IUCN Pakistan Programme

Northern Areas Strategy for Sustainable Development

Background Paper

# Agriculture and Food Security

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| | |
|---|---|
| AKRSP | Aga Khan Rural Support Programme |
| AKDN | Aga Khan Development Network |
| AKCSP-P | Aga Khan Cultural Services, Pakistan |
| AKES | Aga Khan Education Services |
| AKHS | Aga Khan Health Services |
| AKU | Aga Khan University |
| BACIP | Building and Construction Improvement Programme |
| BAEJ | Baltistan Association of Environmental Journalists |
| BCF | Baltistan Cultural Foundation |
| DFID | Department for International Development |
| FWO | Frontier Works Organisations |
| GoP | Government of Pakistan |
| GCIC | Gilgit Information and Conservation Centre |
| HERP | Hunza Education Resource Project |
| HWF | Himalayan Wildlife Foundation |
| KADO | Karakoram Area Development Organisation |
| MoKANA | Ministry of Kashmir and Northern Areas Affairs |
| NACS | Northern Areas Conservation Strategy |
| NA | Northern Areas |
| NAA | Northern Areas Administration |
| NCS | National Conservation Strategy |
| NDO | Nounehal Development Organization |
| NGO | Non-Governmental Organization |
| NRM | Natural Resource Management |
| MACP | Mountain Areas Conservancy Project |
| PRIF | GEF – Pre-Investment Facility Project |
| SPCS | Sarhad Provincial Conservation Strategy |
| SAP | Social Action Programme |
| VCC | Village Conservation Committee |
| VC | Village Councils |
| VO | Village Organisations |
| WO | Women Organisation |
| WASEP | Water and Sanitation Extension Programme |
| WWF-P | World Wide Fund for Nature, Pakistan |

# 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.

# EXECUTIVE SUMMARY

Agriculture in the NA is rain fed as well as irrigated. There is a general scarcity of irrigation water, hence a lot of culturable waste cannot be brought under cultivation. The components of food security are crops, orchards, livestock, fisheries and poultry.

In crops the efforts are mainly on subsistence farming. There are indigenous /native cultivars and even wild relatives of many crops scattered all over NA. People are content with them, The food stocks in the present situation may be at the most for two months. If the human population goes on increasing at the existing rate, then there may be famine like situation.

Therefore, it is imperative that an effort be made for a sustainable agriculture that is not only proficient but also profitable. Focus on agriculture will be on exploitation of potential for higher yield where it exists in cereal and horticulture crops by encouraging diverse research areas

For poultry the potential situation during summer as well as winter for egg laying and fattening of birds for meat has been analysed. For fisheries exotic vis-à-vis indigenous breads out put per available water resources. In case of livestock the breads improvement for milk, meat and drought through replacement of poor performer animals with quality wise better ones. For this cross breeding, artificial insemination and focus on fodder and pasture availability for sustainability has been emphasized.

The sustainability and preservation of top soil layer fertility by using organic matter, NPK and trace elements is equally important. Practices which will check the erosion, degradation of soil structure, soil fertility, degeneration of pastures, depletion of forests and facilitate soil permeability for movement of water have been indicated where desirable.

The economic conditions of people of NAcan be improved by growing cash crops, and replacing low value crops with high value crops. Promotion of economically important and health wise beneficial medicinal plants be carried out. As the NA exist in isolation, day temperatures are high, night temperature are low, humidity contents are also low, oil seed crops produce maximum oil contents under such conditions. Likewise, because of above environmental parameters the NA are extremely useful for seed production of number of cereal and vegetable crops. Such crops have been indicated.

The physical scenic beauty stuffed with wild flowers, forests, protected areas, lakes rivers, streams and orchards make the area suitable for bee keeping, export of cutflowers, attractive for fish and wild life hunting and catchy for tourists.

Due to dwindling resources of forests, agro-forestry needs to be promoted and a number of trees have been identified that can go for this enterprise. Added with the

propagation of mulberry trees is the industry of sericulture. One of the stakeholders that makes all these activities possible is the banking system that loans out money for in time execution of all the farming practices. Therefore, elements of micro credit has also been highlighted. Women constitute almost 53% of the population, their integration in the system, with improved skills, greater participation and changed role has been indicated as an imperative for the future.

Wherever possible the issues needing immediate attention for research or otherwise, per stakeholders demand, have been hinted upon. As the data on many of the above facets are scattered, maximum update information has been collected and added in this report. Since, most data in agriculture are discipline wise, there is very little or integrated agriculture, so this weakness will be reflected . Likewise, most agricultural practices are meant to provide livelihood, by nature these are anti conservation. These ought to change under new resource based consideration. This weakness will also be come across. The present document has been built on scattered and mostly unpublished information, collected through person to person contacts.

# 1. INTRODUCTION

The Northern Areas Administration, Planning and Development Department in collaboration with IUCN carried out public consultations at tehsil level throughout NA., to identify various issues and then prioritised them for undertaking sustainable resource management through NACS. In all the five districts of NA, Agriculture surfaced as priority No.1. Until now although a subsistence farming, agriculture has been a source of food security and sustenance for the rural population of NA. Rapid population growth, deforestation, soil erosion, use of agro-chemicals and unplanned urbanisation, all pose a threat to the very edifice of agriculture, hence food security. Many of the traditional livestock, crops, vegetables and fruit varieties are being replaced by improved varieties at an accelerated rate to meet the human and animal food and feed requirements, respectively. Such varieties/land races have come to exist under high stress and harsh environment after decades of hit and trial by the native people. While their safety and perpetuation is of great concern to the conservation people, these are also part and parcel of the social and cultural set up of the native communities. There is a great push for their replacement by out side agencies to help improve the efficiency of the system, but it is difficult to change the tradition as quickly as the facilitating agencies would want it to happen.

Before proceeding any further it is imperative to define agriculture and food security for setting limits of coverage.

## 1.1. Agriculture

Speeding (1988) defined Agriculture as "Agriculture is an activity (of man) carried out primarily to produce food, feed and fibber (and fuel, as well as many other materials) by the deliberate and controlled use of (mainly terrestrial) plants and animals".

This would exclude gardening and landscaping unless products could be described for them (such as money), but forestry, fish farming and a number of industrial processes would be included. The word "primarily" implies that there are other important products and this is indeed so. Since definitions are never as permanent as they sound, new dimensions have also been added to agriculture, especially when farming is becoming integrated with non-farming enterprises.

However, when one looks at the Northern Areas, agriculture is not a factory or industry. It is not merely a sector of production. Agriculture is a way of life, a cultural practice with all the implications of the word culture. They comprise growing crops with local seeds, caring animals that have adapted to the environment, relishing vegetables and fruits of their own kind and quality. There exists a system of self-reliance and sustainability. It is an ecological agriculture in its true sense.

The importance of agriculture to the economy can be identified in three ways: first, it provides food for consumers and fibber for industry; second it is a source of foreign exchange earnings; and third, it provides markets for the industrial growth.

## 1.2. Food Security

It is not only a question of a sufficient amount of foodstuff in quantitative terms as it is often expressed in official documents. The quality of food available for the masses is important as well. Thus, apart from safety of food, the question of food security also means diverse and quality food for healthy lives. Green revolution is known to be the crop production boosts, although productions are very low even though hazardous fertilizer, weedicide and pesticide-use have increased manifold. Thus, it was both ecologically and economically unsustainable. Conventional intensive agricultural practices cause severe effect on nutrition and welfare of people and cause severe health hazards. In comparison, sustainable ecological agriculture has the potential to provide cheap, safe and healthy food to the communities in a sustainable way. It is a safe way of producing that ensures cheap and easily available food. This is rich in nutrients and taste and best for human health as well. If this sort of system is revived, majority of the population residing in rural areas will be able to fulfil all their basic needs, "Health, Education, Clothes, Shelter, Food, Money etc" through this approach.

With regards to food security, there are some other traditional lifestyles, which are important but have become extinct these days. Few of these are:

1. Use of uncultivated food by the communities: If old villagers are interviewed, they will disclose that almost 50 percent of their food were obtained from uncultivated plants, weeds etc., then, in fact, overall food was a mix of cultivated/uncultivated food plants and domesticated/wild animals' meat. In the conventional modern agriculture, uncultivated plants are considered weeds and are eradicated through weedicides. The remaining uncultivated plants are mostly not fit for health due to indiscriminately used agro-chemicals. In comparison, sustainable ecological agriculture protects the uncultivated plants as they play an important role in the ecosystem and if used for food, they are healthy too.

2. Food diversity in the routine life: At this time, our food has become limited to only a few easily available and mostly industrialized items. In comparison, a few decades ago food was simple, diverse and rich in quality. There are several advantages of diverse food. For instance, it provides diverse important nutrients to the human body needed for a healthy life. Similarly, growing diverse food crops, coupled with on-farm livestock, poultry and fishponds, is also best to maintain soil fertility, avoid severe pest attacks, offer hundreds of uncultivated food plants and present a healthy environment. As discussed above, in conventional agriculture only a few cash crops are preferred which leads to a monoculture. In comparison, sustainable ecological agriculture ensures hetero-culture comprised of a mix of diverse crops, vegetables, fruit, livestock, poultry and fish farm on the same farm resulting in a good food diversity.

3. Urban agriculture: Under the concept of sustainable agriculture, it is believed that urban dwellers should also be involved in food production. This was, in fact, another important factor in the traditional lifestyle a few decades ago. Urban dwellers were not totally dependent on villagers and used to produce vegetables, milk, eggs and poultry, etc within homes and in urban peripheral areas. Although, there are still examples of urban agriculture in a few urban centres in Pakistan, but due to weak policies, over time, these are getting rare. The sense of deprivation is the highest among rural poor especially in female-headed households and children. In NA almost 70 percent of population resides in scattered places and villages. Agriculture is their main occupation. Most of the rural poor are small and marginalized farmers, landless folk, artisans, female-headed households, aged persons and children. By and large, small farmers are engaged in subsistence agriculture where their basic concern is survival and getting ahead of life with farming. This is why the dimensions of their farms are (most often) more or less than 0.079 ha/farm and they usually grow multiple crops associated to their basic needs of food, clothing and shelter. To satisfy other needs (education, health, clothes, money etc) farmers market the surplus of their crop yield. This clearly shows that agriculture for farmers is a way of life, rather than just an economic activity. As compared to the concept of yield in the modern agricultural system that this much inputs will result into that much yields, many farmers do not own it. According to them the yield of an agricultural activity can only be concluded seeing how better their level of subsistence is being satisfied. Hence, their social and cultural values are emotionally involved with agriculture. The way modern technologies are growing and agriculture is being commercialised, rural communities are gradually going down the poverty line and loosing their subsistence agriculture as well as their social and cultural values. It is also widely recognized that these technologies have benefited few of the giant landlords and, particularly, corporation involved in agriculture. As a result, most of the farmers are gradually loosing their hold on agriculture due to the fact that they cannot afford the increasing costs of modern inputs to compete. Consequently, a constantly alarming number of villagers are leaving their agricultural activities and migrating to and settling down in urban centres. Perhaps due to these circumstances, we are not able to achieve self-sufficiency and sustainable development.

Through its basic shift in values and priorities from a narrow focus on production and productivity to a broader emphasis on healthy systems which nurture over the generations, sustainable food systems approaches can contribute in two fundamental ways towards sustainable development. First, it can be an important part of reducing global warming, pollution, the loss of biodiversity, and social and economic inequities. This is because they use much less fossil fuel and have less environmental impact than conventional approaches. They also encourage the maintenance and enhancement of both bio-and cultural diversity (Dahlberg, 1996) Second, by pursuing sustainable approaches which are more environmentally and socially efficient-as well as more economically sustainable they make sustainable development more likely. Pursuing the new frontier of sustainable and regenerative food systems at all levels can thus help avoid the high risk , while facilitating the development of healthier citizens, more sustainable economics, increased equity, and healthier natural systems.

The present status paper attempts to look forward to food security options and opportunities in view of the available background information for major grain, horticultural and fodder crops, livestock, poultry and fisheries. NA having no education and research system in agriculture but survives only on rudimentary extension service. The meagre manpower, limited resources and little access to modern training and literature all push NA, agriculture to a lower ebb. Until strenuous efforts are made expected improved situation may not be possible. Liberty has been taken to interwove in the paper some of the latest approaches such as biotechnology to help bring revolution in the thinking process, without loosing sight of conserving the existing traditional land races of crops, vegetables, fruits, medicinal plants and livestock and the various genes that have bestowed perpetual continuation of these organisms for centuries.

## 1.3. Northern Areas

The Northern Areas of Pakistan are located between 35-37 N and 72-75 E. The majority of the area is mountainous and covers over 72,496 square kilometres with a population of one million in 831 villages scattered all over the area. Human settlements are on alluvial fans and terraces from 4000 ft to 11500 ft elevation on either side of the Indus and its tributaries where water is available for agriculture. Density is of 14 persons/km2. Roughly 0.86 per cent area is under agriculture, double of this is arable, 4.0 per cent under forest and the rest is covered by range lands, glaciers and mountains. Small land holdings (1-2 kanals or 0.073 to 0.074 ha/capita) and existence of 75 per cent agricultural land in single cropped area and 25 per cent in double cropped area in the arid mountains confine the production below subsistence level. Agriculture is irrigated owing to scanty precipitation and subsequent aridity all over the mountain region. People of the area live a very hard life.

The land comprises of exposed surface of various rock types. Most of the rocks are igneous and metamorphic. Geological erosion of these mountains is very active. The mountain soils are coarse loamy and sandy. Although some fine loamy and fine silty soils are also found.

"Presently, NA are divided into five administrative districts of Gilgit, Diamir, Ghizar, Skardu, and Ganche. The area is mostly covered by The Himalayas, the Karakoram, Pamirs, and the Hindu Kush. K-2, Nanga Parbat, Gashbrum-1,2, Broad peak, and numerous world ranking peaks majestically stand above the heights. Outside the Arctic World's largest glacier, Siachin, is located here. Also the highest battle ground in the world being manned by the soldiers in temperatures close to minus fifty. It also houses in its folds mammoth glaciers like, Batura, Baltoro, Biafo etc. Mighty Indus flows out of these to irrigate the entire country". (Khan, 2001). KKH is the main communication link, joins China with Pakistan and also connects Northern Areas with the rest of the country.

Maximum attention has been paid by intellectuals, writers, photographers and other creative personalities to depicting the NA physical and cultural diversity, which is unmatched in its serene beauty and majestic grandeur.

"Mountains are the main sources of water, which is vital for the survival of millions of people living in the mountains and down country. Mountains are near

wilderness areas which are the last stronghold for many species of plants and animals, home to many threatened and endangered species including the snow leopard, markhor, ibex, blue sheep, musk deer, and a range of avifauna. The Karakoram Mountain Ranges are one of the world's richest ecosystems in term of biodiversity. Mountains are used by all and sundry for fishing, hunting, hiking, skiing, sight seeing and bird watching" (Javed, 2001).

During droughts and dry spells the mountains and peaks receive snow in negligible quantity and consequently the fountains and lakes dry, thereby affecting the agricultural production. During the drought of 2001 some fountains had dried in lower parts of Diamir due to less snowfall in winters. Thus the farmers either harvested the wilted crop for hay or could not cultivate in the water scarcity valleys/villages. Easy, fertile and productive land has already been brought under cultivation by gravitational irrigation system and the land for which water could not be arranged is still lying virgin. Indus water flowing in deep depression is essentially required to irrigate the arable lands lying several hundred feet above water level either by gravitational system or by lift irrigation system which could not be attended probably due to lack of technical and financial backstopping.

Being mountainous with high gradient the area does not have any ground water and hence tubewells, karez system and rodkohi system do not exist. Recently, with the development of new interventions, pipe flow irrigation system has been widely introduced. This system is feasible for small stream size and land sliding areas. Under NAADP, AKRSP-sponsored participatory development approaches the communities have been encouraged to use pipe flow irrigation system rather than open channels to avoid damages from land sliding and to reduce the maintenance cost. Contrary to other parts of the country the maintenance of water channels (kuhls) are carried out by the communities using traditional systems called "Alla shery".

Cultivation is limited to valley bottoms and depends largely on irrigation water from mountain spring and river. The economy of the Northern Areas was mainly based on subsistence production of agricultural and horticultural crops.

NA are with 19 mountain peaks higher than 7600 m above sea level and more than half the land above 4500 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 aspect, shaping both the natural and the man-made environment . Below 3000 m, precipitation is minimal, rarely exceeding 200 mm annually, but there is a strong gradient with altitude and at 6000 m the equivalent of 2000 mm year falls as snow. Temperatures in the valley bottoms can vary from extremes of 40 C in summer to –10 C in winter.

The mountain ecosystems tend to be relatively unstable, un-resilient, and of low inherent productivity. The area is also subject to sudden mudslides and rock falls which frequently block roads and irrigation channels. Within this fragile environment there are a variety of ecological niches upon which people base their livelihoods. These include old river terraces and fans on valley floors where sparse soils have accumulated. These terraces lie between unstable scree slopes

on valley side, and high elevation forests and alpine meadows on the other. Surface water supplies are available from seasonal river flow, springs, glacial streams and seasonal snow melt. Meadows and forests exist where snowfall, shade and terrain allow soil to retain some moisture, but the cultivated lands lower down depend on irrigation with water derived from melting glacial ice, snow and springs Agriculture is therefore constrained by scarcity of land and water, but where these limitations can be overcome, pockets of high agricultural productivity are found.

Rivers and streams fed by springs are the most dependable sources of water for irrigation engineering problems at the intakes along river banks.

Soils are relatively low in organic matter, very free-draining, contain virtually no clay, and have low natural fertility. As a result, water and nutrient retention is very poor The amount of farmyard manure available is limited, and other methods of building up soil organic matter must be sought. Growing legumes and returning more plant residues to the soil are two options. Chemical fertilizers are being used by farmers as availability has increased and credit has become available. At elevation over 2,300 m, where only single cropping is possible due to the shorter growing season, the importance of livestock in the farming system increases significantly, creating heavy demands for forage from trees, shrubs and grasses that are highly seasonal in production.

Until recently remoteness of most of the village in the region meant that near self-sufficiency was essential. Change has come with improved communications. The household economy is slowly becoming less dependent on farm production, Farmers' thinking, however, is still dominated by subsistence production and the need for food security, especially in the higher-altitude and more remote areas is more important.

The import of subsidized wheat, flour, and beef from the plains has reduced the incentive for the local production and enabled farmers to consider alternative cash crops.

Altitude, aspect, access and irrigation source induce great variability in cropping and agricultural technology. At lower altitudes two cereal crops are possible during the spring and summer growing season. At higher altitudes the shorter growing season permits only one grain crop followed by a short season crop, but livestock numbers and dependence on livestock increases. Between these two basic systems there are transition zones and local variations.

At lower altitudes the main crop is winter wheat followed by maize. As altitude rises a quick maturing spring barley substitutes for wheat varieties FSD-83, Chakwal-86, Parwaz-94 are as early maturing as barley, which may replace barley with improved management practices (so as to retain the following crop). Or winter wheat is followed by vegetables (such as peas, turnips or radishes) instead of the second grain crop. Crops may be harvested before maturity when growth rates have been less than usual, either to allow the planting of the following crop on time or to get the crop off the fields before livestock from alpine pastures return to the village to graze. Other crops of importance include potatoes, small grain millets, pulses, buckwheat, spinach, alfalfa and other fodder crops.

### 1.3.1. Present Land Use

An estimate of the present land use of the NA is presented in Table 1. Only some 1% of the NA is cultivable. About 4% is occupied by forest and 23% are rangelands mainly alpine pasture. Tables 1, 2 and 3 show land use statistics in NA.

**Table 1: Summary of present land use in Northern Areas (000 ha)**

| S. No. | Type of land | Area | Percentage |
|---|---|---|---|
| 1. | Mountains/Lakes/Rivers/Glaciers | 4,810 | 66 |
| 2. | Forest: a). Protected = 65 1%<br>b). Private = 219 3%<br>c). Social Agro/Farm = 362 5%<br>Total forest = 646 9% | 646 | 9 |
| 3. | Rangeland | 1,646 | 23 |
| 4. | Cultivated Area | 58 | 1 |
| 5. | Cultivable Waste | 90 | 1 |
| Grand total | | 7,250 | 100 |

Source: Department of Forest, NA.

**Table 2: District-wise land utilization statistics (hectares)**

| | | | | Cropped Area under other (hectares) Crops. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S. No. | District | Cultivated area | Cultivable area | Cereal | Potato | Other veg | Fodders | Fruits | Total |
| 1. | Gilgit | 11,900 | 18,073 | 10,821 | 574 | 634 | 3,679 | 1,399 | 17,107 |
| 2. | Ghizar | 7,800 | 7,896 | 7,000 | 93 | 376 | 2,529 | 2,230 | 12,220 |
| 3. | Skardu | 15,200 | 20,859 | 10,713 | 521 | 582 | 3,533 | 1,400 | 16,749 |
| 4. | Gahkuch | 7,900 | 11,636 | 6,089 | 525 | 425 | 3,394 | 1,100 | 11,533 |
| 5. | Diamir | 14,900 | 32,000 | 11,202 | 520 | 530 | 3,133 | 900 | 16,285 |
| Grand total | | 57,700 | 90,464 | 45,825 | 2,233 | 2,547 | 16,268 | 7,029 | 73,902 |

Source: 1990 Agricultural Census.
Note: In the census 90464 hectares land shown as cropped, area which is actually cultivable waste and the cropped area is 73902 hectares.

**Table 3: District-wise land use in Northern Areas**

| | | | | Farm Area uncultivated (ha) | | | |
|---|---|---|---|---|---|---|---|
| S. No. | District | No. of farm | Farm area (ha) | Cultivated | Cultivable land (ha) | Forests waste | Total |
| 1 | Gilgit | 17573 | 21624 | 11900 | 18073 | 17028 | 35101 |
| 2 | Ghizar | 11302 | 15223 | 7800 | 7896 | 7740 | 15636 |
| 3 | Diamir | 16,008 | 13,583 | 14,900 | 32,000 | 249,784 | 281,744 |
| | | | | | | (218,784 Private) | |
| 4 | Skardu | 22,746 | 22,127 | 15,200 | 20,859 | 9,288 | 30,147 |
| 5 | Ghanche | 11,351 | 25,557 | 7,900 | 11,636 | 100 | 11,736 |
| Grand total | | 78,980 | 98,114 | 57,700 | 90,464 | 283,900 | 374,364 |

Source: 1990 Agriculture census DoA. NA.

| Table 4: Approximate altitudes (masl) of important cities and village in zone 7 | |
|---|---|
| **City/Village** | **Altitude (masl)** |
| Chilas | 1,260 |
| Bunji | 1,350 |
| Sai Juglote | 1,400 |
| Gilgit | 1,490 |
| Jaglote Tangir | 1,600 |
| Darel Gumari | 1,700 |
| Gorikot (Astore) | 2,000 |
| Gupis | 2,144 |
| Astore Proper | 2,150 |
| Skardu | 2,197 |
| Shigar | 2,250 |
| Ishkoman | 2,300 |
| Karimabad | 2,450 |
| Yasin | 2,450 |
| Gulmit | 2,500 |
| Passu | 2,500 |
| Astore | 2,500 |
| Khaplu | 2,600 |
| Khuda Abad | 2,800 |
| Naltar | 2,880 |
| Babusar | 3,000 |

Source: Saunders, 1983; Whiteman, 1985.

### 1.3.2. Climate

The climate is basically Himalayan, though modified by location and altitude. Thus in the south western Gilgit, in parts of Astore, rainfall is as high as 1000 mm per year, but most of the cultivated areas receive below 500 mm and a broad tract across Ghizar, Gilgit and much of Baltistan receives below 125 mm.

In some cases correlated with this and in other cases superimposed is the effect of altitude, which varies from around 1250 m in the Indus Valley to over 8000 m for some peaks.

The lower valleys are classed as arid and higher valleys as semi-arid. Above about 3000 m elevation, near the limit of cropping, conditions are more semi-humid and areas of forest and postures occur. Higher still, snowfall on the mountains can be significant as well as in excess of 1000 mm annual precipitation. Altitude will obviously influence temperatures across NA, for example maximum temperatures in Gilgit being some 6dc higher than those for Astore.

Annual rainfall in some areas is generally less than 200 mm except at higher elevations. Above 3000 m there is a large increase in rainfall reaching some 2000 mm a year as snow at 6000 m. In the agricultural areas evapotranspiration exceeds rainfall in all months and crop production is confined to alluvial fans and terraces on the valley bottoms wherever irrigation water is available from locally tapped rivers, springs, glacial streams, streams and seasonal snow melt.

| Table 5: Mean monthly precipitation in Northern Areas (mm) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Altitude (m) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| MD Chilas | 1,260 | 8.5 | 14.9 | 36.5 | 40.2 | 26.4 | 6.6 | 7.7 | 11.1 | 2.6 | 1.2 | 4.0 | 5.4 | 165.1 |
| MD Gilgit | 1,490 | 4.4 | 6.3 | 15.0 | 28.3 | 27.4 | 6.3 | 15.0 | 14.4 | 6.8 | 6.8 | 2.1 | 3.4 | 131.7 |
| MD Gupis | 2,144 | 4.4 | 8.4 | 10.4 | 22.1 | 32.8 | 9.0 | 9.3 | 15.7 | 7.6 | 6.3 | 1.7 | 5.4 | 133.4 |
| MD Astor | 2,148 | 37.9 | 52.0 | 92.9 | 90.3 | 76.0 | 20.0 | 20.4 | 25.3 | 18.5 | 33.4 | 15.6 | 19.4 | 501.8 |
| MD Skardu | 2,200 | 20.7 | 23.6 | 40.1 | 26.1 | 29.2 | 7.3 | 12.2 | 11.6 | 6.2 | 7.9 | 5.4 | 11.9 | 202.2 |
| W Karimabad | 2,400 | 4.2 | 4.3 | 7.0 | 20.6 | 23.2 | 13.3 | 21.7 | 26.5 | 13.7 | 4.6 | 1.1 | 3.7 | 145.1 |
| FAO Yasin | 2,450 | 6.4 | -- | 28.0 | 15.6 | 25.4 | 2.6 | 10.9 | 6.7 | 18.6 | 6.3 | 2.9 | 2.6 | 126.0 |
| W Naltar | 2,880 | 11.5 | 15.5 | 63.8 | 65.2 | 93.0 | 23.0 | 13.5 | 69.8 | 43.2 | 2.5 | 3.8 | 6.1 | 410.9 |
| FAO Babu-sar | 3,000 | 21.1 | 37.1 | 23.1 | 76.4 | 27.9 | 34.8 | 25.1 | 39.9 | 42.4 | 10.7 | 9.1 | 47.7 | 395.3 |
| MD Misghar | 3,100 | 6.2 | 6.8 | 13.7 | 18.7 | 25.3 | 4.7 | 10.1 | 10.6 | 6.8 | 6.6 | 5.1 | 14.1 | 128.7 |

Source: Mountain Oases –PTS. Whitman, 1985

### 1.3.3. Soils and Land Potential

Cultivated areas have been developed mainly on alluvial fans and to a lesser extent from the reclamation of old river terraces. Alluvial deposits at the base of screes are an other major cultivated land form and are mainly used for trees and forages. Soils are generally low in clay content, high in silt and sand fractions and low in organic matter (usually less than 1%).They are generally calcareous with a pH well above 7, have a low cation exchange rate and a moderately high conductivity. Soils are poor in nitrogen while other major and minor elements are reported to be mostly adequate. As soil testing is however, not done systematically, little is really known about the available nutrient content of the soils and there are increasing observations of deficiency symptoms in some crops for phosphorous, N,K, and micro-elements such as zinc in potatoes, boron in apples, and iron in pears and cherries. (Table 6 a). Very little data have been available in quantitative terms as far as agricultural inputs are concerned. One has to move door to door to collect any desired information. There is a strong need for working out appropriate doses of fertilizers to maintain soil fertility.

