Introduction of quality rams and bucks is necessary for improving the breed of existing small ruminants in terms of meat and wool for sheep and meat and milk for goats.
- Introduction of improved varieties of fodders for irrigated cropped lands under the Kuhl commanded areas should be given high priority. These varieties should provide multi-cut harvests, high yielding and require much less water. In future, water shortage in the existing commands will be severe and there will be a competition between various crops and for increasing the cropping intensity.
- Establishment of facility for livestock feed production and molasses block facilities are needed to provide balance feed and to meet the shortfall in the availability of feed to the livestock. The Feed Units should be of optimal size to meet the need of the local population and to avoid unnecessary transport cost, which can be excessive in the mountainous environments and cause unnecessary drudgery.

- Training of public sector staff and rural communities in developing the improved feeding mechanisms for small and large ruminants should be a continued activity so that balance feeding can be provided to the livestock.

6.2.1.3. Long-term Recommendations

- Strengthening of existing artificial insemination facilities and training of the Village Organizations is essential for the operation of these centres. The public sector should be made responsible for the provision of technical backstop support and skill enhancement to the selected unemployed youth.
- Establishment of livestock research facility at the KARINA establishments and strengthening of the existing staff to add livestock and health and production specialists.
- Fodder breeding and improvement programme should be established under the existing establishments of KARINAwith strong linkages with the Northern Areas Department of Agriculture, AKRSP and the Village Organizations;
- Continuing education system should be introduced in collaboration with the national institutions dealing with veterinary and animal production aspects, so that para-vet staff of the organized communities can have an option for further improvement in their knowledge and skills.

6.2.2. Recommendations for Rangelands

6.2.2.1. Short-term Recommendations

- The Village Organization concept was very successful for the Kuhl command areas; therefore, a similar approach can be introduced for organizing the livestock owners and graziers. The organized action is the basic requirement for introducing any intervention in the rangelands for improving productivity.
- Multi-purpose trees be introduced which suits local environments and provide forage and fuel wood to meet the needs of the rural communities.

6.2.2.2. Medium-term Recommendations

- The deteriorated rangelands can be improved through reseeding efforts and for this purpose there is a need to develop range and grass reserves for the production of seed. Such facility is not available at the moment.
- The aridity is one of the basic issues of the Northern Areas because nothing can be grown without irrigation. The extremely coarse textured soils further demands frequent irrigations to meet the evapotranspiration and seepage requirements. One of the most promising interventions would be the planting and seeding of forage and multi-purpose tree species along the sides of the channels, where seepage is sufficient to support establishment. Such non-traditional interventions have to be tried.

6.2.3. Long-term Recommendations

- A strong programme for testing, evaluation and screening of germplasm of forage and grasses be established for selection of promising varieties and production of basic seed, which can be multiplied by the organized communities;
- Range Management programme has to be integrated with the livestock programme to have positive impacts in the Northern Areas. The range aspects

are being taken care by the Forest Department, whereas livestock aspects are being taken care by the Agriculture Department. The culture of these two departments is different and sometime contradicts each other's efforts. Therefore, efforts are needed for changing the cultures, which can only be bridged by active involvement of rural communities.

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