Economic feasibility of fertilizer practices should be an essential element of studies aimed at improving crop productivity. Basically, the farmer is an economist and he adopts only those improved practices or innovations, which are paying and, more and easily workable. On the basis of current market prices of fertilizers and maize grain, the obtainable income from additional yields was worked out. Table-6 (b) reflects the comparative economics of different fertilizer levels.

**Table 6a: Effect of different fertilizer levels on grain yield of 5 maize cultivars (Tones/Hectare)**

| Fertilizer Levels (Nutrient in kg) | | Mean grain yield (T/ha) of 5 cultivars (Tones/Hectare) | | | | | |
|---|---|---|---|---|---|---|---|
| N | $P_2O_5$ | PR-80 (VI) | KHYBER (X) (V2) | SARHAD WHITE | GHANGEZ (V4) | AZAM (V5) | F.AVERG. |
| 00 | 00 | 1.650 | 1.437 | 1.621 | 1.739 | 1.708 | 1.631 |
| 50 | 00 | 2.508 | 2.305 | 2.787 | 3.394 | 3.280 | 2.855 |
| 50 | 25 | 3.610 | 3.500 | 3.878 | 4.667 | 4.238 | 3.969 |
| 75 | 25 | 4.930 | 3.950 | 4.980 | 5.632 | 5.500 | 4.998 |
| 75 | 50 | 4.980 | 4.210 | 5.660 | 6.515 | 6.405 | 5.554 |
| 100 | 50 | 5.880 | 4.880 | 6.320 | 7.590 | 7.220 | 6.398 |
| 100 | 75 | 6.135 | 5.350 | 6.890 | 7.990 | 8.110 | 6.895 |
| 125 | 75 | 7.226 | 6.360 | 7.880 | 8.780 | 8.970 | 7.843 |
| 125 | 100 | 7.780 | 6.800 | 8.330 | 9.300 | 9.120 | 8.266 |
| 150 | 100 | 8.870 | 7.890 | 9.240 | 9.870 | 9.640 | 9.102 R |
| 150 | 125 | 8.900 | 7.995 | 9.480 | 10.160 | 10.110 | 9.329 |
| 175 | 125 | 8.700 | 8.150 | 9.670 | 10.580 | 10.490 | 9.718 |
| 13 | Var. Mean | 5.847 | 5.236 | 6.395 | 7.185 | 7.066 | 6.346 |

Source: Mountain Oases –PTS. Whitman, 1985

**Table 6b: Comparative economics of different fertilizer levels on the yield of maize cultivar Azam White**

| Fertilizer treatment (Nutrient kg/ha) | | Cost of fertilizer @ Rs.430/- & Rs.450/- per bag of Urea & Nitro phose | Average yield (t/ha) | Add yield (t/ha) | Gross income per ha @ Rs.9/- per kg Grain | Net Income per ha | Cost/ Benefit ratio |
|---|---|---|---|---|---|---|---|
| N | $P_2O_5$ | | | | | | |
| 00 | 00 | -- | 1.708 | -- | -- | -- | -- |
| 50 | 00 | 937 | 3.280 | 1.572 | 14148 | 13211 | 1:14.10 |
| 50 | 25 | 1918 | 4.238 | 2.530 | 22770 | 20852 | 1:10.87 |
| 75 | 25 | 2387 | 5.500 | 3.792 | 34128 | 31741 | 1:13.30 |
| 75 | 50 | 3368 | 6.405 | 4.697 | 42273 | 38905 | 1:11.55 |
| 100 | 50 | 4305 | 7.220 | 5.512 | 49608 | 45303 | 1:10.52 |
| 100 | 75 | 5286 | 8.110 | 6.402 | 57618 | 52332 | 1:9.90 |
| 125 | 75 | 7755 | 8.970 | 7.262 | 65358 | 57603 | 1:7.43 |
| 125 | 100 | 8736 | 9.120 | 7.412 | 66708 | 57972 | 1:6.64 |
| 150 | 100 | 9673 | 9.640 | 7.932 | 71388 | 61715 | 1:6.38 |
| 150 | 125 | 10654 | 10.110 | 8.402 | 75618 | 64964 | 1:6.10 |
| 175 | 125 | 11123 | 10.490 | 8.782 | 79038 | 67915 | 1:6.11 |
| Grand mean | | | | | | | 1:9.35 |

Evidently, there could be no additional income from control plot, which received no fertilizer doses. The cost benefit ratio ranged from 1:6.10 to 14.63 in case of treatments 150 kg N+125 kg P2O5 and 50 kg N+00 kg P2O5 per hectare. Although the net income was the maximum in fertilizer treatment 175 kg N+125 kg P2O5 per hectare, but the cost benefit ratio was the lowest according to the Law of Diminishing Return. The cost benefit ratio was maximum in case of treatment 50 kg N+00 kg P2O5. The aggregate mean of cost benefit ratio was 1:9.35. The treatment

150 kg N+100 kg P2O5 per hectare was the best combination for beneficial use of fertilizers for maize crop and further increase in fertilizer dose could not increase the grain yield significantly. It is also obvious from the data that with the investment of one unit in inputs per unit area in the form of fertilizers, the output per unit area can be increased from 6.10 to 14.10 times.

Soils are free draining and have a moderate to low water retention capacity and because of the generally limited soil depth of some 30 cm to 90 cm a limited total water availability and need, therefore, frequent irrigation. Irrigation water availability is, however, generally not a constraint and frequent and abundant irrigation, (Subject to enough snowfall on mountains otherwise irrigation water is a serious constraint in many areas) leads to the leaching of soil nutrients in the predominantly sandy and silty soil which will have to be replaced by fertilizer. The most important limiting factor is, however, the low content of organic matter and farmers insist that above all the other management factors under their control it is the amount of manure and water which are putting the most influence on the yields.

## 1.3.4. Physiography and Soils

Physiography, which is a product of relief, slope and aspect, controls soil development, soil moisture and temperature regimes and ultimately land use. Soils provide moisture, nutrients and a foothold for roots and as such a base for plant growth. The following physiographic units have been recognized in the region.

Mountain: These comprise of various rocks such as igneous, metamorphic and sedimentary, the mountains are rugged, with high relief amplitude and strong slopes ranging from 13 to 160 percent. Geologic erosion in these mountains is substantial. At places, very deep gorges have formed while at other locations sharp cliffs and peaks stand out. Rock debris is found at the foot of the mountains. Generally, accessible slopes with thick soil cover are terraced for arable farming, as instead of rain fed irrigated cropping.

Because of their sloping surface, the mountain soils are the most unstable and subject to active water erosion. The intensity, however, depends upon the vegetation cover and the slope gradient. Generally, the surface soils are thick, well-humidified, dark coloured and sufficiently base rich. The surface horizon is more pronounced in moist and cooler locations. The organic matter content of the surface mineral horizons has been found to vary from about one to more than nine percent. The virgin soils may contain more organic matter than their cultivated counterparts. The surface soils are weak to moderate granular whereas the sub-soils are pre-dominantly sub angular blocky.

The pH values range from 5.5-7.3. They show strong relationship with the parent rock. The bulk of the soils are moderately acidic to neutral, pH 5.5-7.3, while those derived from limestone's and calcareous soils are slightly alkaline. Only those soils that have originated from calcite bearing rocks may show calcareousness.

### 1.3.4.1. Gravelly fans and terraces

These are of limited extent and located below mountain slopes. These are characterized by gravelly loamy soils, containing lime in varying quantity.

Infiltration rate in the gravelly soils is rapid and water holding capacity is low. Their use is limited to grazing, although locally some arable farming is done with irrigation.

### 1.3.4.2. Piedmont plains

These are of minor extent and found throughout the area in narrow strips below the mountain slopes. These are formed in finer alluvium deposited as intermittent sheet floods and shifting of torrent channels at a much smaller gradient. The soil materials are mainly silt loam's and silty clays and originate from a wide variety of igneous and metamorphic rocks. Locally, these are dissected by gullies and streams. The soils of the piedmont plains have gentler slopes; these are deep and have lesser coarse fragments as compared to the mountain soils. Generally, no bedrock is encountered at shallow depths but at places, gravel and / or stone beds may underlie these soils. The soils close to the mountains are usually coarser in texture and comparatively shallower. With distance, the texture becomes finer and the profile thickness increases.

These are brighter in colour with less than one percent organic matter content. The pH ranges from slightly acid to moderately alkaline.

### 1.3.4.3. Loess plains

These are of very minor extent. Loess deposition has been quite prominent in the area. Remnants of the original loess are locally found in mountain troughs; elsewhere they have been eroded from the mountain slope by water. The loess is estimated to have been deposited in the area in the main coldest period of the last glaciations some 50,000-200,000 years ago. It probably originated in the broad river plains for the present Indus valley. The loess plains are level to gently undulating and used for irrigated agriculture. Eroded loess mixed with local alluvium has been accumulated in some localities in patches. The surface of these plains is generally level to nearly level and concave.

The soils are very deep and dominantly silty to clayey in texture. The soils in comparative depressions are non-calcareous while those on the margin of the basins or slightly raised parts are calcareous and brightly coloured. The organic matter content is generally less than one percent. Their reaction ranges from neutral to moderately alkaline. They are generally well drained.

### 1.3.4.4. Alluvial plains

Active and recent flood plains mainly occur in small patches along both sides of Indus and other rivers. These small areas have been built up commonly around the junction of the tributaries with the main streams and occupy higher positions than the usual river level.

During floods due to ice melting on mountains in summer, which are alluvium.. with each inundation sealing the surface and making it compact. The areas away from the stream courses receive flash flood deposits.

Sub-recent floodplains are of very limited extent occurring along the main river in the area. higher than the active and recent flood plains. They are seldom flooded.

The stream and river deposits are usually greyer in colour and may have common distinct mottles. The soils close to the active courses are stratified while the distant ones are homogenized. The soils are generally deep silty and non-calcareous except where derived from calcite bearing rocks or having admixture of loess. The soils derived from non-calcareous material are slightly to mildly saline while the others are moderately alkaline.

# 2. CURRENT SITUATION

## 2.1. Food Crops

**Table 7: Ecological Zones in Northern Areas**

| Zone | Location | Characteristics |
|---|---|---|
| I | At the base of valleys near the Indus river: with compact village | Elevation 1900 m: double cropping zone with typically wheat as a winter crop and maize in summer; about one third of cultivated area |
| II | At the middle and higher reaches of the valleys: usually with dispersed settlements | Elevation 1900 to 2300m marginal single cropping zone which can be converted into double cropping zone with early maturing wheat and barley varieties like FSD-83, Chakwal 86, Parwaz-94 etc. |
| III | High elevated valleys | Elevations 2300m to 3000m single cropping zone. |
| IV | High pastures | Elevations above 3000m alpine pastures, no cultivation, snow bound in winter. |

**Table 8: Crops and zone-wise cropping**

| District | Double cropping zone | Marginal single cropping zone | Single cropping zone |
|---|---|---|---|
| Gilgit | Wheat (70%)<br>Maize (G&F)<br>Barley<br>Potato (table)<br>Vegetables<br>Millet, Oats, fodders | Only Rabi crops, e.g. wheat, maize, buck- wheat, peas, potato, barley | Barley, wheat, potatoes, peas |
| Skardu | Due to snow fall only single cropping system is practiced | Wheat, barley, maize buckwheat, potato, small grain millet | Wheat, potato |
| Diamir | Rabi (below 1,800)<br>Wheat (70% Area)<br>Potato<br>Barley<br>Peas<br>Kharif<br>Maize<br>Beans (cash crop) | At 1800 meters to 2400 m only Rabi crops, wheat, maize buckwheat, vegetables, small grain millets | Barley, wheat, potato, peas, other vegetables, maize |
| Ghizar | 85 % of the land falls in the high altitude<br>Rabi<br>Wheat<br>Barley<br>Potato<br>Millet<br>Faba beans | Above 1800-meter only Rabi crops like wheat and maize, buckwheat, small grain millets. | Wheat, barley, vegetables, peas |
| Ghanche | Due to heavy snow in winter only single cropping pattern is practiced | Barley, potato (commercial wheat crop) Maize (fodder) buckwheat after barley | Potato, wheat, barley, etc. |

### 2.1.1. Crop Area, Production and Yields

Tables 7 & 8 give an indication of the importance of different crops in the NA as a whole. Table 9 summarizes estimated average yields and production of major crops. Table 10 gives estimates of food, feed and seed required for NA.

**Table 9: District-wise estimated cropped area, yield and production in NA (ha)**

| S. No. | Crop | Gilgit | Ghizar | Skardu | Ghanche | Diamir | Total | % Aged Cropped Area | Yield (T/Ha) | Production (T) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Wheat | 5,671 | 3,943 | 7,878 | 4,613 | 6,678 | 28,783 | 39 | 1.8 | 51,809 |
| 2. | Maize | 4,100 | 2,570 | 572 | 35 | 5,371 | 12,648 | 17 | 2.0 | 25,296 |
| 3. | Barley | 1,050 | 487 | 2,163 | 1,441 | 253 | 5,394 | 7 | 1.6 | 8,630 |
| Sub Total | | 10,821 | 7,000 | 10,613 | 6,089 | 12,302 | 47,825 | 63 | – | 85,735 |
| 4. | Potato | 574 | 93 | 521 | 525 | 520 | 2,233 | 3 | 25 | 55,825 |
| 5. | Other Vegetables | 634 | 376 | 582 | 425 | 530 | 2,547 | 3 | 20 | 50,940 |
| 6. | Fruits | 1,399 | 2,230 | 1,400 | 1,100 | 900 | 7,029 | 10 | 25 | 175,725 |
| Sub Total | | 2,607 | 2,699 | 2,503 | 2,050 | 1,950 | 11,809 | 16 | – | 282,490 |
| 7. | Fodder | 3,679 | 2,529 | 3,533 | 2,394 | 3,133 | 15,249 | 21 | 25 | 381,225 |
| Grand Total | | 17,107 | 12,228 | 16,649 | 10,533 | 17,385 | 73,902 | 100 | – | 749,451 |
| 1. | Wheat Straw | 5,671 | 3,943 | 7,878 | 4,513 | 6,678 | 28,783 | – | 2.7 | 77,714 |
| 2. | Maize Stover | 4,100 | 2,570 | 752 | 35 | 5,371 | 12,648 | – | 6.0 | 15,888 |
| 3. | Barley Straw | 1,050 | 487 | 2,163 | 1,441 | 253 | 5,394 | – | 2.5 | 13,485 |
| Total Fodder | | 13,500 | 9,529 | 14,146 | 8,483 | 15,435 | 62,074 | – | – | 548,312 |

Source: 1990 census and personal experience.

**Table 10: Total food, feed and seed requirement in Northern Areas**

| Detail of component | Rate/Capita/Day | Quantity |
|---|---|---|
| Children | 200 gm | |
| Women without child | 300 gm | |
| Women with child | 350 gm | |
| Men | 400 gm | |
| Average rate in NA, may be 450 gm/capita/day | | |
| Annual Food requirement for a population of I million @ 164.25 kg per year (0.4500 x 365) | | 164,250 Tones |
| Wheat seed requirement @ 8 kg/Kanal or 160 kg/ha (28,783 x 0.160) | | 4,605 |
| Maize seed requirement @ 1.5 kg/Kanal or 30 kg/ha | | 379 |
| Barley seed requirement @ 7kg/Kanal or 140 kg /Ha (5,394 x .140 ) | | 755 |
| Feed for Animals | | 6,000 |
| **Total Requirement** | | **175,989 Tons** |
| Annual Production | | 85,735 |
| Net food grain deficit | | 90,254 |
| Food grain supplied through Food Dept. NA.70,000 | | |
| Food grain supplied through Traders/shopkeepers | | 20,254 Tons |

### 2.1.1.1. Constraints

In the crop sector limited land holdings, lack of quality seed, existence of strong agro-ecological zones, perpetuation of traditional farming system, absence of research systems, weak extension, general absence of training and human resource development, as well as poor linkages between and amongst various agencies have cumulatively adversely affected the overall performance of crop production. Constraints affecting crop development are ecological and institutional.

Ecological constraints include the limited area suitable for crop production:

- Agro- climatic conditions are favourable only in the lower parts of the valleys where double cropping is possible, allowing for the cultivation of a wide range of crops but difficult in the upper reaches of the valleys where frost and long snow coverage shorten the growing season to a few months;
- Due to rapid growth (increase) in population and successive divisions/fragmentation of the limited land, the land holdings are so small (0.073 ha or 1.5 kanal/capita) that these can neither provide increased food nor income except below subsistence level of production/income from traditional system of farming. It is the lowest per capita income in the country.

Institutional constraints limiting the efficiency of crop production are summarized as follows.

- Appropriate extension advice is not available because DOA staff activities are not focused on the needs of the farmers. The staff is not trained in extension methodology and technology development and dissemination:
- The technology developed in other parts of the Pakistan and other countries with similar agro- ecological conditions needs to be tested under the NA agro-climatic and socio-economical conditions. The participatory on-farm trials will be able to address the issues relevant to the production systems prevailing in the area:

**Table 11: Mean wheat grain yield (T/ha) out of an area of 6.4 sq.m. (Mean of 3 replications in each location)**

| S. No. | Name of Variety | Name of local | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Ghowari 1991 | Saling 1991 | Babusar 1992 | Chilas 1993 | Gonar Farm 1994 | Gorikot 1994 | Grand mean |
| 1. | Chakwal-86 | 7.306 | 9.663 | 9.355 | 8.655 | 8.406 | 5.645 | 8.097 |
| 2. | Satlug-86 | 7.513 | 8.734 | 7.728 | 6.719 | 6.948 | 3.703 | 6.891 |
| 3. | FSD-85 | 6.966 | 6.427 | 6.544 | 6.172 | 5.730 | 3.777 | 5.939 |
| 4. | Pirsbak-85 | 6.278 | 6.556 | 3.542 | 6.719 | 6.875 | 3.750 | 5.620 |
| 5. | Shagetsi | 5.969 | 8.092 | 6.963 | 4.297 | 4.270 | 3.495 | 5.514 |
| 6. | Khyber-87 | 5.083 | 5.782 | 7.161 | 5.469 | 5.520 | 3.661 | 5.446 |
| 7. | Pb-85 | 5.142 | 6.173 | 7.030 | 4.859 | 6.042 | 3.292 | 5.423 |
| 8. | KARINA-87 | 3.906 | 4.844 | 3.719 | 4.063 | 5.208 | 3.636 | 4.229 |
| 9. | Local Check | 1.591 | 1.992 | 4.241 | 3.172 | 2.938 | 3.645 | 3.930 |
| Grand mean | | 5.530 | 6.407 | 6.476 | 5.638 | 5.771 | 3.845 | 5.677 |

Source: Personal experimentation (DoANA)

- Most of the necessary inputs for crop production are expected to be available either from the private sector in the main marketing centres (fertilizers, agro-

chemicals) or from local business people (threshers, tractors). There is, however, a major problem in the supply of "improved high quality cereal, vegetable seeds and seed potato". Without assured supply of improved seed there is little chance of increasing yields.

- Sustained production of cash requires adequate linkages between the producers and the consumers. Marketing of cash crops can be difficult resulting in lower prices which could act as disincentives to the CO members to introduce cash crop production. The COs need to organize marketing for their produce;
- The Agricultural Development Bank of Pakistan (ADBP) has branches in the area to provide credit to the farmers for crop loans. But due to complicated terms and conditions the farmers are unable to get credit facilities easily. The collateral requirement discourages farmers to have access to formal credits. The revolving fund will be able to meet the demand of the CO members.
- Livestock contributes over 22% of the aggregated household income or about 50% of the agricultural income. Livestock husbandry aims at the production of a variety of outputs: motive power for agricultural; operations. Farm-yard manure to maintain soil fertility, milk products food intake of an average rural households, cash from "distress sales" of young and culled-age animals hides, skins and wool.
- Traditionally livestock owners view the number of animals as more important than their productivity, so the concept of keeping fewer animals with higher productivity based on improved breeds and management will not be easy to introduce in the short term. The higher productive animals are more sensitive to diseases, feed and environmental stress. A comprehensive feeds and feeding and disease prevention system has to be organized prior to improved animals are introduced in the area.

**Table 12: Cereal crop grain production gap between potential and actual production in Northern Areas**

| Management conditions | Average yield (T/Ha) | Area (in ha) | Total production (in Tones) |
|---|---|---|---|
| Optimum | | | |
| Wheat | 5.677 | 28,783 | 163,401 |
| Maize | 5.166 | 12,648 | 65,340 |
| Barley | 3.200 | 5,394 | 17,261 |
| Total | | 47,825 | 246,002 |
| Actual (2000-2001) | | | |
| Wheat | 1.80 | 28,783 | 51,809 |
| Maize | 2.00 | 12,648 | 25,296 |
| Barley | 1.60 | 5,394 | 8,630 |
| Total | | 47,825 | 85,735 |
| %age of optimum | 34.85 | | |

Source: Department of Agriculture Northern Areas.

It is evident from the above table that the existing production of cereal crop grains is only 34.85% of the potential production of cereal crop grains in NA. The low yield is due to the use of degenerated indigenous varieties susceptible to diseases, and their repeated cultivation since ages, unbalanced fertilizer application, lack of proper land management by the farmers due to illiteracy, absence of scientific

rotation, monoculture operation, unawareness regarding the use of improved modern technology in Agriculture.

### 2.1.1.2. General recommendations

An overview of Northern Areas Agriculture reveals that there is a lot of cultivable waste (more than 90,000 hectares) virtually in every district which can be developed for cultivation purposes, through construction of feeding channels, siphon Irrigation system, constructing small dams on suitable sites of the rivers for power generation and water lifting with the same generation, small dams on suitable places on the mountains for snow storage and glacier grafting on the dry mountains to create additional water resources in areas where thousands of hectares of land is lying waste. In this way a Green Revolution in Agriculture may be observed in the area and the region not only become self-sufficient in its food grains requirements but also become a potential exporters for high quality vegetable seeds, potato, off-season vegetables and medicinal plants for the development of medicinal industry in the country.

- The irrigation system can be improved and further water resources can be developed through storage and dam building
- By joining various commodity national coordinators, conducting on farm trials through participation of farmers, varieties for different target areas can be developed. There are sufficient opportunities for this.
- The potential of farmers, women, researchers, extensionists and close linkages among them can be improved through training for skill development.
- Likewise, institutes capacity can be upgraded through collaboration with similar but better institutes at national and international level.
- To meet the food and feed requirements, a scientific shift towards intensive and extensive agriculture is a must. For this short duration varieties, good crop rotations, mechanization, etc should be looked into.
- A multi-disciplinary Research and Development Institution in line with NARC, Islamabad in addition to PARC (KARINA) Juglote should be established in the NA on the pattern of provinces to create a competitive atmosphere among the scientists.
- An On-Farm Demonstration/Out Reach Programme unit may be established within the Department of Agriculture Research Northern Areas. to coordinate and confirm the results obtained on the research station in farmers fields under their prevailing circumstances for rapid development of new technology.
- Human Resource Development Programme should be started within the Department of Agriculture for capacity building of staff. An Agriculture Training Institute may be established within the Department of Agriculture.

### 2.1.1.3. Current production systems

Farmers in the NA are mostly subsistence farmers whose main aim is to produce enough grains, meat and milk to satisfy household consumption demands.

Farming practices are characterized by various kinds of transhumance. The farming system is dominated by animals, farmland and pastures. Animals are integrated in the farming system and provide valuable manure to maintain soil fertility of irrigated farmland. A typical geographical sequence of farming activities is as follow:

- The lowest part, the river banks of the Indus is not cultivated due to flooding and difficulties in constructing irrigation channels:
- The main village farmland is located on river fans in the valley bottom of the tributaries and on alluvial deposits in the hill-sides in side valleys. In the lower parts of the valleys double cropping allows for two staple food crops. Wheat in winter (November-July) and maize in summer (June/July-October) while in the marginal single crop zone (1900-2300m) maize is the main crop (growing season: (May to October). Which can be converted in double cropping zone by introducing early maturing barley and wheat (Oct. June – July) and maize (June-July-Oct) and improved cultural/modern management practices. In the single crop zone maize /wheat/potato/vegetable are grown for human consumption. In both the double and the single crop zones some vegetables for home consumption and fodder for winter-feeding are grown. The land is irrigated with water supplied by diverting river tributaries or springs and snow melt through canals in the hill sides. During winter animals are free to graze on crop land, a practice which makes the adoption of new practices such as the introduction of winter fodder species difficult;
- The marginal single crop zone 1900-2300m is presently utilised as a single cropland which can be converted in to double crop zone by introducing early maturing wheat and barley genotypes and improved modern management practices
- Above the farmland on the lower side of the irrigation canals water is released to occasionally irrigate a mixture of forest and fruit trees, shrub and grassland. Grass is used to produce hay for winter feeding; tree foliage is used for animal feed in autumn and the trees provide firewood and timber
- Above this village forest/pasture area, the mountain side is up to an elevation of above 3000 m where the high forest starts and reaches up to some 4000 m. This area includes also alpine pastures which are to valley farming since they supply grazing for sheep. goats and cattle in summer. Usufruct rights are customary to the various valleys and villages . Farm households use these pastures in two different ways: (i) part of the family moves to the alpine pasture and stays there during summer while some family members stay in the village to attend the fields and some cattle which are not taken to the high pasture; or (ii) farmers may leave their animals with semi-nomadic "Gujars)" who herd the flock during summer and are paid by giving usufruct rights to milk and wool while the animals are in their custody.

Through this kind of transhumance, people are able to exploit the whole ecosystem of the valleys. The various niches are interdependent in an integrated system of irrigation. Farmland needs manure to be productive and the alpine pasture makes it possible to keep herds sufficiently big to supply meat and milk to the family and manure to maintain soil fertility. The complementarity between irrigated cropland and alpine pasture is made possible by the existence of the village forest/pasture area which supplies winter fodder in addition to some cultivated annual or pluri-annual irrigated fodder crops such as shaftal (Trifolium resupinatum, Perian clover) and alfalfa (Medicago sativum)

**2.1.1.3.1. Management practices**

In spite of some limited adoption of improved seeds in case of major crops and fertilizer application in varying doses, farming practices of the area are generally

traditional for several reasons including: (i) poor quality of soil with low productivity (ii) small plot size limited by terraces especially in the valleys: (iii) uneconomic holding sizes: (iv) physical limitation for the distribution of irrigation water: (v) non-availability of quality improved seeds; and (vi) generally weak downstream services.

#### 2.1.1.3.2. Land preparation

Land is generally prepared by plough . Although tractors are available in all major valleys., farmers use little mechanical traction because of small plot size and of steep terraced land. For land preparation, mainly draft animals are used while tractors are mainly used for transport. The fact that many farmers have only one draft animal or no draft animal at all, confirms that a large proportion of farmers depend on others' animals for land preparation and other operations as well. Households possessing only one head share with others.

#### 2.1.1.3.3. Cultural practices

Almost all field operations between land preparation and harvesting, such as sowing, thinning, weeding and fertilizing are done manually and/or with implements. Farmyard manure is used by all farmers and is given at a rate of 10-20 t/ha to wheat in the double cropping zone or to maize in single cropped areas. Manure application is, however, reported to be decreasing as an increasing shortage of fuel-wood is compensated by using manure for fuel. Chemical fertilizer is used by many farmers mainly in the form of urea and di-ammonium phosphate (DAP) nitro-phosphate/single super phosphate are used if available. Fertilizer use is, however, arbitrary as no locally tested fertilizer recommendations are available. Non timely availability of chemical fertilizers and high prices due to black marketing are the main causes for limited use of fertilizers otherwise recommendations are available locally as given below:

**Table 13: Effect of different fertilizer levels on grain yield of 5 maize cultivars (Tones/hectare)**

| Fertilizer level (in Nutrient kg) | | Mean grain yield (T/ha) of 5 cultivars | | | | | |
|---|---|---|---|---|---|---|---|
| N | $P_2O_5$ | PR-80 | Khyber | Sarhad | Changez | Azam | F.AV. |
| 00 | 00 | 1.650 | 1.437 | 1.621 | 1.739 | 1.708 | 1.631 |
| 50 | 00 | 2.508 | 2.305 | 2.787 | 3.394 | 3.280 | 2.855 |
| 50 | 25 | 3.610 | 3.500 | 3.878 | 4.667 | 4.238 | 3.969 |
| 75 | 25 | 4.930 | 3.950 | 4.980 | 5.632 | 5.500 | 4.998 |
| 75 | 50 | 4.980 | 4.210 | 5.660 | 6.515 | 6.405 | 5.554 |
| 100 | 50 | 5.880 | 4.880 | 6.320 | 7.590 | 7.220 | 6.398 |
| 100 | 75 | 6.135 | 5.350 | 6.890 | 7.990 | 8.110 | 6.895 |
| 125 | 75 | 7.226 | 6.360 | 7.880 | 8.780 | 8.970 | 7.843 |
| 125 | 100 | 7.780 | 6.800 | 8.330 | 9.300 | 9.120 | 8.266 |
| 150 | 100 | 8.870 | 7.890 | 9.240 | 9.870 | 9.640 | 8.266 |
| 150 | 125 | 8.900 | 7.995 | 9.480 | 10.160 | 10.110 | 9.329 |
| 175 | 125 | 8.700 | 8.150 | 9.670 | 10.580 | 10.490 | 9.718 |
| Nur Mean | | 5.847 | 3.236 | 6.395 | 7.185 | 7.066 | 6.39 |

Source: Department of Agriculture Northern Areas Gilgit

Seed rates are high. Particularly for maize (60-100 kg/ha) since green fodder from thinning is at least as important as grain. Varieties used are mainly traditional although research has tested and recommended some improved varieties, which are now on Government seed farms. Most of these varieties have been developed long ago by the Pakistan research system and maintenance of variety characteristics is reported to be a problem due to a limited capacity for maintenance breeding.

### 2.1.2. Wheat and Barley

Wheat is one of the major cereals of Pakistan occupying the largest area (about 8.5 million hectares) under any single crop. A significant hectareage (10-20% of total acreage) of wheat is grown under high elevation (1,000 masl) environment in Pakistan where cold and drought are the most occurring stresses.

Wheat is largely grown as winter crop in the valleys of NA and terraces of these high mountainous areas, in the double cropped zone. In the Rabi season almost every farmer devotes major part of his land, up to 70% for wheat crop. The crop has a pivotal position in the rural economy, as it fulfils basic food and fodder requirements of human and animal population. Where ever farmers grow local varieties, these are susceptible to diseases like rusts and smuts. The yield at such places is about 30% lower than the national average. Such a low yield is not enough to meet the local consumption needs. At several places additional wheat has to be purchased from the down country. The cultivation of wheat in the NA starts from the month of Oct. November and is completed in the last week of February. While the harvesting begins in May-June and is finished in the first week of July. The major reasons for low grain yield even in the District of Diamir are cultivation of local tall wheat varieties, low quantities of inputs, prevalence of diseases like rust and smut and lodging. There is a lack of suitable varieties for these harsh environments and therefore the production is much lower than the potential varieties developed for plains, generally, are not suitable for high elevation areas because of specific plant ideotype requirements of those areas. Very little efforts were made in the past to develop material for the northern areas. A major area is still grown under local varieties. Although these local varieties are well adapted to specific environmental conditions, the varieties are susceptible to diseases and have low yield potential (1800 kg/ha). The challenge and opportunity for researchers to develop high yielding disease resistant varieties with acceptable grain and straw quality, and well adapted to cold and drought is obvious.

#### 2.1.2.1. Cropping zone in the area

The following four major cropping zones exist in the area at different elevations

- i) Double cropping zone at 1,200-1,900 meter above sea level
- ii) Transitional cropping zone at 1,900-2,300 meter above sea level
- iii) Single cropping zone at 2,300-3,000 meter above sea level
- iv) High posture / forest land from 2500 to 4500 meter

#### 2.1.2.2. Major constraints

A diagnostic survey was carried out by NARC scientists assisted by Agriculture Department NA to identify major constraints and researchable issues regarding wheat and barley production in northern areas. The major constraints are outlined below:

- Lack of suitable varieties/improved seed: Major area is still planted with unimproved local varieties / land races. These varieties have low yield potential and are susceptible to diseases.
- Maturity and crop phenology: Lack of early maturing varieties to fit in double and transitional cropping system due to the climate limitations.
- Moisture stress: A prolonged juvenile drought and cold stress in transitional cropping zone (4 -5 months moisture stress in early crop season) results in poor crop stand
- Cold tolerance growth habit: In single cropping zones, spring planting is done mostly under existing situation due to non availability of cold tolerant winter or facultative cultivars. The existing varieties give low yield. Therefore, there is a need to introduce cold tolerant winter and facultative types for planting in single cropping zone to increase yield in the target area. Recently such material has been introduced from ICARDA, Turkey. The performance evaluation trial data are given in tables 14-15-16 below.
- Non-availability of seed of improved varieties.
- Lack of improved production technologies.
- Major diseases: Rusts are the major diseases in the area. Barley Yellow Dwarf Virus (BYDV) and Powdery mildew are the other diseases.

**Table 14: Comparative economics of different fertilizer levels on the yield of maize cultivar Azam**

| Fertilizer treatment (Nutrient kg/ha) | | Cost of fertilizer @ Rs.430/- & Rs.450/- per bag of Urea & Nitro phose | Average yield (t/ha) | Add yield (t/ha) | Gross income per ha @ Rs.9/- per kg Grain | Net Income per ha | Cost/ Benefit ratio |
|---|---|---|---|---|---|---|---|
| N | $P_2O_5$ | | | | | | |
| 00 | 00 | -- | 1.708 | -- | -- | -- | -- |
| 50 | 00 | 937 | 3.280 | 1.572 | 14,148 | 13,211 | 1:14.10 |
| 50 | 25 | 1,918 | 4.238 | 2.530 | 22,770 | 20,852 | 1:10.87 |
| 75 | 25 | 2,387 | 5.500 | 3.792 | 34,128 | 31,741 | 1:13.30 |
| 75 | 50 | 3,368 | 6.405 | 4.697 | 42,273 | 38,905 | 1:11.55 |
| 100 | 50 | 4,305 | 7.220 | 5.512 | 49,608 | 45,303 | 1:10.52 |
| 100 | 75 | 5,286 | 8.110 | 6.402 | 57,618 | 52,332 | 1:9.90 |
| 125 | 75 | 7,755 | 8.970 | 7.262 | 65,358 | 57,603 | 1:7.43 |
| 125 | 100 | 8,736 | 9.120 | 7.412 | 66,708 | 57,972 | 1:6.64 |
| 150 | 100 | 9,673 | 9.640 | 7.932 | 71,388 | 61,715 | 1:6.38 |
| 150 | 125 | 10,654 | 10.110 | 8.402 | 75,618 | 64,964 | 1:6.10 |
| 175 | 125 | 11,123 | 10.490 | 8.782 | 79,038 | 67,915 | 1:6.11 |
| Grand mean | | | | | | | 1:9.35 |

### 2.1.2.3. Achievements

Based on the available information, a research project was initiated, by NARC Wheat Programme with two approaches; 1) Testing/evaluation of existing advance lines with diverse growth habit in target locations and 2) a hybridisation program to improve local wheat's from high elevation areas which are susceptible to diseases, lodging and have low yields potential. The new material has performed better than the local has and yields are more than double compared to the local types. In addition they are also resistant to diseases with acceptable straw quantity. Data of the high yielding NARC advance lines at different locations in northern

areas during 1998. (Table 17a) Performance of the 28 crosses developed through the use of local types from high elevation areas in preliminary yield trial at NARC during 1999-2000 gave a yield range of 1583 -4333 kg/ha so there are ample opportunities for improvement suited to diverse elevations. Material has also been developed through hybridisation at NARC using the local types from highland areas as parental material.

During the year 1999-2000 extensive evaluation of the material continued in target area with the collaboration of AKRSP, KARINAand Agriculture. Extension Dept. in Gilgit and Skardu regions. Type of Material included NARC advance lines (NR's), and exotic material from CIMMYT-ICARDA-TURKEY.

Based on the report ( June 2001) of the AKRSP consultant Dr. John Witcombe regarding the performance of the NR's' (The wheat material developed by NARC wheat program) the excellent performance of NR74, NR 142 and NR152 during the years 2000 & 2001 was confirmed in Gilgit and Skardu regions and hence the proposals to release the above three advance lines in the two regions are being prepared, by NARC (Table 17a)

The department of Agriculture, NA has been actively involved in maintaining about 1000 local + exotic germlines of wheat. Field trials to find out the best yielders of grain and straw were carried out even with 26 approved varieties at diverse localities. The results achieved so for are presented in the table given below:

**Table 15: Yield data (T/ha) on exotic wheat cultivars planted during 1998-99 at various locations in Northern Areas**

| GAHKUCH | | | | | | | | SKARDU | | CHILAS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HARWYT (35 entries) | | ESWYT (50 entries) | | IWWONIR (78 entries) | | BYDSN 44(BW) | | HRWYT (35 entries) | | ESWYT (50 entries) | |
| Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) |
| 27 | 8.035 | 16 | 7.263 | 227 | 7.360 | 34 | 7450 | 24 | 6.280 | 17 | 6.548 |
| 05 | 6.788 | 05 | 7.133 | 240 | 7.291 | 44 | 7.139 | 14 | 6.200 | 02 | 6.584 |
| 23 | 6.287 | 36 | 5.998 | 226 | 6.980 | 38 | 6.322 | 90 | 5.960 | 80 | 6.310 |
| 03 | 6.092 | 12 | 5.974 | 217 | 6.945 | 11 | 6.024 | 34 | 5.600 | 44 | 6.191 |
| 06 | 6.966 | 40 | 5.911 | 257 | 6.822 | 08 | 5.744 | 33 | 5.200 | 36 | 6.141 |
| 26 | 5.955 | 04 | 5.909 | 222 | 6.542 | 637 | 5.575 | 08 | 4.604 | 10 | 6.077 |
| 30 | 5.729 | 18 | 5.908 | 264 | 5.572 | 60 | 5.640 | 30 | 4.600 | 47 | 6.072 |
| 22 | 5.308 | 28 | 5.788 | 215 | 5.515 | 30 | 5.454 | 10 | 4.320 | L.chec | 6.070 |
| 35 | 5.261 | 27 | 5.715 | 241 | 5.485 | 15 | 5.153 | L.ch | 2.048 | – | – |
| L. chec | 2.236 | L. chec | 2.644 | L.chec | 2.320 | L.chec | 1.079 | – | – | – | – |

Note: HRWYTC (High Rain fall Wheat Yield Trial), ESWYT (Elite Selection Wheat Yield Trial), BYDSH (Barley Yellow Dwarf Screening Nursery) introduced from CIMMYT (Mexico) and IWWONIR (International Winter Wheat Observation Nursery for Irrigated Areas from ICARDA(Turkey).

**Table 16a:Grain yield (T/ha) performance evaluation trial/comparison between improved and local wheat varieties in Northern Areas conducted during 1991 to 1994. Area sown 16.4 sq.m in each location**

| Name of Variety | Ghowari 1991 | Saling 1991 | Babusar 1992 | Chilas 1993 | Gonar Farm 1994 | Gorikot 1994 | Grand Mean (T/ha) |
|---|---|---|---|---|---|---|---|
| Chakwal-86 | 7.306 | 9.663 | 9.355 | 8.655 | 8.406 | 5.645 | 8.057 |
| Satluj-86 | 7.513 | 8.734 | 7.728 | 6.719 | 6.948 | 3.703 | 6.891 |
| FSD-85 | 6.986 | 6.427 | 6.544 | 6.172 | 5.730 | 3.777 | 5.939 |
| Persbak-85 | 6.278 | 6.556 | 3.542 | 6.719 | 6.875 | 3.750 | 5.620 |
| Shagetsi | 5.969 | 8.092 | 6.963 | 4.297 | 4.270 | 3.495 | 5.514 |
| Khyber-87 | 5.083 | 5.782 | 7.161 | 5.469 | 5.520 | 3.661 | 5.446 |
| Pb-85 | 5.142 | 6.173 | 7.030 | 4.859 | 6.042 | 3.292 | 5.423 |
| KARINA-87 | 3.906 | 4.844 | 3.719 | 4.063 | 5.208 | 3.636 | 4.229 |
| Local check | 1.591 | 1.992 | 4.241 | 3.172 | 2.938 | 3.645 | 2.930 |
| Grand mean | 5.530 | 6.407 | 6.476 | 5.569 | 5.771 | 3.845 | 5.600 |

**Table 16b:Mean straw yield (T/he) performance evaluation trial/comparison between improved and local wheat varieties in Northern Areas conducted during 1991 to 1994. Area sown 16.4 sq.m in each location**

| Name of Variety | Ghowari 1991 | Saling 1991 | Babusar 1992 | Chilas 1993 | Gonar Farm 1994 | Gorikot 1994 | Grand Mean (T/ha) |
|---|---|---|---|---|---|---|---|
| Chakwal-86 | 13.306 | 10.513 | 10.555 | 13.256 | 10.266 | 8.453 | 11.058 |
| Shagetsi | 12.975 | 9.847 | 8.120 | 14.287 | 8.328 | 4.922 | 9.748 |
| Satluj-87 | 12.959 | 8.039 | 7.852 | 13.233 | 9.891 | 6.109 | 9.681 |
| Local check | 13.172 | 7.852 | 6.559 | 12.109 | 11.984 | 5.469 | 9.524 |
| KARINA-87 | 11.375 | 8.844 | 7.000 | 9.969 | 10.938 | 5.078 | 8.867 |
| FSD-85 | 11.897 | 7.866 | 5.883 | 11.427 | 8.859 | 6.796 | 8.788 |
| Khybar-87 | 9.967 | 6.889 | 5.144 | 8.239 | 8.828 | 4.922 | 7.332 |
| Pb-85 | 11.136 | 6.883 | 6.067 | 11.108 | 8.859 | 5.719 | 8.295 |
| Grand mean | 12.243 | 8.390 | 7.350 | 11.394 | 9.567 | 5.766 | 9.118 |

It is evident from the table that Chakwal-86 was the highest grain and straw yielder with a net increase of 5.127 and 1.940 tones/ha over the local variety respectively and hence it was recommended for general cultivation and as such about 15 tones of its seed has been distributed among the farmers during the last 2 years.

**Table 17a:Comparison of the highest yielding nr's with the local types in the Northern Areas during 1998**

| Location | Yield t/ha (Highest yielding line) | Local check Yield t/ha | %Increase over local check |
|---|---|---|---|
| Hunza | 4.1 (NR-74) | 1.8 | 114 |
| Nagar | 5.2 (NR-74 & NR-33) | 2.0 | 158 |
| Gahkuch | 4.3 (NR-33) | 1.8 | 115 |
| Nasirabad | 5.7 (NR-33) | - | |
| Faizabad | 4.1 (NR-58 & NR-33) | 2.7 | 52 |
| Aliabad | 5.3 (NR-61) | - | - |
| Sheskhat Gojal* | 3.5 (NR-100) | 2.3 | 52 |
| **FMU-Nagar** | | | |
| Nilth | 5.6 (NR-142) | 2.2 | 155 |
| Broshal Hopper | 4.1 (NR-74) | 2.0 | 105 |
| **FMU-Gilgit** | | | |
| Pari | 5.1 (NR-74) | - | - |
| **FMU- Punyal** | | | |
| Gahkuch Paeen | 3.8 (NR-33) | 3.1 | 23 |
| Hasis* | 4.8 (NR-152) | 3.3 | 46 |
| **FMU Gupis** | | | |
| Gupis proper* | 3.8 (NR-33) | 1.9 | 100 |
| **FMU-Astore** | | | |
| Astore Proper* | 2.5 (NR-58) | 1.8 | 39 |

*–Spring Planting

**Table 17b:Data on approved wheat varietal trial conducted at Gahkuch during 1999 (Area sown 11.8 m$^2$)**

| Name of Variety | R1 | R2 | R3 | Total | Mean | Yield (T/ha) |
|---|---|---|---|---|---|---|
| Chakwal-86 | 7.625 | 7.875 | 8.125 | 23.625 | 7.542 | 7.875 |
| Chakwal-97 | 6.625 | 7.125 | 6.750 | 20.500 | 6.500 | 6.833 |
| M.H-97 | 6.125 | 6.250 | 6.125 | 18.500 | 6.167 | 5.226 |
| Nawshera-96 | 6.000 | 5.750 | 6.000 | 17.750 | 5.917 | 5.014 |
| Pb-96 | 5.875 | 5.200 | 6.625 | 17.700 | 5.900 | 5.000 |
| NR-102 | 6.637 | 5.750 | 5.000 | 17.125 | 5.708 | 4.837 |
| Sulman-96 | 6.700 | 4.640 | 5.375 | 16.715 | 5.572 | 4.722 |
| Parwaz-94 | 6.825 | 4.750 | 5.000 | 16.575 | 5.525 | 4.682 |
| NR-58 | 5.000 | 5.150 | 5.200 | 15.350 | 5.150 | 4.364 |
| Naltaril check | 2.200 | 2.350 | 2.350 | 6.875 | 2.292 | 1.942 |

Chakwal-86 and Chakwal-97 having been higher grain and straw yielders have been recommended for large scale cultivation. 24 tones of improved seed of these varieties was distributed among the farmers during last growing season.

| Table 17c: Comparison of different wheat varieties introduced | |
|---|---|
| **Varieties** | **Average yield (Ton/ha)** |
| Chakwal-86 | 8.097 |
| Satluj-86 | 6.891 |
| Fsd-85 | 5.939 |
| Pirsbak-85 | 5.620 |
| Shagetsi | 5.514 |
| Khyber-87 | 5.446 |
| Pb-85 | 5.423 |
| Inqulab-91 | 3.411 |
| Pirsbak-91 | 3.183 |
| Local | 2.930 |

Barley is grown in the high altitude single-cropping areas. Little has yet been done to introduce new varieties. Local varieties are susceptible to lodging and to yellow stripe rust, but yield up to 3 tone per hectare.

Area under Pak-81, increased from about 2 percent of the total wheat area in 1983/84 to 24 percent in 1988/89. But now it has totally been discarded in whole of the area. 93 percent of the farmers in Gilgit District use chemical fertilizers.

| Table 18: Recommended cereal crop varieties in Northern Areas | | |
|---|---|---|
| **Name of Variety** | **Maturity** | **Diseases Resistance** |
| **Wheat** | | |
| Chakwal-86 | Last week of May in the plains 1-2 week early from local varieties. | Resistant to Rusts, powdery mildew, but susceptible to loose smut |
| Chakwal-97 | Last week of May in the plains 1-2 week early from local varieties | Resistant to rusts, smut, but susceptible to powdery mildew |
| Shagetsi | End of June in plains but late from as local vars, fit for comparatively high altitudes | Resistant to stem and stripe rust, loose smut, but susceptible to leaf/yellow rust, powdery mildew |
| Inqlab-91 | Just like Chakwal-86 | Susceptible to powdery mildew, Helminthosporium sativum |
| Suleman-96 | Mid June in plains some what late to Chakwal-86, Inqalab-91 | Resistant to rusts, smut, blight but susceptible to powdery mildew etc |
| Tatara | Just like Suleman –96 | Resistant to rusts, smut, blight, powdery mildew etc |
| Persbak-85 | End of June | Resistant to drought but has been discarded |
| Parwaz-94 | End of June, very early suited for higher altitudes | Rust resistant |
| M.H-97 | Mid of June | Rust resistant, but susceptible to Powdery mildew etc |
| Pak-81,Maxi-Pak Sanine have almost discarded | Mid of June | Resistant to rust, smut, blight, susceptible to powdery mildew |
| Kamsarati, Naltari, Sharoti and other local varieties | End of June in the plains | Susceptible to rusts, blight loose smut, powdery mildew lodging etc |

| Name of Variety | Maturity | Diseases Resistance |
|---|---|---|
| **Maize** | | |
| Shaheen | End of Sept | Blight susceptible but rust resistant |
| New Shaheen | Early of Oct. Mid Oct | Rust and blight resistant |
| Kashmir Gold | Early Oct | Blight resistant |
| Sarhad white | Mid to end of Oct | Blight susceptible |
| NA-I White | Mid to end of Oct | Resistant to rust, blight etc |
| NA-II White | End of Oct | Resistant to blight |
| Kisan-90 White | Mid of Oct | Resistant to rust and blight |
| Azam White | Mid of Oct | Blight susceptible |
| Gohar White | Mid of Oct | Susceptible to rusts, blight, lodging etc |
| Local White | Mid of Oct | Susceptible to rusts, blight, lodging etc |
| Local Yellow | Mid of Oct | Susceptible to rusts, blight, lodging etc |

Wheat is the major crop grown on about half of the farm area. Most farmers still grow traditional varieties although new high yielding wheat varieties have been introduced.

**Table 19: Wheat grain yield (T/ha) out of an actual area of 6.4 m² each location**

| Name of Variety | Ghawar 1991 | Saling 1991 | Babusar 1992 | Chilas 1993 | Gonar Farm 1994 | Gorikote 1994 | Grand mean |
|---|---|---|---|---|---|---|---|
| Chakwal-86 | 7.306 | 9.663 | 9.355 | 8.655 | 8.406 | 5.645 | 8.097 |
| Satluj-86 | 7.513 | 8.734 | 7.728 | 6.719 | 6.948 | 3.703 | 6.891 |
| FSD-85 | 6.986 | 6.427 | 6.544 | 6.172 | 5.730 | 3.777 | 5.939 |
| Pirsbak-85 | 6.278 | 6.556 | 3.542 | 6.719 | 6.875 | 3.750 | 5.620 |
| Shagetsi | 5.969 | 8.092 | 6.963 | 4.297 | 4.270 | 3.495 | 5.514 |
| Khyber-87 | 5.083 | 5.782 | 7.161 | 5.469 | 5.520 | 3.661 | 5.446 |
| Pb-85 | 5.142 | 6.173 | 7.030 | 4.859 | 6.042 | 3.292 | 5.423 |
| KARINA-87 | 3.906 | 4.844 | 3.719 | 4.063 | 5.208 | 3.636 | 4.229 |
| Inqulab-91 | | | | 4.395 | | 2.427 | 3.411 |
| Pirsbak-91 | | | | 4.663 | | 1.703 | 3.183 |
| Local Check | 1.591 | 1.992 | 4.241 | 3.172 | 2.938 | 3.645 | 2.930 |
| Grand mean | 5.530 | 6.407 | 6.476 | 5.379 | 5.771 | 3.521 | 5.149 |

**Table 20: Mean straw yield (T/ha) actual plot sown was 6.4 m²**

| Name of Variety | Ghawar 1991 | Saling 1991 | Babusar 1992 | Chilas 1993 | Gonar Farm 1994 | Gorikote 1994 | Grand mean |
|---|---|---|---|---|---|---|---|
| Chakwal -86 | 13.306 | 10.513 | 10.555 | 13.256 | 10.266 | 8.453 | 11.058 |
| Shagetsi | 12.975 | 9.847 | 8.120 | 14.287 | 8.328 | 4.922 | 9.747 |
| Satluj-86 | 12.959 | 8.039 | 7.852 | 13.233 | 9.891 | 6.109 | 9.681 |
| Pb-85 | 11.136 | 6.883 | 6.067 | 11.108 | 8.859 | 5.719 | 9.508 |
| Local check | 13.172 | 7.852 | 6.559 | 12.109 | 11.984 | 5.469 | 9.524 |
| Pirsbak-85 | 12.823 | 8.584 | 8.159 | 10.156 | 8.859 | 5.094 | 8.946 |
| Pirsbak-91 | 12.823 | 8.584 | 8.159 | 10.156 | 8.059 | 5.095 | 8.946 |
| KARINA-87 | 11.375 | 8.844 | 7.000 | 9.969 | 10.938 | 5.078 | 8.867 |
| FSD-85 | 11.897 | 7.866 | 5.883 | 11.427 | 8.859 | 6.797 | 8.788 |
| Khyber-87 | 9.967 | 6.889 | 5.144 | 8.239 | 8.828 | 4.928 | 7.332 |
| Grand mean | 12.243 | 8.390 | 7.350 | 11.394 | 9.567 | 4.766 | 9.118 |

**Table 21: Statement showing yield data (T/ha) on exotic wheat cultivars sown during 1998-99 at various locations in Northern Areas**

| Sown at Gahkuch | | | | | | | | Skardu | | Chilas | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HARWYT (35) | | ESWYT (50) | | IWWONIR (78) | | BYDSN (44) | | HRWYT (35) | | ESWYT (50) | |
| Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) | Entry No | Yield (T/ha) |
| 27 | 8.035 | 16 | 7.263 | 227 | 7.360 | 34 | 7.450 | 24 | 6.280 | 17 | 6.548 |
| 05 | 6.788 | 05 | 7.133 | 240 | 7.291 | 44 | 7.139 | 14 | 6.200 | 02 | 6.584 |
| 23 | 6.287 | 36 | 5.998 | 226 | 6.980 | 38 | 6.322 | 19 | 5.960 | 18 | 6.310 |
| 03 | 6.092 | 12 | 5.974 | 217 | 6.945 | 11 | 6.024 | 34 | 5.600 | 44 | 6.191 |
| 06 | 5.966 | 40 | 5.911 | 257 | 6.822 | 08 | 5.744 | 33 | 5.200 | 36 | 6.141 |
| 26 | 5.955 | 04 | 5.909 | 222 | 6.542 | 37 | 5.675 | 30 | 4.600 | 10 | 6.077 |
| 13 | 5.729 | 18 | 5.908 | 264 | 5.572 | 16 | 5.640 | 08 | 4.604 | 47 | 6.072 |
| 22 | 5.308 | 28 | 5.788 | 215 | 5.515 | 13 | 5.454 | 10 | 4.320 | Local | 6.070 |
| 35 | 5.261 | 27 | 5.715 | 241 | 5.485 | 15 | 5.153 | Local | 4.200 | Inq-91 | – |
| Local (15th) | 4.236 | Local (10th) | 4.644 | Local (60th) | 4.320 | Local (42nd) | 1.079 | 32 | 4.048 | – | – |

Note: High rainfall wheat yield trials
Source: Mr. Juma khan, D.D. Agriculture, Ghizar

| Table 22: Data on improved varietal trail conducted at Gahkuch during 1999 | | | | | | |
|---|---|---|---|---|---|---|
| **Name of Variety** | **R1** | **R2** | **R3** | **Total** | **Mean** | **Yield (T/ha)** |
| Chakwal-86 | 7.625 | 6.875 | 8.125 | 22.625 | 7.542 | 6.392 |
| NR-38 | 6.625 | 6.125 | 6.750 | 19.500 | 6.500 | 5.508 |
| Nowshera-96 | 6.125 | 6.125 | 6.250 | 18.500 | 6.167 | 5.226 |
| Punjab-96 | 6.000 | 5.750 | 6.000 | 17.750 | 5.917 | 5.014 |
| NR-102 | 5.875 | 5.200 | 6.625 | 17.700 | 5.900 | 5.000 |
| Suleman-96 | 6.637 | 5.750 | 5.000 | 17.125 | 5.708 | 4.837 |
| Purwaz-94 | 6.700 | 4.640 | 5.375 | 16.715 | 5.572 | 4.722 |
| MH-97 | 6.825 | 4.750 | 5.000 | 16.575 | 5.525 | 4.682 |
| NR-58 | 5.000 | 5.150 | 5.200 | 15.350 | 5.150 | 4.364 |
| Tatara | 3.100 | 3.150 | 4.250 | 10.500 | 3.500 | 2.966 |
| Kohistan-97 | 3.250 | 4.375 | 2.625 | 10.250 | 3.417 | 2.896 |
| Chakwal-97 | 2.875 | 3.750 | 2.900 | 9.525 | 3.175 | 2.691 |
| Naltari(Local check) | 2.200 | 2.350 | 2.350 | 6.875 | 2.292 | 1.942 |

Source: Mr. Juma khan, D. D. Agriculture, Ghizar

| Table 23: District-wise Rabi and Kharif crops in NA (area in hectares) | | | | |
|---|---|---|---|---|
| **District** | **Rabi crops** | **Kharif crops** | **Orchards** | **Total** |
| Gilgit | 9,556 | 6,152 | 1,399 | 17,107 |
| Ghizar | 6,664 | 3,,34 | 2,230 | 12,228 |
| Diamir | 8,697 | 6,888 | 900 | 16,285 |
| Skardu | 4,971 | 5,224 | 1,400 | 16,749 |
| Ghanche | 8,781 | 1,652 | 1,100 | 11,533 |
| Grand total. | 38,669 | 23,250 | 7,029 | 73,902 |

The imported wheat variety namely Entry No. 27 from Mexico gave a yield of 8.035 T/ha as compared to local variety Chakwal 86, Which gave 4.236 T/ha in the high rainfall wheat yield trails at Ghizar district. This shows almost more than 90% yield difference in the existing yields of food grains

## 2.1.3. Maize

Maize is the second major crop after wheat, mostly grown in the kharif season. In some areas of Gilgit and Ghizar it is cultivated as Rabi crop also. It is mainly cultivated for domestic consumption as fodder and grains. The grains are an essential part of the daily diet of the people in the winter season. The dry matter (stover) is used for livestock, during winter. Generally maize cultivation starts in June and continues till 1st week of July. In Ghizar it starts from 20th April and ends by 30th June. Harvesting begins from the 3rd week of the September and finishes in the 4th week of the October. The main causes of low yield are: (i) cultivation of local varieties (ii) use of self-maintained seed (iii) High seed rate (iv) less use of inputs (v) lodging and (vi) lack of knowledge about modern crop management techniques. AKRSP took initiative to distribute improved seed of Maize and Wheat. It is one of the major cereal crops grown in the Northern Area. The average yield is 1600 to 2400 kg/ha. Depending on the zone and position in the rotation indicates that substantial opportunity exists for production increases. Improved production

practices in terms of better cultivars, proper seedbed preparation depending upon soil type and topography, appropriate method of planting, timeliness in planting, optimum plant population, efficient use of fertilizer and irrigation and timely control of weeds, diseases and pests need to be adopted. Under improved management practices a yield of more than 4000 kg/ha is achievable. Much higher yields are possible if the farmers are prepared to buy hybrids.

**Table 24a: Mean data on maize cultivars performance evaluation trial conducted at Chilas, Gonar Farm, Tangir during 1993 and at Gahkuch during 1998 and 1999. Area sown (2x5=10 sq.m) – Mean data for grain yield (replicated thrice) in each location.**

| Treatment by ran | Chilas (in kg) | Goner Farm (in kg) | Tangir (kg) | Gahkuch (kg) | Total (kg) | Mean (kg) | Yield (T/ha) |
|---|---|---|---|---|---|---|---|
| NA-I White | – | – | – | 9.363 | 9.363 | 9.363 | 9.363 a |
| NA-II White | – | – | – | 6.852 | 6.852 | 6.852 | 6.852 b |
| Chilas Composite | – | – | – | 6.262 | 6.262 | 6.262 | 6.262 b |
| Goher White | 9.599 | 6.188 | 5.990 | 5.241 | 24.081 | 6.004 | 6.004 b |
| NA-II Yellow | – | – | – | 5.465 | 5.465 | 5.465 | 5.465 b |
| Sultan Yellow | 5.698 | 5.532 | 5.872 | 4.168 | 21.270 | 5.318 | 5.318 c |
| Faisal Yellow | 5.388 | 4.162 | 5.442 | 4.464 | 19.456 | 4.864 | 4.864 cd |
| Kisan-90 | 5.510 | 4.683 | 4.837 | 4.373 | 19.403 | 4.850 | 4.6001 cd |
| PSEV-6088 | 4.488 | 4.283 | 5.331 | 4.754 | 18.856 | 4.714 | 4.714 de |
| PSEV-II | 4.173 | 4.424 | 4.360 | 4.799 | 17.756 | 4.439 | 4.439 de |
| Sarhad Yellow | 4.377 | 3.174 | 4.461 | 4.437 | 16.449 | 4.112 | 4.112 de |
| Azam (L.check) | 4.283 | 4.206 | 4.143 | 3.039 (Golo Dass) | 15.725 | 3.931 | 3.931 e |
| Grand mean | 5.530 | 6.407 | 6.476 | 5.569 | 5.771 | 3.845 | 5.600 |

**Table 24b: Mean data on maize cultivars performance evaluation trial conducted at Chilas, Gonar Farm, Tangir during 1993 and at Gahkuch during 1998 and 1999. Area sown (2x5=10 sq.m) – Mean data on maize stove yield.**

| Treatment by ran | Chilas (in kg) | Goner Farm (in kg) | Tangir (kg) | Gahkuch (kg) | Total (kg) | Mean (kg) | Yield (T/ha) |
|---|---|---|---|---|---|---|---|
| NA-I White | – | – | – | 23.401 | 23.401 | 23.401 | 23.401 a |
| NA-III Yellow | – | – | – | 22.351 | 22.351 | 22.351 | 22.351 a |
| Chilas Composite | – | – | – | 20.649 | 20.649 | 20.649 | 20.649 b |
| NA-II White | – | – | – | 18.784 | 18.784 | 18.784 | 18.784 c |
| Sarhad Yellow | 15.192 | 12.619 | 12.560 | 13.906 | 54.277 | 13.567 | 13.567 d |
| Goher White | 15.963 | 11.686 | 11.780 | 13.805 | 53.234 | 13.309 | 13.309 d |
| Kisan-90 | 12.653 | 11.230 | 9.930 | 17.778 | 51.591 | 12.898 | 12.898 d |
| Sultan Yellow | 11.882 | 12.103 | 12.670 | 11.980 | 48.635 | 12.159 | 12.159 de |
| Azam + as (L.check) | 13.650 | 10.833 | 8.790 | 15.093 | 48.366 | 12.091 | 12.091 e |
| PSEV-6088 | 11.300 | 11.230 | 10.380 | 9.788 | 42.698 | 10.675 | 10.675 f |
| Faisal Yellow | 11.219 | 10.178 | 10.240 | 9.560 | 41.197 | 10.299 | 10.299 f |
| PSEV-II | 11.286 | 8.293 | 9.880 | 9.340 | 38.799 | 9.700 | 9.700 f |

Note: Azam was included as local check at Chilas and Gonar Farm.
The mean values of treatments followed by common alphabet do not differ significantly.

| Table 25: District wise maize area and production in NA | | |
|---|---|---|
| District | Area (ha) | Production(Tones) |
| Gilgit | 5,180 | 11,075 |
| Ghizar | 3,055 | 6,730 |
| Skardu | 936 | 2,403 |
| Ghanche | 109 | 217 |
| Diamir | 10,642 | 58,913 |
| Total | 19,922 | 79,338 |

| Table 26: Comparison of different maize varieties introduced | |
|---|---|
| Varieties | Average yield (Ton/ha) |
| Gahkuch-1 White | 9.363 |
| Gahkuch-2 White | 6.852 |
| Composite White | 6.262 |
| Gahkuch-3 Yellow | 5.465 |
| Gohar abad White | 5.241 |
| PSEV-II | 4.799 |
| PSEV-6088 | 4.754 |
| Azam White | 4.644 |
| Faisal Yellow | 4.464 |
| Sarhad Yellow | 4.437 |
| Kisan-90 White | 4.373 |
| Sultan Yellow | 4.168 |
| Local | 3.093 |

## 2.2. Fodder

**Table 27: Mean data on winter fodder fresh yield collected from the trials conducted during 1993-94, 1994-95 and 1995-96 at Chilas (the mean includes data of 3 replications and all cuttings.**

| Treatments | 1993-94 (kg/6m$^2$) | 1994-95 (kg/6m) | 1996-97 (kg/6m) | Total | Mean of Treatment | Yield (T/h) |
|---|---|---|---|---|---|---|
| Qats Bereem | 105.750 | 110.580 | 80.570 | 296.900 | 98.967a | 164.9 |
| Ryegrass Berseem | 92.780 | 88.760 | 76.890 | 258.330 | 86.330 | 143.5 |
| Oats/Shaftal | 88.080 | 90.370 | 78.150 | 256.600 | 85.533 | 142.55 |
| Ryegrass Shaftal | 82.550 | 87.260 | 77.820 | 247.630 | 82.453 | 137.57 |
| Qats | 81.880 | 80.330 | 73.650 | 78.620 | 131.0 | |
| Ryegrass | 76.320 | 74.830 | 70.330 | 221.480 | 73.821 | 123.04 |
| Shaftal | 73.090 | 72.380 | 68.100 | 213.570 | 71.190 | 118.65 |
| Block Total | 600.450 | 604.410 | 525.510 | 1,730.370 | | |

The challenge for the future will be how to develop integrated systems of farming in different environments of the area, that are compatible with the farmer's need for

food and the farmer's ability to generate an income for the purchase of other commodities. The livestock industry can make a contribution in this field – better fodder supplies, better animals and better management can all play a part in the goal of improving total farm income.

Lack of quality fodder is the major factor that limits animal's production. The animals in the Northern Areas have to range over large distances to obtain their summer fodder on high pastures. Therefore, intensification of production near villages would be advantageous in order to produce more feed of better quality, for maintaining animals over winter and for weight gain in spring. Under prevailing situation where insufficient fodder of low quality is available in the area, consequently the animals are not thrifty.

There is a great need for feed of high quality in order to get most value from improved breeds and particularly year round supplies of nutritious fodder to improve milk production from stalled cows in villages. Improved fodder and its quality could be of immense benefit to the livestock and to the health and welfare of the people in the Northern Areas. The cattle of the northern areas are of small size, therefore, have less feed requirements. Thus a little effort can be very effective.

**Table 28: Means data on fodder yield (T/ha) of maize cultivars in different locations of Northern Areas**

| Varieties | Chilas 1994 | Gonar Farm 1997 | Tangir | Chakha | Mean |
|---|---|---|---|---|---|
| Gahkuch-1 white | - | - | 23.0 | 23.401 | 23.401 |
| Gahkuch-3 yellow | - | - | - | 22.351 | 22.351 |
| Gamposit white | - | - | - | 20.649 | 20.649 |
| Gahkuch-2 | - | - | - | 18.784 | 18.784 |
| Local check | 15.192 | 12.619 | - | 15.093 | 15.093 |
| Sarhad yellow | 15.963 | 11.686 | - | - | 13.906 |
| Gohar white | 13.650 | 10.833 | - | - | 13.805 |
| Azam white | 11.882 | - | - | - | 12.242 |
| Sultan yellow | 14.300 | - | - | - | 11.993 |
| FSEV 6088 | 12.653 | - | - | - | 11.956 |
| Kisan-90 | 13.210 | - | - | 17.778 | 13.887 |
| Faisal yellow | 14.286 | - | - | - | 11.699 |
| FSEV-II | - | - | 11.98 | - | 11.290 |
| Grand means | 13.892 | 10.813 | | 19.509 | 15.316 |

Notes: x- Azam white was included as local check in white and Gonar Farm.

It is revealed from the above table that the improved varieties exhibited great potentiality for grain and stover yield Gahkuch-1 expressed the highest grain and fodder yields of 9.363 and 23.401 tonnes per hectare respectively as compared to he local check which yielded 3.093 and 15.093 tons of grains and fodder per hectare respectively. Varieties Gahkuch produced 3 and 3.550 times more yield of grains and fodder over local check from per unit area. With optimum management conditions the per unit area output can easily be boosted up making the are a self sufficient in its food and fodder requirements.

### 2.2.1. Traditional Fodder Production Practices

Farmers of the Northern Areas are aware of the need for maximizing quantity as well as quality of fodder and have therefore, evolved the following practices:

- Have compromised for grain production by retaining tall growing wheat and maize varieties with a low harvest index and lot of wheat straw and maize stalks. Some improved wheat varieties e.g. Chakwal-86, Chakwal-97, MH-97, Shagetri, Suleman-96 and Maize varieties i.e. NA-III, # Chilas Composit, Azam, Kisan-90 given in table 18, are better for some areas for straw/fodder yield.
- Cereal crops like wheat and maize are planted at 2-3 times than the recommended seed rates in order to maximize straw/stover production to allow thinning for green fodder.
- A variety of trees are planted along field boundaries and on marginal lands not suited for crop production. The leaves and bark of these trees provide supplementary sources of fodder during winter. In some villages, the dried leaves are collected and stored for winter use.
- Summer grazing at high altitudes in alpine pastures is exploited to the maximum.
- Small areas of high quality leguminous fodder crops are cultivated—shaftal for green feeding during spring and lucerne for drying as winter hay feed. Lucerne varieties Sunder gives double the yield of local ones.
- About 70-80 percent of the available total digestible nutrients (TDN) are obtained in the form of dry maize stalks and wheat straw. The animals cannot eat enough to satisfy their diet requirements especially protein. The efficiency of feed conversion could be improved by preservation of straw through urea supplements and feeding grains for high milk.

Maize is grown mainly in double-cropped regions after wheat, but it is also grown in the shorter-season single-cropped areas where fodder becomes the main use. Grain yield are usually poor, and there is much potential to select better adapted cultivars. Little is known of the relationship between plant stand, time of thinning, and final fodder dry-matter yield. Good yields require large fertilizer applications.

Livestock feed production is a critical component of the farming system. Alfalfa occupies a key place, particularly in single-crop areas. Use of the fodder legumes is small in comparison to alfalfa but could increase with the identification of suitable new species and development of appropriate management systems

Fodder brassicas such as mangels and fodder beets, turnips, rapes, and kales are exceptionally productive and can provide forage into the winter and early spring, mix cropping has also great potentiality for increased fodder production in NA.

Other crops grown as fodder, mainly comprise lucerne which is grown in both the double and single crop zones and annual shaftal and some cash crops. Potatoes and vegetables being the most important.

It is evident from the above table that the mix cropping of Oats + Berseem, Ryegrass + Berseem, Oats + Shaftal and Ryegrass + Shaftal was better than single cropping of these crops. Mix cropping of oats and berseem was the best combination producing a mean fresh fodder yield of 164.945 tones as compared to shaftal (101.428) tones per hectare. As such there is a net increase of 63.517 tones per hectare. It was also experienced that under the climatic conditions of Chilas the first cutting out of these

crop was obtained in January/February (the period of acute shortage of fodder) provided that the crop is sown during October /early November.

**Table 29: Fodder crop production potential in Northern Areas under optimal management conditions (Years of experimentation and mean fresh fodder yield in kg from an area of 6. sq. m)**

| Name of Crop | 1993-94 | 1994-95 | 1995-96 | Total | Mean | Yield (T/ha) |
|---|---|---|---|---|---|---|
| Oats + Berseem | 105.750 | 110.580 | 80.570 | 296.900 | 98.967 | 164.945 |
| Ryegrass + Berseem | 92.780 | 88.760 | 76.890 | 258.330 | 86.110 | 143.517 |
| Oats + Shaftal | 84.550 | 88.380 | 81.820 | 254.750 | 84.917 | 141.528 |
| Ryegrass + Shaftal | 82.560 | 87.250 | 77.820 | 247.630 | 82.542 | 137.570 |
| Oats | 81.880 | 80.330 | 73.650 | 235.860 | 78.620 | 131.033 |
| Ryegrass | 77.320 | 75.830 | 71.330 | 224.480 | 74.827 | 124.712 |
| Berseem | 75.360 | 72.450 | 79.150 | 216.960 | 72.320 | 120.533 |
| Shaftal (Local Check) | 63.090 | 61.380 | 58.100 | 182.570 | 60.857 | 101.428 |
| Grand mean | | | | | | 133.221 |

### 2.2.1.1. Mixed cropping for fodder

During 1993-97 NAAgriculture Dept. has carried out field trials on mixed cropping of oats and berseem. This can give 164.94 T/ha fodder yield as compared to shaftal (local) grown alone, which gives only 118.65 T/ha. The differential yield can go a long way in meeting the fodder shortage. Ray grass + Berseem, oats + shaftal have given 143.50 T/ha and 142.55 T/ha yield of fodder, respectively. This reflects that mixed cropping can help overcome fodder shortage. Thus there is scope for research in this area.

### 2.2.1.2. Double cropping farms

Fodder derived from the agricultural base comprises mainly maize-stover and some wheat straw, supported by green-fed spring/early summer shaftal (Trifolium resupinatum)

Fodder produced on farm is insufficient and animals therefore, mostly rely on the off farm fodder areas. Because farm sizes are small, there is considerable reluctance on the part of the farmers to grow more than the minimum of fodder, and some with areas too small to produce sufficient crops residue may purchase maize stover or wheat straw. All arable land is dedicated to main crops of maize and wheat. The entire area is planted to maize at very high seed rates, which is thinned during the growing season and the thinning is used as fodder There is no under-sowing of maize with legumes at the time to thinning. The nutritional quality of winter fed fodders does not meet the requirements for maintenance. At present as little as 30% of Dry Matter (DM) and less Digestible Protein (DP) and Total Digestible Nutrients (TDN) are provided from farm resources. The livestock are reported to lose up to 20%of live weight over the winter period on these farms.

### 2.2.1.3. Single cropping farms

Where irrigation is available mainly maize and occasionally wheat are planted. In addition some shaftal, followed by eight months of fallow.. The lower pastures above the villages may be planted to perennial lucerne which is cut and hayed for

storage as winter fodder. However, the cutting of hay in full bloom reduces the feed value in all other respects. Livestock have access to summer pasture grazing in the same manner and to the same conditions prevalent in the other farm types.

### 2.2.1.4. Improved maize varieties vs. local maize

Majority of farmers plant local maize varieties, which are disease prone and low in fodder, stover and grain yields. In the past no serious effects were made to evaluate and select improved maize cultivates for Northern Areas. There are quite a few improved maize varieties/hybrids available in Pakistan which can be evaluated for selection of suitable cultivars with maximum fodder, stover and grain yield potential for NA. This extra yield will finally improve livestock health and productivity. With this objective, three improved maize cultivars and one local check were evaluated for green and stover yields at different locations in NA by Muhammad (1993). The results are summarized in Tables 30 and 31.

**Table 30: Green and dry matter yields (T/ha) of maize varieties at three different sited in the Northern Areas**

| Varieties | Sites | | | | | |
|---|---|---|---|---|---|---|
| | Gilgit | | Khaiber | | Skardu | |
| | GWT | DWT | GWT | DWT | GWT | DWT |
| C777 | 54 | 22 | 40 | 18 | 50 | 21 |
| Shahanshah | 60 | 25 | 44 | 19 | 57 | 24 |
| LM 2092 | 44 | 20 | 38 | 16 | 42 | 19 |
| Local maize | 30 | 15 | 26 | 12 | 28 | 13 |
| Average | 47 | 21 | 37 | 16 | 32 | 19 |

Note: Sowing dates were May 1993; row to tow distance was 30cms; and fertilizer was applied @ 200kg nitrophos and 100kg urea/ha.

**Table 31: Grain stover yields (T/ha) of improved and local maize varieties at three different locations in the Northern Areas of Pakistan**

| Varieties | Sites | | | | | |
|---|---|---|---|---|---|---|
| | Gilgit | | Chilas | | Skardu | |
| | Grain | Stover | Grain | Stover | Grain | Stover |
| C777 | 5.50 | 38 | 4 | 34 | 3.25 | 30 |
| Shahanshah | 5 | 40 | 4 | 36 | 3 | 3.5 |
| LM2092 | 6 | 35 | 5 | 32 | 4 | 29 |
| Gauhar | 3.75 | 26 | 3.50 | 24.26 | 3.35 | 23.26 |
| Azam | 4.50 | 31 | 4.24 | 28.38 | 4.03 | 28.03 |
| Pehari | 3.40 | 23.56 | 3.16 | 21.89 | 3 | 20.08 |
| Kisan | 3.25 | 22.52 | 3.12 | 21.62 | 3.20 | 22.19 |
| Local | 2.25 | 16 | 2.30 | 15 | 2 | 17 |
| Average | 4.24 | 29.01 | 3.67 | 26.89 | 3.23 | 25.57 |

Note: Sowing dates were June 1993 at Gilgit and Chilas and May 1993 at Skardu. The fertilizer was applied @ 200kg nitrophos and 100kg urea/ha.

The improved maize varieties were superior in dry matter, grain yield, and stover yield than the local maize at all the locations (Table 31). The improved varieties produced 1.5 to 3 times more yields as compared to local ones.

A slight decrease in yield was observed with the increase in altitude. This variation in yield might be partly attributed to low temperatures, poor soil fertility and short growing seasons at high altitude areas like Khyber, Yasin, and Skardu.

It might be important to point out that all the improved maize varieties evaluated were 20-30 days late in maturity than the local maize. All the improved varieties had broader leaves and 2-3 cobs per plant with stay green traits as compared to small leaves with 1 cob per plant in local maize. None of the improved variety could fit into the local maturity limit for maize, in comparatively high altitude of double cropping zone. Any maize variety to be successful in the area must be white seeded and mature till 15th October otherwise free grazing livestock will destroy. Therefore, future efforts ought to be concentrated on selecting high yielding varieties with more or less similar maturity period. Some selection has been made from NA-I for early maturity with the same high yielding potentiality otherwise it will be difficult to protect the crop from free grazing animals after 15th October.

As the maize accounts for about 20 percent of the cereal crop in NAoverall there is a need to increase production to satisfy an increasing population, whilst the anticipated more commercial approach to livestock production is also likely to increase demand. To find varieties of short enough duration has proved very difficult. The future programme should include hybrids and varieties from a wider range of sources (Kenya has high altitude varieties of 100 days duration). Promising varieties should also be tested in the other areas.

### 2.2.2. Researchable Themes for Maize

- High grain yield.
- Good taste (fresh roasted, dried roasted and flour form,
- High stover yield
- More tolerance to diseases and insects
- Less bird damage due to tight husk cover
- More wind (lodging ) resistance due to strong plant and better root system
- Less storage loss
- Better germination of seed.
- Introduction of early maturing dwarf cultivars for different ecological zones.
- Development of area specific improved production technologies.
- Introduction of suitable high yielding hybrid/synthetic varieties.
- Evolution of improved production technology.
- Inter-cropping to enhance cropping intensity.
- Introduction/production of hybrid and composit varieties.

### 2.2.3. Approaches to Crop Improvement

How wide is the gap between what is being done and that which is possible? Can we reduce the spread between average yield of crops, top yields, and record high yields. What are the biological limits in crop productivity? If all the available technology were assembled, crop by crop, what could be accomplished? Can we meet calamities of the present and future, such as those we have experienced in the past, drought and dust storms, plant disease epidemics, insect infestations, and adversities in weather? Are there still new frontiers and unexplored dimensions for crop productivity that could result in substantial break through in the now prevailing yield barriers? Plants can be roughly separated into two categories, those

with little or no photorespiration, 4-carbon plants; and those with high rates of photorespiration, the 3-carboa plants. Species without photorespiration are maize, sorghum, sugarcane, sunflowers, and some varieties of rice. Such plants have low compensation points: light saturation is not achieved even at full sunlight; there is only a modest response to atmospheric CO2 enrichment; oxygen does not affect the rate of CO2 fixation; and peroxisome respiration is absent. There is increased efficiency of photosynthesis at higher temperatures. Translocation rates from the leaf are high. Such plants more effectively utilize water during growth and are less subject to competition by weeds.

Species where photorespiration is significant include soybeans, other legumes, most cereal grains, tobacco, potatoes, cotton, and most fruits and vegetables. These plants have high compensation points, oxygen inhibits photosynthesis and growth; light saturation occurs at levels well below full sunlight. Translocation rates from the leaf are low. There is a striking response to atmospheric CO2 enrichment; and peroxisome respiration is prevalent. Weed control is critical because seldom does the cultivated crop outgrow its more photo synthetically efficient competitors.

There is a great challenge ahead in developing varieties of crops having low photorespiration, and in the formulation of chemicals that will inhibit photorespiration.

Other approaches in modifying photosynthetic efficiency are to change the architecture of the plant and improve the light receiving system. All crops show marked varietal differences in photosynthetic efficiency and photosynthetic heterosis has been identified .

Photosynthesis remains today as the world's most important energy producing process. The greatest challenge man faces in food producing systems today is to manipulate plants under environments to maximize this energy conversion process. The importance of building a stock of plants for agricultural purposes with the 4-carbon pathway in photosynthesis is suggested. Agricultural practices should be adjusted to exploit this great renewable resource potential both for food and energy production.

The least efficient photosynthetic mechanisms exist in fruits and vegetables. Little has been done to identify genotypes having higher photosynthetic efficiencies or to minimize photorespiration. With all plants there are three possible complimentary and parallel routes-select genetic variables with greater photosynthetic efficiencies, modify plant architecture for better light reception, and apply chemicals to suppress photorespiration. The balance between photosynthesis and respiration can be chemically, physically, and genetically altered to maximize productivity.

Biological Nitrogen Fixation. Enhancement of biological nitrogen fixation in the soil, and particularly in the plants' rhizosphere, constitutes one of the greatest of opportunities to improve production efficiency of all crops, especially the legumes. The rhizobia along with the blue-green algae and the azotobacters appropriate 5 to 10 times more nitrogen from the atmosphere than is now accomplished from chemical fixation in the production of fertilizer for crop improvement. Nitrogenase activity is reflected by the reduction of acetylene to ethytene. This natural plant

biological system may be the best avenue for incorporating nitrogen into our soils and protein into our food supplies.

Biological nitrogen fixation in rice paddies ranges from 22 to63 kilograms per hectare per year. Up to 90kg of nitrogen per hectare have been fixed by semi-symbiotic association of Azotobacter pospali with roots of a tropical grass Paspalum notatum.

Environmentally speaking productivity could at the same time be maximized, energy inputs reduced, and the release of nitrates into lakes, streams and ground waters minimized making nitrogen from the air available to some of the major food crops. Peas, beans, including Soybeans, pulses and lentils are the logical crops for initiating research.

#### 2.2.3.1. Somatic-cell hybridisation

The production of new plants without recourse to sexual reproduction, and fusion of protoplasts of vegetative cells from different species affords one of the greatest potentials for the future. The hybrid is the same as that produced by sexual methods. Thus, there is now the potential of breeding widely divergent, species and creating new crop varieties not heretofore possible for conventional variety development techniques.

#### 2.2.3.2. Trickle irrigation

Trickle irrigation offers a exciting innovation in water use for crop production. Drip or trickle irrigation may reduce water requirements for crop production by one third. Trickle irrigation is particularly adapted for high-value row and fruit crops in areas where water is limited, costs are high, and where the greatest efficiency in water utilization and conservation is desired.

The non-variable root environment is a key for optimal production for many row crops which can be had through a constant water table from below, or trickle or drip irrigation on the surface. Many crops can benefit from foliar applications of both the micro and the major nutrients under certain climatic and soil conditions and with appropriate carriers.

#### 2.2.3.3. Host resistance

Host resistance to insects or diseases means control without cost to the grower or toxic residues, no damage to pollinating insects, and nature's balance between insects and their natural enemies is not upset.

Fruit insect pheromones or female sex attractants are good weapons against insects. They are now available for many species of Lepidoptera and Coleoptera. In juvenile hormone analogs there are over 500 compounds, They do not kill immediately but cause developmental disturbances which are lethal and prevent reproduction. Contrary to insecticides they are not toxic to insects and hopefully to higher animals, Most have selective action against determined insect pests.

#### 2.2.3.4. Protected cultivation

By protected cultivation it is possible to grow crops around the calendar prolong the growing season, and extend the areas of productivity. Future use of protection

or covers over crops is one of economics rather than technology. It does offer a technology for magnifying by several fold the productivity of crops per unit land area.

Protected cultivation has progressed worldwide. There are many unique environmental, ecological, economic, social, geographical, and technological features of food producing systems in greenhouses. Arid lands and desert coast lines offer unique advantages for these food producing systems.

### 2.2.3.5. Carbon dioxide enrichment

Associated with protective coverings of glass or plastic over plants has been a surge of interest in the enhancement of plant growth by enriched atmospheric levels of carbon dioxide in these contained or enclosed structures. It is economically feasible to add carbon dioxide under intensive field cultivation systems. Enrichment under field conditions with proper crop selection and management may have considerable potential for increasing crop yields. It enhances growth rates and the economic commercial productivity of many vegetable and flower crops. Root-top ratios, relative growth rates, and net assimilation rates are increased. Full benefits are conditioned by adjustments in other variables-light, temperature, plant variety, soil moisture, and nutrient levels. More dramatic increases in productivity from atmospheric carbon dioxide enrichment of crops in the field have been with cotton, grain sorghum, potatoes, and rice.

### 2.2.3.6. Multiple, and intensive relay cropping

Water management through irrigation is usually essential. Two, three, and even four crops can be produced in many areas of the earth, and double cropping in many places. Two additional facets of intensive cropping tend to optimise crop productivity. The first is early planting to produce leaf coverage of the soil as quickly as possible. This maximizes incident radiation interception. Secondly, plant populations may be increased by higher rates of seeding, narrower rows, or equidistant planting.

### 2.2.3.7. Reduced Tillage

Favourable effects of zero or minimum tillage on the productivity of corn for water, soil, and energy conservation have long been known. The practice has now been extended to asparagus and the small grain crops.

Direct drilling or zero tillage of cereal grains reduces the energy input into these food production systems. It is also a soil and water conservation practice. Growth regulants are significant in crop production. They circumvent environmental limitations, relax genetic restraints, improving quality, enhancing production, and aid mechanical harvesting. 2,3,5 Triiodobenzoic acid (TIBA) has been used successfully for improving the yield of soybeans through foliar application. Pod set is increased, lodging is reduced, earlier maturity is stimulated, and harvesting is facilitated with an overall yield increase. The gibberellins are widely used in the production of seedless grapes, and Alar is applied to regulate the flowering of fruit crops. CCC or Chlormequat is used extensively on wheat and rye in western Europe to prevent lodging, and to enhance productivity. The use of ethylene and ethylene-generating chemicals for

the induction of male sterility in wheat for possible hybrid seed production have been promoted.

Genetic vulnerability is great if food plant sources are limited. The increase in the production of grain sorghum as an alternate to corn, and triticale for wheat and rye are major steps to increase variability. Oats are particularly adapted to cool lands, have the highest protein content, and best amino acid balance of the cereal grains. Newly developed hybrids yield up to 30% more than the old inbred cultivars. Tree crops have not been extensively utilized in many parts of world. There is a future for new initiatives.

Science must dedicate itself to the building of new food species. The biological efficiency and desired new qualities cannot always be obtained from existing germplasm combinations. Species building programs will greatly enhance productive capacity reserves in food production systems. The incorporation of genetic materials from wild species into useful plant varieties could extend ever further the limits of crop productivity in the Northern Arid. This could be a significant research venture in view of the recently observed climatic changes. Food crop production under less than optimal conditions (cool regions, arid lands and high temperatures) could be maximized.

Man's search for new industrial, food, and feed crops includes faba beans, sunflowers, triticale, bird resistant sorghums, hybrid pearl millet, sainfoin, rape, feed wheat, tassel-seeded corn, and wild rice. Can we go for similar ventures in NA.

## 2.3. Fruit Crops

The whole of the NA is covered with scattered fruit and trees with apricot, grapes, apple, cherry, mulberry and walnuts being the most important species. The total number of plants is estimated at some 2307, 800 in the NA. Most of it is used for fresh home consumption and surpluses are either dried (apricots)or simply wasted because of the bad road infrastructure which makes marketing of fruit almost impossible. Plants are in DOA nurseries, which exist in all districts and sold to farmers at subsidized prices. Government nurseries are reported to be very inefficient and few plants are produced compared with the area by such nurseries. AKRSP had started a programme to establish private village based nurseries and a considerable part of the plants are being produced by these nurseries and sold to the villagers with subsidy to meet the requirement of the area. In a recent survey of Gilgit District, the average household had about 30 trees producing 2280 kg of fruit per year and 130 kg of dried fruit, about half of which is eaten and cherries, and pears which are of high value and readily transportable. Diverse statistics and information is provided in tables below:

| Table 32: Orchards in the Northern Areas | | | | | |
|---|---|---|---|---|---|
| Name of fruit | Status in Districts | | | | |
| | Gilgit | Skardu | Diamir | Ghizar | Ghanche |
| Apple | + | + | + | + | + |
| Apricot | + | + | + | + | + |
| Plum | + | +Extensive | + | + | +widely grown |
| Grapes | + | + | + | + | + |
| Almond | + | + | + | + | + |
| Walnut | + | + | + | + | + |
| Pear | + | + | + | + | + |
| Peach | + | + | + | + | + |
| Mulberry | + | + | + | + | + |
| Pomegranate | + | + | + | + | - |
| Persemum | Negligible | + | + | + | + |

| Table 33: Fruit nurseries and agriculture farms (Hectares) | | | | | |
|---|---|---|---|---|---|
| District | No. of Nurseries | Area | No. of Farms | Area | Total Area |
| Gilgit | 5 | 9.48 | 2 | 11.00 | 2.48 |
| Ghizar | 6 | 7.75 | 0 | 0.00 | 7.75 |
| Skardu | 17 | 92.75 | 2 | 6.80 | 99.55 |
| Ghanche | 6 | 9.65 | 1 | 12.45 | 22.10 |
| Diamir | 13 | 9.00 | 3 | 21.00 | 30.00 |
| Total | 47 | 128.63 | 8 | 51.25 | 179.88 |

| Table 34: Fruit production in Northern Areas | | | | |
|---|---|---|---|---|
| Fruit | Bearing Tree No. | Non Bearing Tree No. | Cropped Area Hectares | Production in tons |
| Almond | 112,126 | 85,590 | 309 | 883 |
| Apple | 500,940 | 258,037 | 1,635 | 24,442 |
| Apricot | 1,861,083 | 860,437 | 6,368 | 60,305 |
| Cherry | 95,545 | 52,938 | 334 | 1,862 |
| Grapes | 136,131 | 54,339 | 396 | 34,500 |
| Mulberry | 293,004 | 192,657 | 1,127 | 18,225 |
| Others | 67,001 | 75,706 | 145 | 53 |
| Peaches | 114,621 | 55,597 | 303 | 4,449 |
| Pear | 80,020 | 30,260 | 403 | 4,128 |
| Plum | 20,189 | 7,289 | 52 | 3,060 |
| Pomegranate | 105,008 | 61,008 | 182 | 2,221 |
| Walnut | 176,935 | 106,101 | 802 | 6,552 |
| Total | 3,562,603 | 1,839,959 | 7,029 | 170,680 |

| Table 35: Number of fruit trees by District | | | | | | |
|---|---|---|---|---|---|---|
| | NA | Gilgit | Ghizar | Diamir | Skardu | Ghanche |
| Orange | 5,490 | 3,585 | 45 | 1,086 | 774 | 0 |
| Apple | 280,563 | 125,882 | 31,051 | 22,588 | 72,256 | 28,786 |
| Plum | 27,740 | 17,083 | 3,627 | 2,030 | 4,252 | 748 |
| Persemum | 754 | 249 | 60 | 99 | 336 | 10 |
| Pear | 46,598 | 27,218 | 9,760 | 885 | 6,740 | 1,995 |

| Table 36: Yield potential and researchable themes in fruits | | | |
|---|---|---|---|
| Fruit | Yield per plant | | Researchable themes |
| | Pakistan | NA | |
| Apple | 60-80 kg | 30-50 kg | Pollination aspect in different varieties<br>Selection of resistant varieties<br>Pre-Post harvest technology |
| Apricot | 50-80 kg | 20-50 kg | Fruit fly problem,<br>Alternate bearing<br>Selection of varieties |
| Plum | 40-80 kg | 15-20 kg | Pre-mature fruit drops<br>Gummosis |
| Peach | 40-80 kg | 20-50 kg | Fruit fly in late varieties, Peach lefcurl<br>Shoot borer, bacterial canker |
| Pear | 40-60 kg | 25-60 kg | Fruit fly in late varieties<br>Selection of varieties |
| Grapes | 25-40 kg | 30-60 kg | For uniform bunch maturity<br>Pruning for fruit quality<br>Resistant varieties for powdery mildew |
| Almond | 6-8 kg | 5-12 kg | Gummosis<br>Selection of varieties |
| Walnut | 60-100 kg | 50-100 kg | Shoot borer, Hairy caterpillar<br>Selection of varieties |
| Pomegranate | 30-40kg | 20-40 kg | Fruit splitting, Fruit fly<br>Bushy Growth |
| Persimmon | 40-60 kg | 25-50 kg | Planting survival<br>Selection of varieties |
| Mulberry | 10-12 kg dry | | Pre-mature fruit drop<br>Selection of varieties |

Source: Director Horticulture Research Institute NARC, Islamabad.

| Table 37: Insect pests and diseases of fruits | | |
|---|---|---|
| **Name of fruit plant** | **Insect pest** | **Disease** |
| Walnut | - Walnut weevil | - Plant pox |
| | Leafhopper | - Marginal leaf burning |
| | - Blister mite | |
| | - Leaf miner | - Leaf blight |
| | - Dusky veined aphid | - Shedding of nuts |
| | - Scale insect | - Husk disease |
| | - Leaf feeding caterpillars | |
| Apple | - Codling moth | - Powdery mildew |
| | - Leaf miner | - Fruit rotting |
| | - Mites, sanjose Seale | - Anthrac nose/whither tip/dieback |
| | - Fruit fly | - Phytopthora |
| | - Woolly aphids | - Crowngall |
| | - Stray grasshoppers | - Bacterial canker |
| Apricot | - Fruit fly | - Shot hole |
| | -Green aphids | - Gummosis |
| Grapes | - Leaf hoppers | - Downy mildew |
| | | - Powdery mildew |
| | | - Blister |
| Peach | - Peach Leaf curling aphid | - Leaf curling |
| | - Green peach aphid | - Powdery mildew |
| | | - Bacterial canker |
| Pear | - Green aphid | - Bacterial blight |
| | - Scale insect | (Leaf tip burning) |
| Cherry | - Leaf miner | - Shot hole, Crowngall |
| | - Mites | - Crown gall |
| Almond | - Green aphid | Powdery mildew |
| Plums | - Green aphid | - Crown gall |
| Pomegranate | - Green aphids, Fruit fly | - Fruit splitting |
| Persiman | - Fruit fly | - Nacrotic spots on leaves |
| Mulberry | - Mealy/Woolly bugs<br>- White grabs, cut worms for All fruit | |

## 2.4. Vegetable Crops

The northern areas of Pakistan can be divided into four different micro agro ecological zones: i) high altitude (> 2400m) (dry) with severe cold winter and cool summers ii) high altitude (>1800m-2400m)(moist) with severe cold winter and mild summer iii) mild altitude (1400-1800m) with cold winter and mild summer and iv)low altitude (1200-1,400m) with cold winter and hot summer. The semi tropical to temperate climate conditions of four distinct micro agro ecological zones of northern areas with deep fertile soils of dividing valleys allow adopting diversified obviculture activities both at household level (growing herbs and vegetables for

home kitchen garden) and commercial scale growing vegetables for fresh market including off season vegetables, Peas, Capsicum, Cucumber, Turnip, etc. Raising nursery seedlings and vegetables seed production in certain areas have good future. From mid to up hills the soil and climatic conditions of growing chemical free vegetables where insect and disease problems are relatively less, growing cool season early vegetables can be an added advantage.

Vegetable production is expanding and future potential exists. Because of the favourable climate and low incidence of pests and diseases, the Northern Areas could be used to produce high quality vegetable seed for the rest of Pakistan and even for export. During winter, fruits and vegetables are imported into Gilgit and Skardu. The marketing period for local produce in the Northern Areas could be extended into the winter months by providing facility for storage of fruits, potatoes and other vegetables in a cold store, or with controlled ventilation in the cooler upland areas where refrigeration would not be needed.

Major vegetables grown are cabbage, cauliflower, tomatoes, onion, carrot, peas, turnip, capsicum, chillies, okra and more commonly sonchal (Malva verticillata) etc. In lower elevations the season extends from March to November and two vegetable crops can be grown in this area while in higher lying areas the season is limited to the period April/May to October. Pea cultivation under contract is becoming increasingly popular in the single cropping zone where good yields can be achieved. The climate of the NA provides a comparative advantage in the production of many vegetable seeds, which are of high value, presently being considered as low value crops.

### 2.4.1. Constraints

The major constraints common to all four distinct ecological zones are:

- Lack of information on vegetable varieties and cropping pattern.
- Non-availability of high quality pure seed /seedlings.
- Production (including IPM of vegetables) constraints.
- Lack of information base (on more remunerative vegetables crop production) and reporting for successful marketing.
- Non-accessibility to main markets.
- High cost of production.
- Weak Marketing information and facility system
- Lack of quick accessibility to main market for off-season vegetable

The common problems of the farmers can be listed as:

- Low Productivity, agricultural output level is lower than even the national average level
- Non-availability of agricultural inputs like improved seed, fertilizers and pesticides, farm machinery and their high cost
- Uncontrolled grazing, calling for rational use and rehabilitation of pastureland
- Shortage to absence of agricultural credit
- Shortage of irrigation water
- Repair and maintenance of water channels
- Severe winter season and small holdings
- Lack of improved production technology
- Lack of processing and marketing

For sustainable vegetable development the following approach may be adopted:

- Technical packages on various aspects of vegetables production be developed.
- One to two days training courses as per requirement of the community and field staff of DOAmay be organized on special topics. Farmers exposure visits of market areas where vegetables are grown successfully be arranged.
- Seed /seedlings along with necessary technical know how be provided to communities.
- Seedlings at community level be raised.
- There should be separate/strong vegetable production and marketing extension programme, at districts level.
- Selection of high yielding environment friendly vegetables be made and introduced.
- Adaptive research studies on variety screening, moisture conservation and planting time to intensify vegetables production may be carried out involving government infrastructure facilitating, the staff and providing them financial resources and capacity building facilities.
- Certified seed production may be carried out in dry and cool (non – monsoon) areas by public and private entrepreneur under the supervision of FSCRD. Seed production of crucifers, onion, capsicum and carrot may be more economical /rewarding.
- Drought and cold tolerant varieties be introduced.
- Growing off season winter vegetables during summer where temperature is mild to cold (at altitude > 2400 meter above sea level) is highly remunerative. Growing off season peas, carrot, cabbage, cauliflower and green coriander seem to be highly paying vegetables. Growing of these vegetables in area at higher altitude (> 2400masl), which are well connected with roads, is recommended.
- Organic vegetable farming is recommended with two options a) growing in chemical free vegetables in area where pests are not problem (especially the high altitude and b) growing vegetables by using, bio-pesticides, where pests are a problem
- Protect the soil from erosion. Through growing vegetables like creeper and practice intercropping.
- Planting of winter hardy vegetables in upland areas where water is severe after kharif crops would enhance cropping intensity up to 200 %. Likewise, cultivation of winter hardy vegetables e.g. peas after potato harvest is recommended instead of wheat or oats which hardly mature.

### 2.4.2. Enhancing Cropping Intensity

In areas (between 1290-2000masl) where at present double cropping is practiced we can easily go for three crops, kharif (e.g. okra, tomato, eggplant, yard long beans) Rabi (e.g. turnip, radish, cauliflower, spinach, broadleaf mustard, garlic) and winter hardly vegetables (e.g. broccoli, peas, fenagneek, Chinese cabbage). By adopting Inter and Relay cropping up to three vegetables crops can be grown in areas up to 1900masl,where as in area where summer is cold and winter is very severe two winter vegetable crops can be successfully grown.

### 2.4.3. Vegetables' Dehydration and Preservation

Vegetable dehydration and preservation e.g. pickling may be introduced amongst communities and household. The isolated area /segments of society deserve priority.

## 2.4.4. Marketing

With the sustainable development a stage will come when products will start coming in bulk for which there should be a market. Awareness on process of harvest handling and marketing needs to be created amongst communities and women organizations (WOs) from the beginning.

People living in mountainous northern areas depend on vegetables mostly grown in plains. Such vegetables are as such highly contaminated with pesticides. Their quality is further deteriorated during transportation to far flung distance .Due to high cost of transportation majority of the people in isolated areas can not afford to buy even cheap vegetables, hence, remain under or malnourished. The Northern Areas are mostly in the mountains which are blessed with agro ecologies best suited to grow variety of vegetables year round. People living in such areas can grow vegetables for self-consumption and can also earn considerable profit from off season vegetable production. The isolated monsoon free pockets permit vegetable seed production. Hence vegetable promotional activities need to be carried out on extensive scale in these areas.

**Table 38: Vegetable production in Northern Area**

| Crop | Area (Ha) | Production (T) | Wastage (T) | Consumption (T) | Marketed (T) |
|---|---|---|---|---|---|
| Beans | 272 | 3,991 | - | 942 | 3,049 |
| Cabbage | 296 | 3,627 | 288 | 3,113 | 226 |
| Others | 29 | 864 | 50 | 700 | 114 |
| Peas | 395 | 1,494 | - | 400 | 1,094 |
| Potato | 3,045 | 76,125 | 2,166 | 6,318 | 67,641 |
| Tomato | 481 | 7,853 | 778 | 5,175 | 1,900 |
| Turnip | 727 | 14,540 | 84 | 14,300 | 156 |
| Total | 5,245 | 108,494 | 3,366 | 30,948 | 74,180 |

Source: 2001 Agricultural Census and DA report 1997

Potato is a crop poised to expand its area of production. Because the Northern Areas are relatively free of virus, insect pests and root knot nematode. There is considerable potential for producing seed potatoes.

Potatoes are grown for seed under contractual arrangement with seed companies. A tissue culture laboratory and micro-tuber multiplication run by the DOA provides pre basic tubers for further multiplication by the companies. About 5000 tons of seed potatoes are multiplied by some 1500 small farmers and are exported to Punjab. Seed. Potatoes are grown in the single crop areas above 2500m where the incidence of diseases, in particular virus disease is less severe. Table potatoes are also grown throughout the NA but marketing is difficult given the low level of consumption and the absence of important urban centres.

| Table 39: Vegetables in the Northern Areas | | | | | |
|---|---|---|---|---|---|
| Name of Vegetable | Status in districts | | | | |
| | Gilgit | Skardu | Diamir | Ghizar | Ghanche |
| Onion | + | + | + | + | + |
| Peas | + | + | + | + | + |
| Tomato | + | + | + | + | + |
| Table Potato (in double zone) | + | + | +commercial | + | +commercial |
| Cauliflower | + | + | + | + | + |
| Chinese cabbage | + | + | + | + | + |
| Cabbage | + | + | + | + | + |
| Spinach | + | + | + | + | + |
| Carrot | + | + | + | + | + |
| Radish | + | + | + | + | + |
| Shuwanchal | + | + | + | - | - |
| Turnip | + | + | + | + | + |
| Lettuce | + | + | + | + | + |
| Beans | + | + | + | + | + |
| Garlic | + | + | - | + | + |
| Brinjal | + | + | + | + | + |

| Table 40: Yield potential and researchabel themes in vegetables | | |
|---|---|---|
| Crop | Yield potential | Researchable themes |
| Garlic | 20-25 tons/ha<br>(CV. Chinese) | 1. Weed control studies.<br>2. Plant spacing in relation to weedicides<br>3. Varietal evaluation<br>4. Post harvest studies in relation to sprout suppressant. |
| Okra | (CV. Sabz Pari) | 1. Management of viruses<br>2. Introduction of high yielding virus resistant cvs.<br>3. Introduction of thorn-less cultivars.<br>4. Shelf life study (Post harvest) |
| Peas | 4-5 t/acre Rondo | 1. Powdery mildew resistant cvs<br>2. Disease management.<br>3. Introduction of early and late maturing varieties<br>4. Studies for raising of off season crop |
| Cauliflower | Early 15-20 t/acre<br>(CV. Taxila local sels.<br>(NARC) | 1. Sequential maturity and Introduction of early and late varieties.<br>2. Buttoning and bolting studies.<br>3. Seed production. |
| Brinjal | 15-20 t/acre<br>Dil Nasheen | 1. Shoot borer |
| | | |

| | | |
|---|---|---|
| Onion | 25-40 t/ha<br>CV. Phulkara | 1. Weed control studies.<br>2. Post-harvest studies in relation to Sprout suppressants.<br>3. Bulb yield and keeping quality in relation to plant nutrition (NPK)<br>4. Bulb yield and shelf life in relation to plant spacing.<br>5. Varietal evaluation for bulb yield and quality<br>6. Off-season production.<br>7. Resistant cultivars against verticillium wilt |
| Carrot | 25-30 t/ha<br>CV` T-29′ | 1. Roots with high carotene.<br>2. Late maturity. |
| Tomato | 20-25 t/ha<br>CV Roma | 1. Virus problems.<br>2. Fruit borer infestation, fruit rot problem.<br>3. Blight.<br>4. Studies for raising of off season crop.<br>5. Introduction of new germplasm. |
| Chillies | CV. Loungi for power | 1. Phytophthora root rot<br>2. Virus Problems<br>3. Verticillium wilt<br>4. Studies for raising of off season crop |
| Radish | 30-35 t/ha | Germplasm, evaluation and selection for late / early maturing cultivars. |
| Turnip | 25-30 t/ha | Germplasm, evaluation and selection for late / early maturing cultivars. |

Source: National Coordinator Vegetables, NARC, Islamabad

Progress in vegetable seed production is slow for reasons of difficulties in organizing farmers in adjacent fields to avoid cross with traditional varieties. Limited labour availability during the summer months and limited market linkages, are the constraints.

**Table 41: Fertilizer trial conducted to determine nutritional deficiencies in the soil for potato crop production in Northern Areas**

| Fertilizer treatment in nutrient kg/ha | | | | Mean yield tones/hectare, out of 3 replications in each location | | | | |
|---|---|---|---|---|---|---|---|---|
| F.Y.M. (t/ha) | Nitro-phose | $P_2O_5$ | $K_2O$ | Naltar | Khyber | Babusar | Total mean | Yield (t/ha) |
| 20 | 250 | 125 | 100 | 63.568 | 62.208 | 67.979 | 193.755 | 64.885 |
| 20 | 200 | 125 | 75 | 63.664 | 62.480 | 67.200 | 193.344 | 64.448 |
| 20 | 200 | 125 | 100 | 62.994 | 62.058 | 66.838 | 191.890 | 63.963 |
| 20 | 200 | 100 | 75 | 62.255 | 58.960 | 65.310 | 186.525 | 62.175 |
| 20 | 150 | 100 | 75 | 56.676 | 51.302 | 50.213 | 153.191 | 51.064 |
| 20 | 150 | 100 | 50 | 47.340 | 48.551 | 49.815 | 145.706 | 48.569 |
| 20 | 150 | 75 | 50 | 43.679 | 43.117 | 42.234 | 129.030 | 43.010 |
| 20 | 100 | 75 | 50 | 34.935 | 33.738 | 33.497 | 102.170 | 34.010 |
| 20 | 100 | 75 | 00 | 30.556 | 29.568 | 32.273 | 92.397 | 30.799 |
| 20 | 100 | 00 | 00 | 28.216 | 25.957 | 28.518 | 82.691 | 27.564 |
| 20 | 00 | 00 | 00 | 15.299 | 14.475 | 14.777 | 44.551 | 14.850 |
| 00 | 00 | 00 | 00 | 8.990 | 7.691 | 9.315 | 25.996 | 8.665 |

Notes: It is revealed from the table-41 that the soils are very poor in organic matter and available nitrogen, phosphorous and potassium, which were needed to be added in adequate quantities for good results. It was also realized that the application of 20 tones farm yard manure - 200 kg N, 100kg P2O5 and 75 kg K2O per hectare was the best and most beneficial combination of fertilizers and further increase in fertilizer dose could not produce higher total tuber yield significantly. All the farm yard manure and fertilizer treatments significantly produced higher yield than the control where no farm yard manure and fertilizer were applied.

## 2.4.5. Biotechnology for Horticultural Crops

Various biotechnological approaches have been effectively adapted to genetic improvement of perennial plants. These include micro-propagation; production of homozygous parental lines by chromosome doubling of haploids; regeneration of inter-specific and inter-generic somatic hybrids for root stock development; in vitro selection for somaclonal variants having enhanced disease resistance and genetic transformations for specific horticultural traits.

Biotechnology is also providing important insights into the regulation of gene expression of important plant processes, e.g. embryogenesis, root and shoot organization, flowering and fruit set, photosynthesis, hormone activity, signal transduction, etc.

The identification of genes that control these processes and the study of gene regulation and expression will eventually enable us to understand and control many aspects of plant growth and development eventually enable us to control these phenomena for crop improvement and management. Although genetic transformation of fruits with selectable and scorable marker genes is not a limiting factor, very few genes have actually been isolated from fruits. Gene coding for such horticulturally important traits as tree size, yield and fruit quality is also not yet available.

#### 2.4.5.1. In vitro selection of somaclonal variation

Genetic and phenotypic variants that are produced during cell and tissue culture cycles are referred to as somaclonal variants. The nature of explant and the length of the time that the tissues have been maintained in culture are the major facts that influence the degree of variation.

Somaclonal variants of a number of fruit species have been recovered.

#### 2.4.5.2. Germplasm conservation

Vast areas have been completely or partially deforested for expanding agriculture. This has caused great genetic erosion within many species and genera. Because of the loss of natural habitat, the establishment of ex situ and in situ germplasm collections of many horticultural plant species is considered to be imperative. The genetic improvement of many species, previously was dependent on the utilization of the genetic variability found within a single species, has now changed by exploiting other species.

To achieve the above targets through Biotechnology, a Biotechnology Research Institute must be established in NA.

## 2.5. Floriculture

Flowers not only beautify the environment, but also express human sentiments. Flowers are used at numerous occasions such as wedding, funerals, social functions, for fragrant crude oil extraction, as medicines and as gifts.

Commercial floriculture is a recent development in Pakistan. There is a tremendous potential for the cultivation of floral crops on a commercial scale due to availability of favourable soil, climate and location in the country. This makes it possible to produce important flower crops almost round the year. Fortunately for us, winter is the best time of the year for the production of roses and certain other flowers like gladiolus, carnations, gypsoptila, statice, etc. whereas this is just the time when large part of the Europe is subject to frost, fog and snow. People appreciate having fresh flowers in their rooms during winter when the out side is so bleak and dreary. The high cost of production in controlled environment is costly due to rising energy prices. Additionally, some of the cut flowers like cut roses defy quality production of blooms under glass as compared to natural environment. These factors, therefore, place NAof Pakistan in a highly advantageous situation. However, major factors involved in the export of flowers are harvesting techniques, packing and transportation methods, which should be well-known to the exporter.

The list of species of cut flowers is quite long. New cultivars are continuously adding to this list. NAhave lot of novel, unknown and rare species. Which can also be commercially exploited. Cut flowers may be produced outdoors in NA, vis-à-vis the use of green houses and shade houses in leading flower producing countries. Some of it can be promoted in the down country. Chrysanthemum, rose, carnation, orchid, snapdragon and some bulbous species are the major green house crops. The principal environmental factors like water, temperature, light and essential elements are either entirely or partially controlled, for quality production.

Green house culture is more or less absent in Pakistan; primarily owing to its high installation cost and costly maintenance. But nature has provided Pakistan with such an environment that nearly all kinds of flowers can be raised in one season in outdoors, i.e., in plains, winter and in the northern parts in summer.

Exportable flowers possess huge expandable potential but the process is quite lengthy and demands patience. Thus by assisting and training the growers and exporters as well as providing the facilities of chilling, marketing, shipment, cargo services, Pakistan can earn its foreign exchange by exporting cut flowers, ornamental and foliage plants around the year. With little effort NAcan join the list of exporters.

The introduction of floriculture in NAwill also provide an opportunity to establish Bee-Keeping industry in the area, where wild bee species are already available and contribute a lot in honey production.

## 2.6. Cash Crops

For improving the economic conditions of farmers, promotion of cash crops is very essential. However, some of the serious constraints are, frequent occurrence of pests and diseases, remoteness and scatter of the plantations, scarcity of quality germplasm, unplanned and non-systematic orchards, absence of quarantine, poor knowledge about economic side of cash crops, no training in farm management, etc.

However, there are ample opportunities to promote these crops because of unique climate and existence of natural physical barriers which can help protect crops from invasion of pests and diseases, promote biological agents and cut-down use of pesticides. Cultivation of multipurpose crops/trees like olive, pistachio, pine, with kernals can be promoted. Indigenous germplasm which has adapted itself to the environment can be conserved. Where possible integrated agriculture can be practiced. Systematic orchards + vegetables for seed production + bee-keeping, etc. The crops which are considered as cash crops are listed below. These have been ranked according to their existing and future potential:

### 2.6.1. Vegetable Crops

1. Potato (seed and table potato)
2. Peas
3. Capsicum
4. Tomato
5. Onion (seed and bulb)
6. Garlic
7. Lady finger
8. Cucurbits

### 2.6.2. Fruit Crops

1. Apple
2. Apricot (fresh and dry)
3. Walnut
4. Cherry

5. Pears
6. Grapes (fresh and dry)
7. Almond
8. Pomegranate

### 2.6.3. Medicinal Plants

1. Seabuck thorn
2. Black cumin
3. Kut
4. Many others

### 2.6.4. Others Options

- Vegetable seeds: Capsicum, peas, onion, reddish. Hybrid seeds of maize, potato seed/table potato
- Oilseed crops: Olive crop, hybrid seed of sunflower, canola seed.
- Cereal crop seed production: Imported wheat varieties give up to 580% higher yield than the local ones. Vegetable production like pepper, peas etc.

- Examples of mixed cropping for increased yield per unit area:
  a. Orchards + Vegetable seed crops + bee keeping.
  b. Maize + beans (lobia) or turnips, or pumpkin or potato or mash.
- Commercial cultivation of medicinal plants such as mushroom, etc.
- Promotion of production technology particularly for cherries and apples.
- Off season vegetable seed production such as peas, capsicum, tomatoes, turnips, etc.

- Potato became a cash crop in Northern Areas by the following:
  a. Import reduction in seed potato by 50% at country level due to local production of seeds in Northern Areas.
  b. Expansion in export volume to 50,000 – 60,000 tones of table potato and 5000 tones of seed potato.
  c. Addition in revenue through sale of potato up to 500 – 600 million rupees annually to the growers of NA.

- Off-season vegetables promotion is due to:
  a. I. Suitability of agro-ecological conditions.
  b. Farmers training & demonstration.
  c. Enhancement of productivity of peas, capsicum etc. in specific areas likes Babusar and Gonar Farm resulted due to environment and technology.

Four years production statistics of off-Season vegetables are given in table 42

**Table 42: Income from off-season vegetables**

| Year | Quantity (Ton) | Income (Million) |
|---|---|---|
| 1998-1999 | 140 | 2.800 |
| 1999-2000 | 180 | 4.500 |
| 2000-2001 | 741 | 10.825 |
| 2001-2002 | 870 | 13.050 |

## 2.7. Seed Production

Most of the crops vegetables and fruits being grown in the hill areas are of indigenous type having no research or commercial base. Farmers themselves arrange most of their requirements of seed by preserving part of their harvest. Development/testing of new seed varieties suited to different ecological zones of hill areas has been inadequate. Consequently, this has led to non-development of any public or private organization/enterprises for production and supply of improved seed varieties. A crash programme funded by the Government may be initiated to establish the following.

- Agricultural seed and crop improvement farms
- Horticultural crops farms
- Animal husbandry farms
- Fish farms

### 2.7.1. General Constraints

- R&D (Evaluation of NA Seed in plains) and poor Market Information Service (MIS)
- Non-existence of a seed producing public and private seed producing body in Northern Areas.
- Lack of seed producers/registered associations.
- Lack of packing, processing and storage facilities.
- In sufficient availability of basic seeds
- Absence of seed testing and diseases diagnostic facilities.
- Lack of capacity to produce suitable hybrid and synthetic varieties.
- Lack of coordination among key stakeholders.
- Free grazing of domestic animals through out the year.
- Lack of awareness and skills.
- High cost of seed production and low returns.
- Non-availability of agric inputs.
- Lack of quarantine services for preventive measures to maintain the existing disease free status of the NA.
- Small land holdings in the areas
- Lack of credit facilities to the seed growers

### 2.7.2. Specific Constraints

#### 2.7.2.1. Potato

- Shortage of quality seed during plantation
- Monoculture of potato
- Absence of disease diagnostic facility
- Week extension services
- Lack of storage facilities
- Lack of MIS and marketing
- Lack of awareness regarding table and seed potato
- Non-availability of certified seed potato during planting season.
- No proper rules and regulation for the seed companies involved in seed potato production in NA.
- Lack of infrastructure for production of high quality basic seed potato(micro and mini-tubers).

- Research on stable seed potato production.
- Development of mass production system of micro/mini-tubers.
- Practical application of newly developed technologies.
- Development of post harvest technologies for seed potatoes.
- Lack of technical staff.

It was heartening to witness a tissue culture lab and green house facility at the Agriculture Complex at Gilgit. They produce disease free seed of cardinal, desiree and diamond to the tune of 33 tons per annum. (pre-basicand basic-1) Which is sufficient for 18ha. This is issued to registered seed potato companies, which are multiplying the same at higher altitudes about 10000 (about 8000 ft above sea level. Some 15-17 seed companies produce certified seed and export it to down country. On an average a quantity of 5000 tons per annum. Out if this certified seed annually 60-70 thousand tons of table potato is produced and marketed in the plains. There is strong for instituting collaborative management regimes for protected areas (Borrini- Feyerabened 1996) and strengthening capacity and infrastructure of the NAForest Department, NGOs and the surrounding communities.

**Table 43: Private companies and organisations involved in seed potato production in Northern Areas**

| S. No. | Name of company/organization |
|---|---|
| 1 | Jaffar Brothers (pvt) Ltd., Lahore |
| 2 | AGB Seed (pvt) Ltd., Lahore |
| 3 | Jabbar Seeds International (pvt) Ltd., Lahore |
| 4 | Gilgit Agriculture Marketing Association, Gilgit |
| 5 | Northern South Seeds, Gilgit |
| 6 | AKRSP |
| 7 | Mountain Seed Company, Gilgit |
| 8 | T.S.Traders, Gilgit |
| 9 | Giliton International, Nagar |
| 10 | Kanjute Multi Traders, Hunza |
| 11 | Kamyab Seeds (pvt) Ltd. Lahore |
| 12 | Nanga Parbat Seed Growers, Chilas |
| 13 | Agriculture Cooperative Society, Chilas |
| 14 | Khyber Seed Growers, Khyber, Hunza |
| 15 | Kiani Seeds, Nagar |
| 16 | Seed potato Growers Association, Yasin |
| 17 | Sipra Seeds, Lahore |
| 18 | No. Seeds, Lahore |

### 2.7.2.2. Wheat

- Lack of high yielding winter varieties
- Non existence of sustainable seed production system in private and public sector at local level of Northern Areas
- Lack of problem driven research and extension services for development, screening, selection and seed production of high yielding varieties
- Lack of coordination and linkages for adopting integrated approaches among key stakeholders

- Lack of awareness raising and capacity building system
- Non existence of Agriculture Research in NA
- Lack of coordination

### 2.7.2.3. Maize

- Lack of awareness
- Hybrid seed expensive
- Non availability of inbred lines
- Lack of synthetic varieties and hybrids
- Lack of improved production technologies
- Non-availability of quality seeds

Based on the use of improved seeds on one third and one forth respectively of the areas for maize and potatoes and wheat, the tentatively estimated seed requirements and the related areas are presented Table 34.

**Table 44: Seed Requirement**

| Crop | Area (ha) | Requirement (kg) | Total (tonnes) | Seed Area (ha) |
|---|---|---|---|---|
| Maize | 12,550 | 30 | 376.5 | 179.29 |
| Wheat | 25,500 | 150 | 3,825.0 | 2,125.00 |
| Potatoes | 2,523 | 2,500 | 6,307.5 | 252.30 |
| Total | | 2,680 | 10,509.0 | 2,556.59 |

**Table 45: Existing seed farms**

| District | No. of Farms | Area (ha) |
|---|---|---|
| Gilgit | 02 | 11.00 |
| Ghizar | - | - |
| Skardu | 02 | 06.80 |
| Ghanche | 01 | 12.45 |
| Diamir | 03 | 21.00 |
| G. Total | 08 | 51.25 |

### 2.7.2.4. Vegetables

- No linkages of NA farmers with farmers of plains
- No Basic seed source in Pakistan
- No seed processing facility in NA.
- Lack of improved production technologies
- Non-availability of quality seed material
- Insufficient involvement of private sector
- Weak marketing information system
- Lack of post harvest technologies, especially processing, packing, storage and marketing
- Lack of capacity and technical expertise to produce high quality vegetable seeds

#### 2.7.2.4.1. Onion

Three popular varieties in the NA are:

- Phulwar
- Taxas white
- Red ball of Karachi

The varieties grown in swat are also being grown in Gilgit area for seed production which is marketed in the down country up to lower Sindh, where it is grown over hundred thousands of acres.

#### 2.7.2.4.2. Pepper

The popular varieties are:

- Capsicum yolo wonder
- Capsicum Ball-NAa
- Capsicum California, is long in shape, while ii & iii are round about, having swellings and two holes in each

**Table 46: Basic information about vegetable seed production in Northern Areas**

| Crops | Seed Rate (grams/ kanal) | Production (kg/kanal) | Income Rs./kanal | Production seasons at different altitudes and locations | | |
|---|---|---|---|---|---|---|
| | | | | Chilas | Gilgit/Ghizar | Hunza |
| Onion (Bulb-Seed) | 300 kg | 30-50 | 10,500-17,500 | Jan-June | Feb-July | Mar-Aug |
| Onion (Seed-Seed) | 350-400 g | 30-50 | 10,500-17,500 | Oct-May | Aug-June | July-July |
| Radish | 300 g | 60-80 | 3,600-4,800 | Nov-April Or Feb-June | Nov-May Or Feb-June | Mar-Aug |
| Carrot | 300 g | 40-50 | 2,600-3,250 | Nov-May Or Feb-July | Nov-June Or Feb-July | May (first year)-June (Second year) |
| Okra | 2 kg | 60-75 | 2,400-3,000 | April-Aug | May-Sep | May-Oct |
| Peas | 5 kg | 50-80 | 1,250-2,000 | Oct-Mar/April | Feb-May | Mar-July |
| Cauliflower | 300 g | 20-30 | 6,000-9,000 | Sep-April | Aug-May | May (first year)-June (Second year) |
| Cabbage | 300 g | 25-35 | 5,000-7,000 | Sep-March | Aug-May | May (first year)-June (Second year) |

Note: These are actual data from AKRSP's North South Seeds seed production activities over the past three years.

It is absolutely crucial to note that, despite the reasonable seed production capacity potential implied by these data, the seed produced must be of the varieties in demand in the vegetable seed markets of Pakistan.

Presently one of the main constraints to the success of vegetables seed production in the Northern Areas & Chitral is the lack of high quality cultivates, that are what the market wants and for which high quality stock seed is readily available.

### 2.7.2.5. Oilseed

The indigenous sunflower races versus NK-212, SF-187, PARC-92E, hybrids, etc evaluated in NArevealed that local races gave the maximum oil contents (2.299). The sunflower has a circumference up to 37 inches of the imported varieties. It shows that the indigenous races if utilized properly for up-gradation of oil contents can be extremely useful. It is therefore recommended that indigenous races of oilseed crops should receive maximum attention for research to meet the national needs in edible oils. Moreover, leaving aside our concern for food security efforts should be made to conserve these races, explore their useful genes and map their chromosomes.

Most experts believe that oil contents are higher in sunflower local races because the climatic conditions are conducive for oil content production in NA. Likewise, NAis also ideal for production of hybrid seed of sunflower due to natural isolation, low humidity due to low rainfall, low temperature during night, high temperature during days and availability of irrigation water during seed formation. Thus a vast scope exists for oilseed crops production (olive, sunflower and canola). The suitable areas are districts of Diamir, Gilgit & Ghizar.

At present no oilseed crops is grown in NA , but on the basic of experiments the potential of some crops has been assessed . These are accordingly ranked as below.

21. Olive
22. Kernal oil (extracted from nuts of stone fruits)
23. Sunflower
24. Soybean as an inter-crop or solo crop in orchards
25. Brassica as an inter -crop in wheat and orchards

- Oak nut production programme
- Olive
- Sunflower
- Canola
- Safflower
- Pistachio
- Pine Kernal increase and production programme

Due to cold growing season in NA the Oil content is much higher than other part of the country, due to small land holdings the farmers can not sacrifice cereal crop

**Table 47: Statement showing seed yield of sun flower varietal conducted at Daril/Tangir and Chilas sub divisions during the year 1993 (area sowing 12 sq.m)**

| Name of cultivars | Tangir | Daril | Chilas | Total | Mean (kg/12 m$^2$) | Mean Yield (kg/K) |
|---|---|---|---|---|---|---|
| Hysun-33 | 1.071 | 2.754 | 3.072 | 6.897 | 2.299 | 95.791 |
| P-6480 | 1.786 | 2.081 | 2.957 | 6.824 | 2.275 | 94.777 |
| SF-187 | 1.881 | 2.038 | 2.256 | 6.175 | 2.058 | 85.763 |
| NK-265 | 1.261 | 2.360 | 2.137 | 5.762 | 1.921 | 80.027 |
| IS-3312 | 1.810 | 1.717 | 1.957 | 5.484 | 1.560 | 76.166 |
| PARC-92 E | 1.35 | 1.395 | 1.928 | 4.680 | 1.560 | 65.000 |

Note: The per kanal income out of sunflower seed @ Rs.30/- per kg. comes to Rs; 2873.73

for these crops. The income of Oil seed crop is not more than cereal crop production which was experimentally proved. (Table 47)

### 2.7.2.6. Fodder

- Lack of winter species
- No continuity in seed supply to the farmers
- No permanent seed supply sources is available locally

## 2.8. Livestock

Northern Areas of Pakistan is blessed with a large number of livestock population (Tables 48 to 50). Livestock are the backbone of rural economy as they provide draught power, milk and milk products, meat, manure, skins, hides, eggs and poultry meat. Native livestock breeds through well adopted are poor performers. The production potential of all kinds of livestock is too low to meet the expanding demands of people. The deficiency is met through import from down country. As a part of subsistence farming every household has some kind of livestock and poultry. A comparative statement is presented in table 50.

**Table 48: Animal population of the Northern Areas**

| Name of Item | Number |
|---|---|
| Cattle | 4,80,577 |
| Buffaloes | 6,208 |
| Goats | 9,82,216 |
| Sheep | 5,24,044 |
| Camels | 141 |
| Horses | 7,903 |
| Mules | 955 |
| Donkeys | 22,406 |
| Poultry | 10,03,078 |
| Ducks etc. | 1,946 |
| Yakes | 15,098 |
| Total: | 30,44,577 |

**Table 49: Number of livestock and poultry birds by district**

| | Gilgit | Ghizar | Diamir | Skardu | Ghanche | Total |
|---|---|---|---|---|---|---|
| Cattle | 114,286 | 50,535 | 165,240 | 106,867 | 43,649 | 480,577 |
| Buffaloes | 171 | 6 | 5,579 | 440 | 12 | 6,208 |
| Goats | 288,798 | 76,907 | 384,242 | 239,430 | 92,839 | 982,216 |
| Sheep | 161,958 | 44,424 | 65,912 | 177,104 | 74,646 | 524,044 |
| Camels | 78 | 31 | 0 | 15 | 17 | 141 |
| Horses | 104 | 512 | 3,624 | 1,261 | 2,402 | 7,903 |
| Donkey | 655 | 5,699 | 13,142 | 1,970 | 940 | 22,406 |
| Yaks | 1,982 | 2,355 | 184 | 7,045 | 3,532 | 15,098 |
| Mules | 6 | 31 | 311 | 96 | 511 | 955 |
| Domestic poultry | 27,166 | 112,759 | 638,234 | 169,201 | 55,718 | 1,003,078 |
| Total | 595,204 | 293,259 | 1,276,468 | 703,429 | 274,266 | 3,642,626 |

Source: Deputy Director, Livestock, Northern Areas, Gilgit.

**Table 50: Household comparison of livestock and poultry in five districts of NA**

| Narration | Gilgit | Ghizar | Diamir | Skardu | Ghanche |
|---|---|---|---|---|---|
| Kind of small ruminants per household | 15 Goats | 10-15 Goats (local breeds) | Goats and sheep (local breeds) 15-20 | 13-14 goats and sheep | Goats and sheep 8-10 |
| Feeding practices of small ruminants | Grazing in pastureland village level feeding | Pasture grazing + house feeding wheat and maize straw | Pasture grazing + village level feeding wheat and maize straw | Pasture grazing in summer + leaves and grass in winter | Fresh grass and fodder in summer; hay, straw and grass in winter |
| Kinds of large animals/ruminants per household | Cows and bulls | Cows, bulls, donkeys | Cows, 15-20 heads | 3-5 cows, bulls and 20/Zome per household 1-2 Yak per village for breeding | Cows, bulls 90 zo/zomes |
| Feeding practices of large animals | Pasture grazing + village feeding | Pasture grazing and house feeding | Free grazing in summer; Wheat and house feeding maize straw in winter | Pasture grazing in summer + Wheat straw and dried grass during winter | Alfa alfa, grasses (fresh) in summer, hay, straw and grasses in winter |
| Common animal diseases | Foot & mouth, Black quarter, H.S. Anthrax, Enterotoxaemia, Pleura pneumonia | All except Anthrax | All except Anthrax | Same as Gilgit | Same as Gilgit except Anthrax and H.S. |
| Number of birds in the back yards | 5-10 | 10 | 7-10 | 3 | 6 |
| Feeding practices | Bread, maize and wheat | Wheat, Bread Maize | Wheat, Bread Maize | Wheat +Millet grains | Wheat, Millet & barley, Floor |
| Climatic effect | Commercial poultry possible | Harsh winter allows only seasonal poultry | Harsh winter allows only seasonal poultry | Harsh winter allows only seasonal poultry | Commercial Poultry has a chance |
| Mortality in poultry birds | 30% | 0-60% | 60% | 25% | 15-40% due to Ranikhat |

Livestock comprise native cattle, sheep and goats, with some donkeys, poultry and decreasing number of horses. At higher altitudes the hardier yak replaces cattle and is also crossed with cattle to produce a hardy hybrid. With more contact and trade with the outside, animal disease problems have increased. In most areas livestock are free grazed or stall fed in winter whilst at the village, but from April/May to late September animals are taken to high summer pastures, often quite distant from

villages. These native alpine summer pastures, which are usually on the cooler, more moist north-easterly slopes, are critical to the rural economy of the Northern Areas. However, the large number of village cattle taken to the high pastures has resulted in overgrazing, with a reduction in the diversity of flora.

Livestock number increased considerably in the past but has showed down to about 3% per year during the last decade due to a depletion of natural feed reserves.

Due to shortage of fodder and lack of proper management, the productive population of in-milk cows has decreased from 74 to 67% and the number of dry cows has gone up. Similarly, the proportion of young stock both in sheep and goat has decreased considerably.

### 2.8.1. Breed Characteristics

Local cattle are of non-descript type (small weighing 200-220 kg). Reach maturity at the age of 3-4 years depending on the level of nutrition. Yield about 300 kg milk per lactation and the intercalving period is over 24 months. Because of the limited feed availability, these cattle are valued for their small size. Low feed demand and draught ability. Female animals are maintained for milk which is consumed fresh during winter. And converted into ghee (clarified butter) and cheese in summer. The males are seldom castrated and are used for draught and breeding. Bull production exclusively for breeding is unusual. Cattle are maintained in the farm to produce manure in addition to meeting milk and meat requirements. Sales are limited because of inefficient marketing channels. Mating is undertaken on the basis of opportunity, usually during the springtime and summer grazing periods. 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.

Actual genetic potential for milk, meat and reproductive performance has not yet been established by livestock research but is estimated to be considerably above present levels under condition of improved nutrition and management. Introduction of artificial insemination can help improve the situation.

Yaks are seen in the high mountain valleys like Astore sub division . Yaks are maintained for cross breeding with cattle to produce a hybrid (ZO) which is highly prized for draught purpose. The males are sterile but the females produce more milk than cattle (400 litters per lactation with higher fat content).

Local goats are mainly dual purpose and kept for milk meat and hair. Goat is a preferred species. Average milk production is about 60 kg in a 80 day lactation period Mature body-weights vary considerably ranging from 30 to 40 kg for males and females, which may go up to 50 kg with proper feeding and management. The smallest body weight appears to occur in the single cropping zone. Neonatal mortality is high. Goat management and housing are poor. First year death rates are reported as high as 33% and are mainly due to under-nutrition and low temperatures combined with parasitic infestation and clostridial diseases. Deaths in adults are reported to be around 25% kiddings are mainly an annual event. Occur during February March and occasionally in September. Twining are reported only in 10% of kinds dropped.

#### 2.8.1.1. Sheep

Sheep have similar reproductive and meat production figures as goats and are reared for meat and coarse wool. Twining are reported in 10% of lambing in the double cropped zones. Mortality and other parameters resemble goats.

With increased awareness for village and communal land plantations there is noted preference for sheep rearing for they are considered less menacing to plantations. The average feed requirement for cattle, goat and sheep are given in table 51.

**Table 51: Estimated annual feed, nutritional requirements for ruminants and supply by farm type**

| Farm type | Average herd composition | Estimated Annual Requirement (kg) | | | Present dry matter supply | Projected dry matter supply |
|---|---|---|---|---|---|---|
| | | Dry matter (DM) | Total digestible nutriment (TDN) | Digestible dry protein (DP) | | |
| Double Crop | 2 cattle | 3,680 | 460 | 52 | 1,881 | 7,020 |
| | 2 sheep | 460 | 113 | 11.3 | | |
| | 5 goats | 1,150 | 281 | 28.2 | | |
| | Total | 5,290 | 863 | 91.5 | | |
| Single Crop | 1 cattle | 1,840 | 234 | 26 | 1,809 | 4,770 |
| | 4 sheep | 920 | 225 | 23 | | |
| | 8 goats | 1,840 | 342 | 45 | | |
| | Total | 4,600 | 801 | 94 | | |

### 2.8.2. Production System

There are four types of livestock production system, i.e., pastoralism, transhumant, sedentary and commercial.

#### 2.8.2.1. Pastoral system

The true pastoralist. Who have ownership over the livestock. According to 1986 livestock census 250 households were known to graze their sheep and goats round the year. The nomadic system is characterized by years round continuous movement of goats and sheep herds along the fixed routes in search of pastures. True pastoralists do not own any land neither do any farming activities. The movement of livestock is between alpine and sub-alpine pastures situated in the upper and lower elevation of sub-tropical rangelands., They spend about 4-5 months in the alpine pastures and rest of the period in the lower ranges in winter. The non local pastoralists have to pay to the communal landowners for grazing their animals for specific period.

#### 2.8.2.2. Transhumant system

Most of the households (80-90%) are reported to have adopted the transhumant system of animal husbandry. Farmers live at lower altitudes for about 7 months where the main house is located. In the cold winter the animals are kept in the houses in the valley where they are fed maize stover, wheat straw and hay. In the summer months the animals are taken up into the mountains to graze on the sub-alpine and finally the alpine pastures. Late April or early May part of the

households start trekking through the mountains. First they move to the edge of the conifer forests where a second house is located. Here they stay 3-4 weeks and then they move up to a third house situated in the middle of the forest staying up to 3-4 weeks, and finally they move to the alpine pastures high up in the mountains. They stay there for about 6-8 weeks before trekking back to the valley with the first snow fall in late September following the same routine. They return to the main house in the valley in October. The flock consists of a few cows, goats, sheep along with two pack and riding animals. The transhumant production system has a variant whereby the owner stays in the village. But during the summer months he hires a shepherd to send flocks at the mountain pastures. Each herdsman keeps 15-40 cattle or 100-200 goats/sheeps or a mixture of both cattle and sheep/goat.

#### 2.8.2.3. Sedentary system

In this system the animals are kept in the farm, about one third of the households are reported to stall feed part of their cattle and to graze part of their small ruminants in the gentle topography and in the field after harvesting season is over. Animals are also grazed in community lands on grasses and weeds of lands lying fallow. Maize stover and some hay and grasses collected are the main feed of the stall fed large animals. In some villages maize stovers, green grass, wheat straw are sold/exchanged among the farmers.

#### 2.8.2.4. Commercial production system

Commercial and sedentary large dairy farms are virtually non existent. There are semi-intensive poultry farms with 50-75 birds. Only a few non-farm households keep 1-5 cows in the towns to supply fresh milk to residents and tea-shops

#### 2.8.2.5. Recommendation

Just like human family planning, we should carefully work for animal family planning.

### 2.8.3. Animal Health

Animal health coverage is inadequate table 52 because of very limited availability of operational funds as well as lack of mobility of veterinary staff. Moreover, difficulties encountered in communication and seasonal movement of livestock make veterinary cover limited.

**Table 52: Animal health care units**

| Name | Total | Gilgit | Skardu | Diamir | Ghizar | Ghanche |
|---|---|---|---|---|---|---|
| Vet. hospital | 10 | 03 | 01 | 04 | 01 | 01 |
| Vet. dispensaries | 121 | 32 | 33 | 28 | 14 | 14 |
| Poultry farms | 03 | 02 | 01 | - | - | - |
| Sheep farms | 01 | - | 01 | - | - | - |
| Diagnostic lab | 01 | 01 | - | - | - | |

Rindepest, Foot and mouth Disease and Rabis are common viral diseases and among bacterial disease Haemorrhagic septicemia. Blackquarter. Anthrax are known to occur every year. Pleuropneumonia. Goat and sheep pox and

Enterotoxaemia in small ruminants are almost an annual event. Besides parasitic burden both ecto and endo. The incidence of liver flukes and intestinal worms are reported to be very high. Diseased animals are generally kept together with healthy animals causing quick spread to disease. In 1994 the Northern Areas experienced a severe outbreak of Rinderpest among the cattle and lost about 3.5000 heads of cattle. However, with vaccination programme the disease is reported to be under control in 1996.

Animal diseases in the mountains were not known in the past but with the opening of the KKH and the transport of slaughtered animals from the southern, the trend is said to be continuing.

Similarly the area was free from New Castle Disease (NCD) in poultry but with the introduction of slaughter or cull birds from the south NCD is now a major problem for poultry development.

Vaccination against the common endemic diseases are undertaken by the Department of Animal Husbandry on a limited scale in the immediate area of their facilities or conducted in response to disease outbreaks. Coverage is limited to only 10 to 15%.

De-worming and delousing drugs are generally not available except very limited supplies which barely covers 1% of the animal population. Antibiotics and other sulpha life saving drugs are in short supply but common items are now available in limited quantities through private medicine shops in towns.

Animal husbandry and extension activities in terms of improved animal feed, better housing conditions, selection, culling, grazing and range improvements are not adequately addressed.

Range management and fodder improvement should be established in PARC-KARINA for getting the attention they deserve.

The livestock within small-scale agricultural production systems be provided the support within development programs that it deserves.

### 2.8.4. Fodder Resources

Because of small landholding and availability of irrigation water, very limited area is planted for fodder crops. Livestock competes with production of cereal grains for arable land. While some farmers grow fodder, crop residues and stubble grazing remain the main stay of winter nutritional, support. Although their nutritional value and digestibility are low, trees are another source of fodder. Leaves are collected mainly for sheep and goats in April and October. In particular from poplar. Mulberry. Willow and apricot trees. The fallen leaves of deciduous trees are also available during autumn and winter. The contribution to the total nutritional requirements of livestock from this sources is limited to about 50 kg of dry matter per year.

With the exception of some farmers in the double cropping areas, who may have access to fodder produced elsewhere, most farmers do not procure additional feed

supplies. And the shortfall is made up almost entirely by summer grazing. Although many animals are poorly fed at this time (when the weather conditions are dry) and must enter the winter in poor conditions. Therefore, the nutritional shortfall is neither met seasonally nor annually.

Double cropped areas generate greater amount of winter feeding crop residues and a greater number of cattle are maintained. Single cropping farms maintain larger flock of goats and fewer cattle. Primarily because the absence of a winter crop permits a free grazing for which the smaller animals are well suited, and because the lower availability of crop residues renders maintenance of larger animals untenable. The opportunities for producing sufficient fodder on single cropping farms are limited to the residues available only from the one annual crop, and animals on this farm type are often poorly served nutritionally.

Livestock particularly lactating cows and goats are deficient in protein, energy and trace elements and vitamins. Winter feed derived from mature maize stovers and dried grass contains high fibre and low digestible energy and protein. Late harvesting of maize and grass at a stage when fibre content and quantity is highest as opposed to nutritive value has a reason. Because of the long tradition of underfeeding, the farmers know that giving the nutritious and palatable feed will increase their speed of digestion. High fibrous feed slows down digestion. Thus the animals can over winter on lesser quality of feed. An estimated 70-80% of TDN comes from stover and cereal straw and the animals are physically unable to consume sufficient to satisfy their needs. In fact the animals starve during the entire winter but manage to stay alive with coarse feed.

The present farm strategy of maximizing cash inputs limits incorporation of high quality protein supplement in the ration. Possible interventions are based on introduction of leguminous such as vetch intercropped with maize and increased areas and higher productivity from shaftal (*Trifolium resupinatum*) and Lucerne (*Medicago sativa*) within the present farming system. Other fodder interventions which are being promoted for high altitude temperate areas are *Phalaris spp*. Red clover and Prairies grass (*Bromus wriloides*).

Planting leguminous forage crops in rotation with other crops introduces a productive fallow which both feeds livestock and increases soil fertility. In arid areas a delay in planting of only a weak or two can drastically reduce final yields, so timely ploughing can be essential. With tractors being uneconomic for most small-holder farmers, draft animals are often the only viable mechanization option available to poorer farmers.

| Table 53: Annual and perennial fodder crops production potentiality in NA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Name of crops | Seed rate Kg/ha | FYM (T/ha) | Chemical fertilizers | | | | Row to row distance | Green fodder yield (T/ha) |
| | | | DAP | SOP | Urea | SSP | | |
| S.S Hybrid (Sorghum Sudan grass Hybrid) | 25-20 | 15-20 | 75 | 75 | -- | -- | 1-1.5ft. | 280 to 300 |
| Bajra | 20-25 | 15-20 | 125 | -- | 125 | -- | 1 | 50 to 60 |
| Lucerne (Local) (3 to 4 cuttings) | 8 | 10-15 in the beginning | -- | 100 | -- | 100 | 1-15 | 50 to 60 |
| Lucerne (Sunder) 7 to 9 cuttings | 8-10 | 10-15 | -- | 100 | -- | 100 | 1-or broad cast | 100-120 |
| Bersem (5-6 cuttings) | 6-8 | 5-10 | -- | 50 every cutting | 100 | 1 | 1-or broad cast | 170-200 |
| Shaftal (3-4 cuttings) | 5-8 | 5-10 | -- | -- | 200 | -- | 1-or broad cast | 100-120 |
| Oats | 70-80 | 10-15 | 150 | -- | 200 | -- | Broad cast | 120-140 |
| Ryegrass | 70-80 | 10-15 | 150 | -- | 200 | -- | Broad cast | 110-120 |
| Red Clover | 12-15 | 5-10 | -- | -- | 160 | 350 | Broad cast | 30-40 |
| Vetch | 50-60 | 5-10 | -- | -- | -- | 100 | Broad cast | 35-45 |

Fodder-livestock ratios are not up to the desired level. There is a strong need to increasing productivity per unit area of fodder either through improved cultivars or through mixed cropping as has been demonstrated through experimentation, in NA.

## 2.8.5. Livestock Research Themes

- Small ruminant animal research has received limited inputs and this perhaps is reflected in the high price of sheep and goat meat. The improvement of sheep and goats for milk and wool has not been pursued.
- Integrated research of reproductive physiology/epidemiology/management of dairy animals is warranted based on demand for milk .
- Long term studies for genetic improvement of animals should be initiated.
- Some research is needed on improving the efficacy of vaccine, durability of vaccine and immunity
- Animal nutrition and management research is badly needed
- Epidemiological and diagnostic research is also a must.

## 2.8.6. Livestock Extension

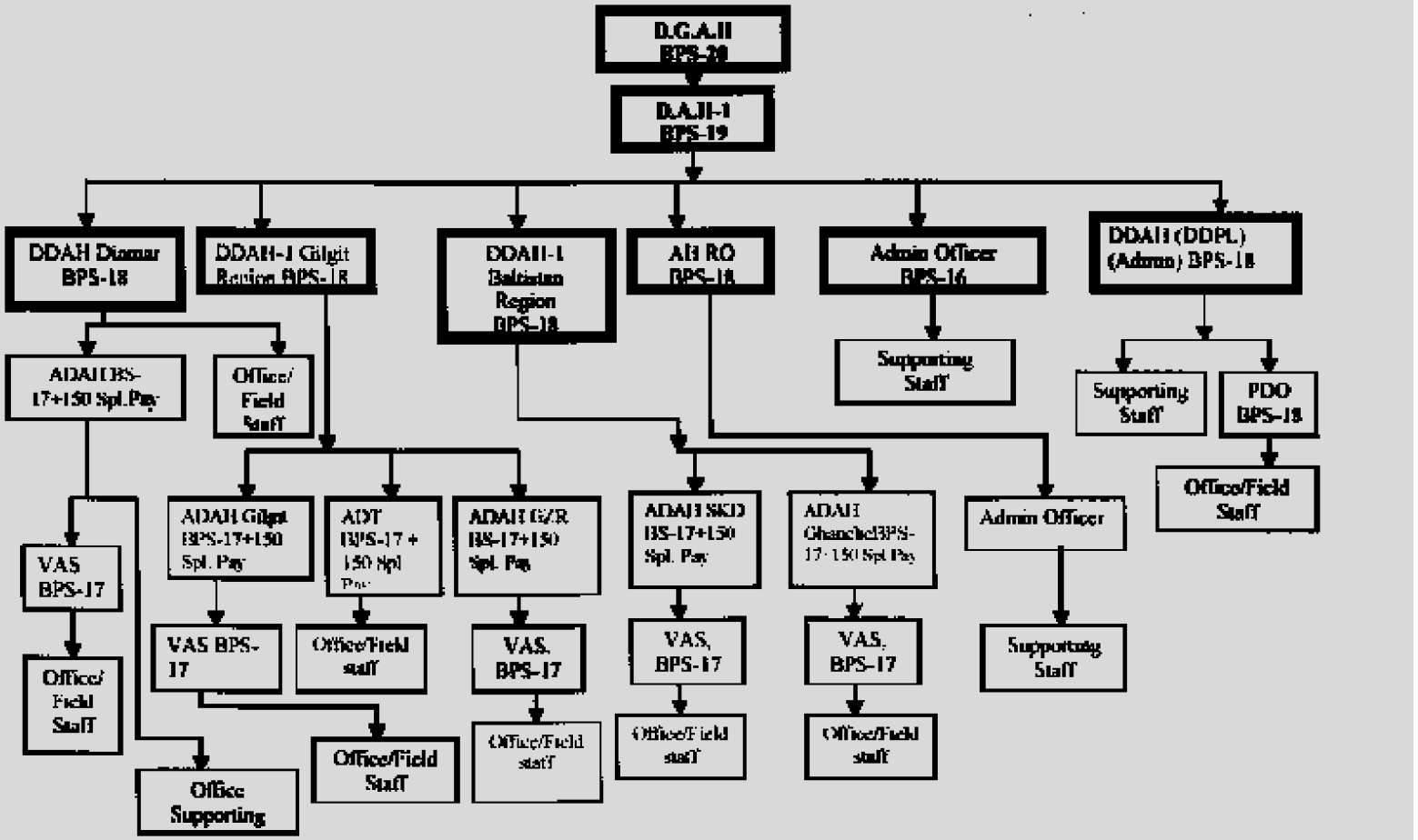
The Department of Animal Husbandry (DOAH) is the Government Institution in the area charged with the responsibility of maintaining health, stock upgrading and extension activities. DOAH is headed by a Deputy Director and is supported by one Assistant Director Poultry and one Research Officer at regional level and three

Assistant Directors at district level. At district level the Assistant Director is responsible for the implementation of all livestock related activities in the district including animal health, breeding and extension. A chart of re-organization is attached.

### 2.8.7. Areas of Immediate Attention for Improvement

- Artificial insemination
- Yak farming
- Marketing systems
- Effective utilization of rangeland, control on free grazing.
- Human resource development.
- Loan facilities to livestock and poultry farmers.
- Introduction of Livestock Insurance.
- Establishment of Quarantine stations at entry points to NA.
- Vaccine production units.
- Establishment of liquid Nitrogen gas plant.
- Community participation with gender equality.
- Extensive land utilization for fodder production.
- Semen collection unit.

## Organizational Chart of Animal Husbandry Department, NA



## 2.9. Poultry

The local poultry birds are hardy and can survive by scavenging and hence are maintained at a very low cost to the household. The average household holding is about 5 birds. True commercial broiler or large farms are non existent but about some semi-internsive with 50-75 birds are known to exist. The local birds produce about 70-80 eggs per year and live weight up to 1.3 to 1.5.kg and hens are broody type and hatch chicks. Poultry meat and eggs are in good demand and are imported from other parts of Pakistan. Backyard semi-intensive farming is becoming popular but constrained for regular supply of chicks and other inputs.

**Table 54: Per capita egg consumption in the Northern Areas**

| Human population | Total female chicken population | Average Egg production per hen per Year | Total eggs produced | Per capita egg consumption |
|---|---|---|---|---|
| 7741,881 | 270,062 | 50 | 13,500,100 | 17.4 |

### 2.9.1. Constraints

- The rate of mortality is very high due to contagious and other diseases especially New Castle Disease because of inadequate vaccination coverage.
- Lack of disease diagnostic facilities.
- Poor poultry keeping and feeding practices.
- Lack of proper training of rural women and farmers
- Non-availability of better productive birds.
- Non-availability of hatching eggs of high yielding varieties of chicken.
- Unawareness of rural population about the technical know how regarding better poultry keep
- Lack of financial resources in public and private sector for research and development
- Peculiar harsh climatic conditions during winter
- Lack of alternatives to curtail the insufficient supply of power/electricity

## 2.10. Fisheries

Northern Areas possess a large cold-water resource endowment, with a variety of habitat ranging from torrent shelly rivers to gently running streams and then from semi to complete stagnant perennial water in lakes and reservoirs. There are 121 streams that drain water in the Great Indus, besides lakes cover an area of 570 hectares. There is great potential for increase in fish production. There are eight major rivers and 121 streams over 12261 hectares besides the Sadpara Lake (48 hectares) and 33 others lakes over 522 hectares. Fisheries are dominated by capture fisheries and is mainly gyrating around artisan fishermen. No commercial exploitation, per se, is exercised. The annual fish production has been low, between 40-60 metric tons in the preceding years. Sport fisheries, popular in artificially planted trout streams, is a dominant feature of the area's fishery. The aquaculture in Northern Areas is marked by production of trout finger lings only. With a battery of as many as seven hatcheries scattered all over FANA, the fingerling are produced in very limited numbers mostly to meet the requirement of stocking in stream. The production of table fish is negligible. The internal markets are poorly developed and with no organization and remote infrastructure facilities.

| Table 55: Fish fauna of Northern Areas | |
|---|---|
| **Biological Name** | **Local Name** |
| **Indigenous Fish Species** | |
| *Schizothorax plagiostomus* | Gahi Chemo |
| *Schizothorax labiatus* | Chohan |
| *Schizothorax esocinus* | Chakhat |
| *Schizothorax skarduensis* | Khaduk |
| *Schizothorax intermedius* | Damnian |
| *Schizothorax longipinnis* | |
| *Schizothorax stoliczkai* | |
| *Pjtychobarus conirostris* | Sianian |
| *Diptychus maculates* | |
| *Diptychus pakistanicus* | |
| *Glyptostrnum reticulatum* | Konozobo |
| *Triplophysa stoliczkai* | Jungli Chemo |
| *Triplophysa gracilius* | |
| *Triplophysa yasenensis* | |
| *Tripolophysa choprai* | |
| **Exogenous Fish Species** | |
| *Salmo trutta (brown trout)* | Angrazi Chemo |
| *Salmo gairdneri (rainbow trout)* | |
| *Cyprinus carpio* (common, Chinese and Gulfam) | |
| *Ctenopharygodon idella* (Grass carp) | |
| *Aristiethys nobilis* (Silver carp) | |
| *Crassius auratus* (Gold Fish) | |

| Table 56: Fisheries potential of Northern Areas | | | | |
|---|---|---|---|---|
| **Type of water** | **No.** | **Area (Ha)** | **Dominated by Trout Fish** | **Dominated by Local Fish Species** |
| River | 08 | 11,605 | 04 | 04 |
| Streams | 121 | 570 | 27 | 94 |
| Sadpara Reservoir Skardu | 01 | 48 | 01 | -- |
| Lakes | 23 | 522 | 18 | 05 |

## 2.10.1. Administrative Set-up

The development planning and regulation of inland fishery resources is the responsibility of a Deputy Director of Fisheries (D.D.F) within the Department of Agriculture, which is a small unit with limited capabilities and resources. Most of the energies of D.D.F. are currently diverted towards sustaining augmentation of trout population in defined waters.

The development potentials for fisheries are immense and the broad goal of increasing fish productivity can be achieved through:

- Aquaculture of trout at farmer's level and this will require demonstration of technology & technology transfer. With limited opportunities for investment,

security and steady cash flows, returns to investment in trout fish production are adequate provided the assumptions with respect to labour, feed costs and the farming practices are handled with care.

- Low risk aquaculture of food fishes using culture able species other than trout, characterized by low input/output.
- Scientific management of river and reservoir/lake fisheries to optimise production per unit area basis

These objectives are versatile and therefore, need a strategic long term planning and of course it will require financial and technical assistance, local resource mobilization, provision of infrastructure facilities, human resource management, applied research and top motivation with a sacred will to uplift the sector.

The area has extensive water potential offering opportunity for development of inland fisheries and aqua-culture

Forty percent of the rivers and lakes are snow and spring water fed, and as clear water, are eminently suitable for various trout species. The remainder of the water is of glacial origin and, as a consequence of its turbidity, is only suitable for local fish species and for carp. Total fish capture in 1988 was about 145 tons, equivalent to 0.29 kg per caput per annum, with sport fishing ( Brown and Rainbow Trout) becoming increasingly important.

Clean water is ideal for trout, while the muddy-water breeds local fish species. The brown trout was introduced during 1908 which has multiplied through hatchery produced fingerlings. The details of trout hatcheries/farms/nursery and carp breeding farm is as under.

**Table 57: Fisheries in the Northern Areas**

| Particulars | Gilgit | Ghizar | Diamir | Skardu | Ghanche | Total |
|---|---|---|---|---|---|---|
| Trout Hatchery | 2 | 1 | 2 | 1 | 1 | 7 |
| Trout Farm | 1 | - | - | - | 1 | |
| Trout Nursery | - | - | - | 1 | - | 1 |
| Carp Breeding Farm | 1 | - | 2 | - | - | 3 |

**Table 58: Trout fish farmers**

| Name | Location | District | Pond area ($m^2$) | No. of fish stock | Stocking year |
|---|---|---|---|---|---|
| Karim Khan (AKRSP) | Morkhan | Gilgit | 506 | 1,000 | 1997 |
| Faridullah (KARINA) | Juglot | Gilgit | 4,047 | 6,000 | 1997-98 |
| Hasan Joo | Kachura | Skardu | 506 | 3,000 | 1997-98 |
| Haji Mushtaq | Shlang | Ghanche | 506 | 1,500 | 1997-98 |
| Haji Sadiq | Tarkati | Skardu | 126 | 700 | 1997-98 |
| Army MDS | Gamb | Skardu | 25 | 500 | 1997 |
| Army S&T | Gamb | Skardu | 25 | 200 | 1997 |
| Karim Khan | Baseen | Gilgit | 51 | 1,200 | 1999-2000 |
| Syed Yahya Shah | Goro | Gilgit | 1,012 | 6,000 | 2000 |
| Nusrat Wali | Kargah | Gilgit | 506 | 1,000 | 2000 |

Source: Department of Fisheries, Northern Areas, Gilgit.

**Table 59: Trout hacheries**

| | District | Production |
|---|---|---|
| Kargah | Gilgit | 30,000 |
| Naltar | Gilgit | Nil |
| Gahkuch (under construction) | Ghizar | Nil |
| Karbay, Gudi (under construction) | Diamir | Nil |
| Chilaly, Daril | Diamir | 5,000 |
| Hosho | Skardu | 30,000 |
| Bara | Ghanche | 20,000 |
| Trout Nursery, Mediabad | Skardu | 30,000 |

Source: Department of Fisheries, Northern Areas, Gilgit.

**Table 60: Carp hatcheries**

| | District | Production (fingerlings) |
|---|---|---|
| Basin Carp Farm | Gilgit | 50,000 |
| Rangu Carp Farm Chilas (old) | Diamir | 10,000 |
| Rangu Carp Farm Chilas (new) | Diamir | 20,000 |
| Khanbury Carp Farm | Diamir | 20,000 |

Source: Department of Fisheries, Northern Areas, Gilgit.

**Table 61: Fish hatcheries and farms**

| District | Name of trout fish hatchery established | Name of fish farm established |
|---|---|---|
| Gilgit | -Kaulot (Kargah Nallah)<br>-Naltar | -Carp Farm Khari<br>-Experimental Trout Farm Kargah |
| Skardu | -Mehdiabad (Khang)<br>-Hosho | - |
| Ghanche | -Barah | - |
| Diamir | -Bobin (Astore)<br>-Chichlay (Darel) | -Carp Breeding Farm Chilas<br>-Carp Breeding Farm Khambury |
| Ghizar | -Gahkuch | |

**Table 62: Status of development project**

| Name of scheme | Total Cost | Expenditure up to Jun 2000 | Allocation 2000-01 | Funds Released | Expenditure Jul 00-March 01 | Utilisation % against released |
|---|---|---|---|---|---|---|
| Cold Water Fish Culture in NA | 12.831 | 7.673 | 1.945 | 1.362 | 1.200 | 88 |
| Aquaculture Development in NA | 9.600 | 0.809 | 2.055 | 1.438 | 1.300 | 90 |

| Table 63: Fish farms established in private sector | | | | | |
|---|---|---|---|---|---|
| District | No. of Carp Farms | No. of Trout Farms | Total | No. of Fingerlings Stocked | |
| | | | | Carp | Trout |
| Gilgit | 22 | 07 | 29 | 11,750 | 13,950 |
| Skardu | 03 | 07 | 10 | 800 | 2,970 |
| Ghanche | - | 01 | 01 | - | 1,050 |
| Diamir | 03 | 02 | 05 | 3,000 | 1,500 |
| Ghizar | 03 | 01 | 03 | 2,000 | 200 |
| Total | 30 | 18 | 48 | 17,550 | 19,670 |

Integration between fisheries and agriculture can contribute to enhanced food security and fish production. The most direct interactions between agriculture and fisheries occur where these two sectors compete for land and water, Modern advances in information and data processing technologies have increased the capacity to analyse complex multiple resource use options and integrate large number of people into decision-making structures. New research findings have greatly enlarged the understanding about the abilities of local communities to co-ordinate common property resource use while maintaining their essential social and cultural attributes. These progresses have created favourable conditions to realize the benefits of better integration of irrigated agriculture and fisheries into the rural economic and production systems.

Recreational fisheries in inland waters, which in many cases contribute to household food supply and subsistence, are gaining increasing economic importance in NA, where they serve as valued tourist attractions.

## 2.10.2. Constraints

- Lack of institutional and individual capacities
- Lack of disease diagnostic and control facilities
- Insufficient infrastructure
- Non-availability of quality cheap feed
- Lack of effective research and extension system
- Lack of information regarding the improvement of local species
- Lack of credit facilities to private sector/farmers and tricky loaning procedures
- Lack of participation of the communities in fish farming and conservation
- Ineffectiveness and poor implementation of NA fisheries Act for proper conservation
- Lack of stable mechanisms to produce quality fingerlings for commercial and natural waters
- Lack of awareness to minimize water pollution for better management of aquatic life
- Lack of capacity of the society to adopt the fish farming on commercial scale to reduce poverty
- Lack of qualified and trained man-power in public and private sector to boost up the sector
- Lack of diagnostic survey and special case studies to explore the potential for better utilization of nature gifted huge clean water for the improvement of fish farming through better natural resource management

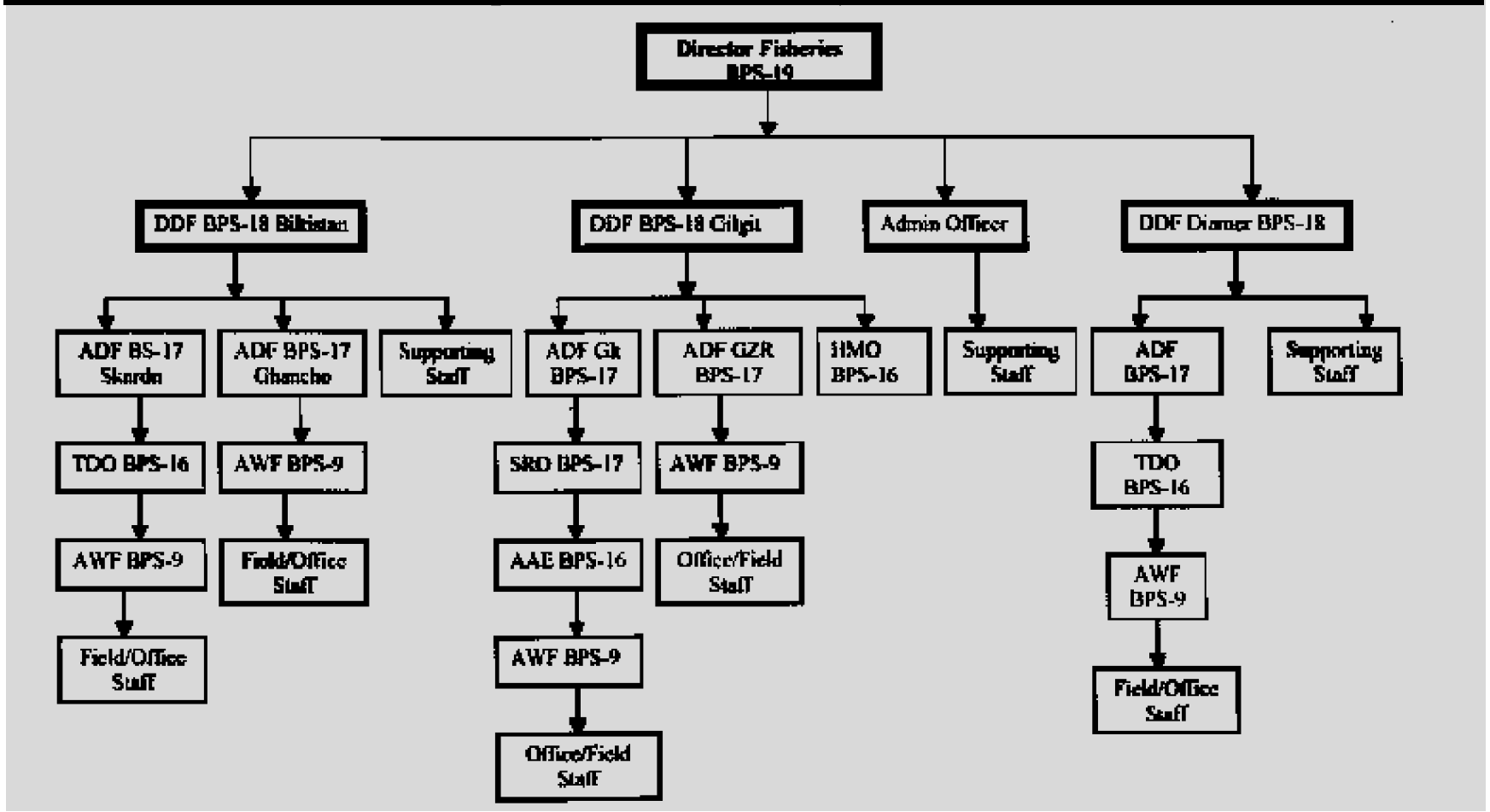
### 2.10.3. Issues to be Addressed for Promotion of Fisheries

- Disease control of fish.
- Insufficient infrastructure.
- Preparation of local fish feed.
- Mechanism for research and development.
- Improvement of local fish species.
- Provide credit facilities to private fish farmers.
- Involvement of communities in fish farming and conservation.
- Amendments and effective implementation of NAFisheries Act.
- Stable mechanism to produce quality fingerlings for commercial and natural waters.
- Taking necessary steps to minimize water pollution for better management of aquatic life.
- In fisheries trout has a great potential, which can be realized with little effort.

**Table 64: Some of the issues and recommendations**

| Issues | Recommendations |
|---|---|
| Tendency of communities for illegal fishing | The Community to be involved in sustainable management of fisheries recourses providing them share out of fishing fees. (70:30%) |
| Inadequate position of staff | The Department needs to be restructured/strengthened by providing the post of Director Fisheries and field functionaries. |
| Cases against the offenders are not decided promptly by court | Deterrent punishment needs to be awarded to the offenders of illegal fishing or magisterial powers delegated to the Fisheries Inspectors |
| Lack of trained man power/capacity | In service training facilities to be provided to the field staff |

## Organizational Chart of Fisheries Department, NA



## 2.11. Extension Services

### 2.11.1. Existing Set-up

There are Department of Agricultural (DOA) Animal Husbandry (DOAH), Forestry (DF) Fisheries, Food Department (DFI) within the Secretariat for Food. Agriculture, Livestock, Forestry and Fisheries . The DOA is responsible for the development of crops, forage, fruits and vegetables. The DOA has five Deputy Directors (DDOA) and progress co-ordinator at directorate level each responsible for DOAactivities in one district. Total DOAstaff in the NAis 538 including five DDOAs, 28 Agricultural Officers (AOs) one per sub-division. 48 Field Assistants (FAs) and about 453 support staff, mainly budder and farm labour. The DOAoperates 50 fruit nurseries (22 ha) and 8 seed farms (52.20 ha) . Fruit plant production is very low (only about 1286,047 per year for the whole of the NA) and the quality of the seedling is reported to be limited and plants are consequently difficult to sell to farmers in spite of widespread demand. Experiences in AKRSP supported areas indicate that supply of good quality fruit and forestry plants is more reliable and cost effective if interested community members are trained and supported to set up small privately management nurseries. Yields of seed production plots are very low and total seed production is completely inadequate for the rapid dissemination of new varieties to farmers. With the assistance of FAO, and DOA4 green houses, 3 screen houses and one tissue culture laboratory was established at Gilgit for the production of virus free pre base potatoes micro-tubers and these facilities are still operational. Production is at a level of about 3 t of pre-base tubers which then are further multiplied by private seed companies under contractual arrangement with farmers in the higher disease free altitude.

Agricultural Officers and FAs are located in sub-division centres and nurseries respectively and have been assigned major job responsibility for supervision of nurseries and seed farmers. Extension activities are, generally, limited to some training in budding and grafting techniques for farmers. Under present set up 50 Field Assistants in the NA are supposed to provide service to some 126000 households (about 2860 farmers per FA) with difficult accessibility. In such situation the traditional system of extension methodologies are not able to bring about any appreciable changes in the production processes of the farmers. Extension through community organizations, each including some 30 to 60 households can be recommended with each Community Organization (CO nominating a Community Extension Worker (CEW) who will be trained to assist the FA in passing message to the community. Under such a system each FA will be able to support some 30 COs.

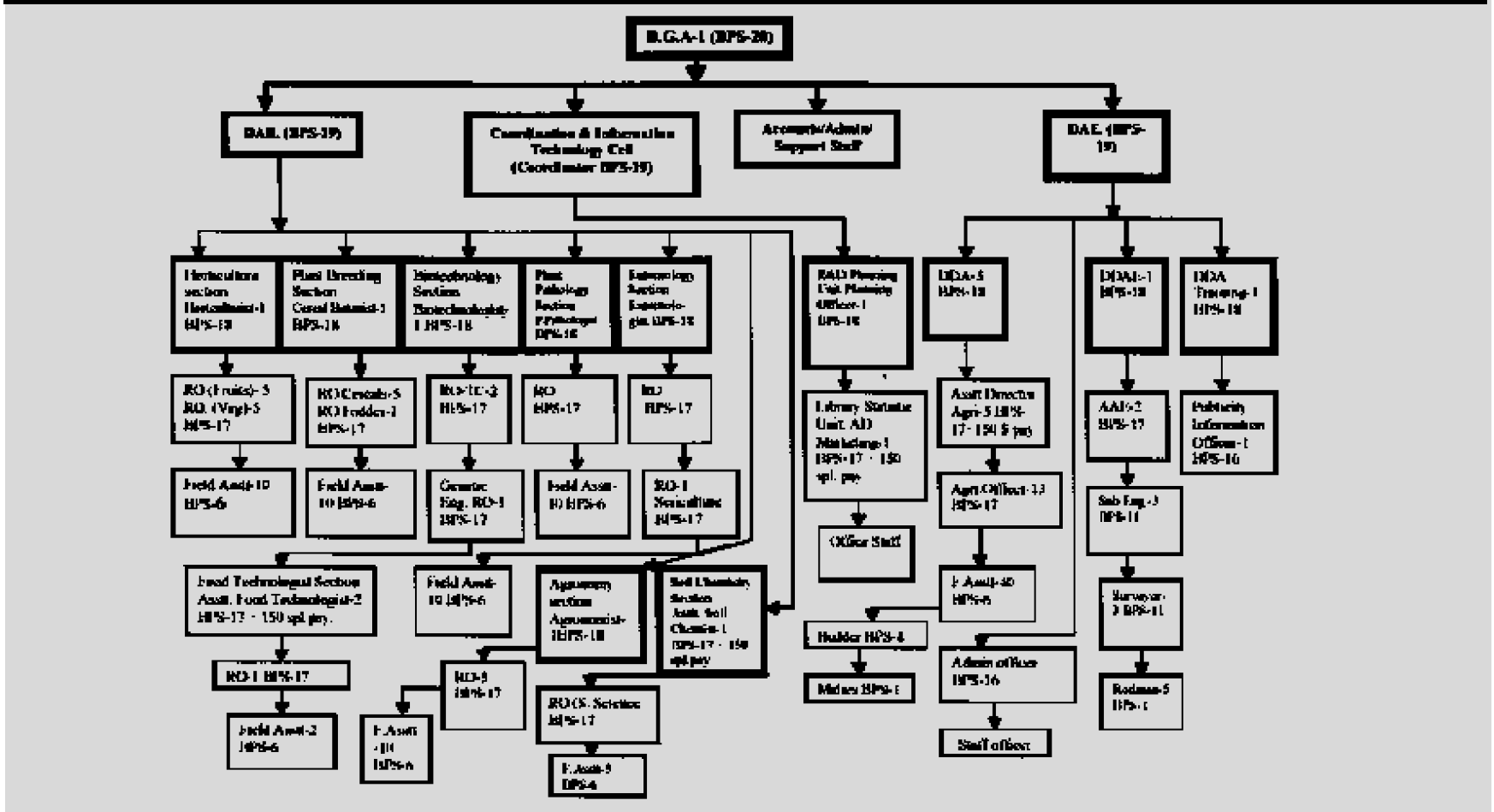
Appropriate extension materials is not available. There are no pamphlets, audio-visual means or extension notes available on recommended varieties, cultural practices, insect and diseases. There are no training facilities and programmes for pre-service and training for departmental staff in the NA

### 2.11.2. Constraints

The existing extension service is deficient in the following respectives:

- No effective liaison between research and extension, as the research is virtually non-existent.
- Multifarious duties assigned to extension agents
- Lack of extensive and regular field demonstration programme.

## Organizational Chart of Agriculture Department, NA



- Too vast operational area and high scatter of farmers to give satisfactory coverage
- Casual, sometime even unorganised and ineffective visits to the farmers
- Lack of effective organizational structure and proper programming.
- Non-existent to insufficient pre- service and in-service training facilities
- No specific evaluation of work
- Unsatisfactory terms and conditions of service, concerning salaries, housing and mobility.
- Lack of interaction between researcher-extension agent and farmers
- Improper duty assignments with out looking to the expertise (no right man for right job)
- Lack of integrated approaches and linkages for coordination among key stakeholders
- Influx of uncertified/diseased planting material in NA.

### 2.11.3. Recommendations

- Development of better links between farmers and extension workers and between both of these and research; and increased effectiveness of the extension workers. By increasing the existing strength of staff.
- The essence of the system in that it should be sufficiently flexible to be used effectively in any type of farming, under any condition. The aim is to improve the use of existing research, concentrating initially key improvements in major crops. In some areas, where farming practices are already efficient and appropriate, this is meant giving farmers technical advice on more productive crops or more appropriate types of fertilizer or seed. In others, advice on better farming methods. When to sow, how to weed-can produce dramatically better yields fairly and quickly without much investment being made by the farmers. Quick and successful results are an important way of demonstration the use of materials and in persuading more farmers to adopt it.
- Providing farmers with relevant, clear and sensible advice, by selecting three to four carefully chosen recommendations fortnightly.
- Extension should be re-organised as shown in the organizational chart.

## 2.12. Eco-tourism

Eco-tourism involves a broad range of interest groups, from local communities and indigenous people to global corporations, national governments and development agencies. Urgency about Eco-tourism has arisen due to:

- degradation of the environment
- damage to local communities and
- emergence of the feeling that existence of a wilderness area does not automatically mean that an eco-tourism initiatives will be successful.

International Tourism Society has defined Eco-tourism as, "responsible travel to natural areas that conserve the environment and sustain the well being of local people. "

The word responsible implies that all tourism should maintain or enhance biological and cultural diversity, use resources in a sustainable way and reduce over consumption and waste, at a number of different levels. Certificates be issued to only those agencies who conduct tourists according to a minimum level of

standard. Lack of regulation in NA has led the Eco-tourism being used as a profitable marketing label for adventure holidays.

The United Nations has declared the year 2002 as International Year of Eco-tourism.. The World Eco-tourism Summit was recently held in Quebec, Canada from 19-22 May, 2002.

The summit emphasized:
- better under standing of impact of Eco-tourism
- improving planning, management, marketing and regulation of Eco-tourism, and
- ensuring equitable distribution of benefits to all stakeholders.

Earlier the Arctic Eco-tourism Conference was held from 25-28 April 2002, at Hemavan, Sweden to address arctic Eco-tourism in the context of conservation, communities, certification, and marketing. The elements of certification, better regulation and appropriate involvement of local communities can make the Eco-tourism as responsible tourism.

From the preceding it emerges that all tourism must be planned, managed and undertaken in a way that avoids damage to bio diversity, and is environmentally sustainable, economically viable and socially equitable.

Since, in NA the communities have control over natural resources, community based Eco-tourism enterprises can flourish if properly supported. People can get equitable share of benefits.

It is recommended that a copy of the proceeding of World Eco-tourism Summit be obtained and various regulations be adopted in the NA.

## 2.13. Agro-Forestry

Human and animal population increases led to degradation of the natural environment around the villages with loss of trees, shrubs, and herbs. Villagers have responded by development of agro forestry as an alternative resource, so that most farmers at all altitudes now have some tree plantings, often both fruit and nut trees (apricots, peaches, apples, mulberries, grape vines and almonds) as well as timber and firewood species, dominated by poplar.

Trees such as Pinus wallichiana, spruce (Picea simitiana) birch (Betula utilis), West Himalaya fir (Abies pindro), deodar cedar (Cedrus deodara) and pencil cedar (Juniperus macropodia) grow in higher regions without irrigation, and these have been traditionally used by villagers and recently exploited commercially. However, for sustainable regeneration an 80-to-120 year rotation is required.

Various attempts to popularise agro - forestry have led to ranking the various plants as under.
1. Mulberry
2. Walnut
3. Russian olive
4. Poplar

5. Robinia
6. Alianthus
7. Willows

## 2.14. Integrated Pest Management and Plant Quarantine

There is "The Pakistan plant Quarantine Act, 1970" which tries to ensure phytosanitary standards, but it has not been implemented in letter and spirit in Pakistan in general and in NA in particular. The NA appear to be an open site for all sorts of pests and diseases that enter various cities, towns and even villages with the movement of commodities, goods, vehicles, tourists, etc. A short visit to two orchards in Skardu revealed several lapses in the sanitation, proper diagnosis, scarcity of knowledge and paucity of trained manpower to deal effectively with them. It is primarily the staff of Directorate of Agriculture that attempts to help the farming community, but limitations of funds, materials and mobility reduces their impact due to multifarious duties. Almost 30-40 % of fruit is lost, which can be easily saved. The situation appears to be equal if not worse in vegetables and other commodities. There is no pest scouting, even appropriate doses of recommended insecticides are not known to the field workers. Research activities in plant protection that will benefit the farmers are:

- Surveys and surveillance systems to determine the key pests in the different districts and agro-zones and to quantify their effects on reducing yield.
- Assessing crop losses caused by pests and researching the intensity yield loss relationship for individual pests.
- Determining the population dynamics or epidemiology of pests as influenced by the environment in different localities
- Basic research on the effect of weather variables like temperature and dew on events in the life cycles of pests
- Predictive systems for pest development and crop loss
- Determination of economic injury and crop loss
- Research on host parasite relationships and populations genetics related to parasite virulence and host resistance. This includes identification of the major pathotypes or races, major genes/ mechanisms of host resistance and methods for effective screening and transfer of resistance. Almost without exception, patho systems have not been clearly defined for the major crops.
- Research on integrated pest management (IPM). The optimisation of pest control using sound economic, ecological and social criteria, is very much needed.

## 2.15. Human Food and Nutrition

Growing grain or grass and then feeding it to animals is an inefficient use of land, for animals are inefficient at converting plant energy into human food. At present in Pakistan, where meat forms a very small proportion of the diet of most people, the total plant energy consumed (actual plant food eaten, plus seed, plus animal feed) is about 3,000 calories a day. By contrast, North Americans, Australians, New Zealanders and the Europeans consume an average of 15,000 calories a day, thanks largely to the amount of meat in their diet. The world's average is some 6,000 calories day. (Omar, 2001).

### 2.15.1. Food Balance

The total cereal production in the NA amounts to some 74563 (Table 65) The estimated total production is based on average yield per ha of crops, derived from government statistics. The total amount of cereals available for consumption comes to about 157000 t. the balance will account for (-82457 t), and storage losses (5%).

In line with the recommended desirable dietary patterns, the total cereal requirement will come to an estimated 160728 tons for the NA. Table presents the consumption of major food crops against total output of the NA . Table indicates that the NA suffers from shortage of all basic foodstuffs.

**Table 65: Consumption and availability of major food groups**

| Food Groups | Intake b/ (person/gm/daily) | Total intake (t) | Available from the area (t) | Balance (tonnes) |
|---|---|---|---|---|
| Cereals | 450 | 157,000 | 74,563 | (-) 82,457 |
| Vegetables | 150 | 54,750 | 44,940 | (+) 9,810 |

## 2.16. Gender Integration

Participation of women in almost all on-farm activities except land preparation is common in the area even though their presence is not very visible. As family labour, women actively participate in manuring, weeding, thinning, harvesting, picking of cobs and vegetables and transportation of harvests. A gender activity profile established by the RRA team in Diamir district reveals that except for land preparation, sowing of maize and transport of grains which are carried out by men, all other crop and livestock production activities are either carried out by both males and female (maintenance of terraces, land levelling, harvesting and threshing of wheat and maize and tending animals in summer pasture), or exclusively by women (all other crop and livestock production activities).

Women provide over 50 percent of the total labour used in farm activities. They are frequently responsible for collection of firewood for cooking and heating as well as collecting fodder and water for livestock and for supplies, and spinning wool. Women's only income-generating asset is their labour. Women have no access to official credit. In Gilgit women have small sums of money, but in Baltistan, women rarely handle money.

Women's status and living standards are below the national average. Several factors help to explain the low social indicators for women. One is their heavy work burden. Another is the lack of apparent government interest in social services. A third reason is the economic, cultural, and religious factors operating at the village and family level that further limit women's access to the few services that are available. In addition, women's lack of freedom to move outside the village and the fact that there are only male interlocutors mean that women have little or no access to health facilities (except on an emergency basis) or to family planning, agricultural extension, technical training, or markets for their products.

### 2.16.1. Gender Disparity

Pakistani women do not have access to resources, which are essential for undertaking any economic activity. The institutional credit and marketing facilities generally are not within their reach. Lack of assets ownership has been the main hurdle in the way of their getting credit from banks and financial institutions for entering any income generating activity.

Secondly, banks on their part also are reluctant to finance micro-businesses of women because of the high administrative costs involved in processing and handling small loans. Above all biased attitude and thinking that women entrepreneur lack business acumen and even basic know-how and would not be able to run their business effectively also impedes the reach of institutional credit to women entrepreneurs that need it badly. Until recently there were no market outlets and marketing facilities provided by the government specially to women, but now some NGO's, Banks (First Women Bank) and Export Promotion Bureau have set up product display centres to enable business women to explore markets for their products (Khatoon, 2001) Gender disparity means giving different treatment to individuals on the basis of their gender. In the UNDP report following figures have appeared with respect to gender disparity in Pakistan.

| | | |
|---|---|---|
| Adult literacy rate | Female = 28.9% | Male = 58% |
| Combined primary, secondary and tertiary gross enrolment | Female = 28.0% | Male = 56% |
| Women representation in parliament | 2% | |
| Women representation in labour force (formal + informal sector) | 34% | |
| Female representation in Govt. senior positions | 9.0% | |
| Female professionals and technical workers | 25.1% of total | |

#### 2.16.1.1. Role of women in food security

- They have to ensure provision of meals to all family members.
- Livestock provides food security to a family while women have a vital role in livestock handling.
- Women can also grow vegetables in their kitchen gardens.
- Women should be involved in food industry and be given more employment opportunities.
- In Northern Areas farmers should be exempt from agricultural income tax.

## 2.17. Micro-credit

Considerable work has been done at governmental and NGO level to enhance accessibility of easy and cheap institutional credit to women. Since women lack in assets ownership, there was the need for a specialised financial institution which could cater to credit needs of micro business owners without asking for conventional tangible collaterals First step in this regard was the establishment of First Women Bank which from its very inception has been launching micro-credit schemes for women from low income groups both in urban and rural sectors. Apart from disbursing credit, for developing and updating entrepreneurial skills among

women, the bank conducts entrepreneurial skill development training programmes all over the country. How did the NAbenefit from it is not known?

Agriculture Development Bank has also come forward to finance micro businesses of women and for that they have set up special windows in their designated branches to look into credit needs of women. Some major NGOs like Orangi Pilot Project and Aga Khan Rural Support Programme apart from doing community development work in the areas of education, health and population planning have major focus on economic empowerment of women. They have their own credit disbursement programmes.

The establishment of the Khushhali Bank is a major break through in this regard as it is exclusively meant for financing micro businesses through loans of very small magnitude secured against communal guarantee only. Apart from above notable NGOs, a large number of NGOs are doing good work in other provinces, these are National Rural Support Programme and Sarhad Rural Support Programme that are associated in credit disbursement programmes of Nationalised Commercial Banks as self-help groups and facilitators. Similar arrangements could be made/initiated in NA. The banks in order to cut down the transaction cost of micro loans and for making credit available at the doorstep of small borrowers induct such NGOs as an intermediary between bank and clusters of communities. These steps on the part of financial institutions, related government departments and of course motivational role of NGOs have enabled the women to go into business and contribute towards growth of the economy. The economic empowerment thus created has given women self-confidence and a sense of achievement.

The country now being signatory to CEDAW (Convention on the elimination of Discrimination against Women) is gradually taking all affirmative steps to eliminate gender disparity and to enhance women's participation in all walks of life. Things are likely to change in NA, as well.

### 2.17.1. Agricultural Development Bank of Pakistan (ADBP) in NA

Agricultural Development Bank of Pakistan has been playing a very significant role in the development of agriculture and socio-economic conditions of rural poor and neglected farming community of Northern Areas since 1970 . It has a set up of 5 branches , at Gilgit, Aliabad , Gahkuch, Chilas and Skardu, 4 field offices at Astore, Gupis, Gojal and Khaplu besides 24 Mobile Credit officers. In the mean time ADBP provides loans in 220 Loanable schemes on off as well as on farm activities. It provides loans on short, medium and long term bases, with 14% and 16% mark up.

Apart from the above ADBP has also taken up the responsibility and introduced micro credit scheme under poverty alleviation programme for landless skilled female and male of the area. So far bank has been able to disburse an amount of Rs.160.000 million under micro credit scheme, which certainly provided tremendous self employment opportunities to both the rural and urban population.

Presently, ADBP has been allocated Rs.250.000 million for disbursement in Northern Areas during the FY 2001-2002, for development of agriculture sector as well as poverty alleviation. Further details are presented in tables.

| Table 66: Tractors financed by ADBP | | |
|---|---|---|
| **Years** | **Number of Tractors** | **Amount Disbursed (million Rs.)** |
| FY' 1986 | 101 | 9.932 |
| FY' 1987 | 35 | 4.092 |
| FY, 1988 | 89 | 11.685 |
| FY, 1989 | 83 | 11.668 |
| FY' 1990 | 56 | 8.971 |
| FY, 1991 | 19 | 3.758 |
| FY, 1992 | 9 | 1.638 |
| FY' 1993 | 27 | 5.578 |
| FY' 1994 | 9 | 1.719 |
| FY, 1995 | 3 | 0.681 |
| FY, 1996 | 48 | 6.395 |
| FY, 1997 | 6 | 1.702 |
| FY' 1998 | 0 | 0.000 |
| FY' 1999 | 33 | 7.730 |
| FY' 2000 | 7 | 1.625 |

| Table 67: Agricultural credit disbursement by major purposes (Rupees in million) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Purposes** | **1999-00** | **1998-99** | **1997-98** | **1996-97** | **1995-96** | **1994-95** | **1993-94** | **1992-93** |
| Development loans | 111.288 | 154.872 | 134.968 | 58.365 | 43.965 | 102.382 | 64.184 | 59.180 |
| Tractors | 9.628 | 7.730 | 0.000 | 0.702 | 6.395 | 0.681 | 1.720 | 5.578 |
| Farm equipment | 3.171 | 5.760 | 11.926 | 0.426 | 0.208 | 0.576 | 0.631 | 1.506 |
| Dairy farming | 28.656 | 35.090 | 28.039 | 22.965 | 16.078 | 42.414 | 21.884 | 14.003 |
| Livestock | 19.369 | 24.118 | 19.168 | 8.933 | 6.585 | 14.412 | 9.897 | 11.450 |
| Tubewells | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Orchards | 11.616 | 15.108 | 9.090 | 4.306 | 0.804 | 8.830 | 7.156 | 6.318 |
| Poultry farming | 0.474 | 1.858 | 1.418 | 1.439 | 0.750 | 2.398 | 0.426 | 0.714 |
| Land development | 0.038 | 0.407 | 0.373 | 0.444 | 0.771 | 2.110 | 0.221 | 0.270 |
| Farm Transportation | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.316 |
| Fisheries | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Draught animal | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Others | 46.331 | 64.801 | 64.954 | 19.150 | 12.374 | 30.961 | 22.249 | 18.005 |
| Production loans | 1.463 | 2.866 | 4.126 | 2.599 | 1.564 | 5.253 | 3.311 | 2.435 |
| Fertilizers | 0.093 | 0.336 | 0.405 | 0.318 | 0.019 | 0.571 | 0.368 | 0.138 |
| Pesticides | 0.007 | 0.033 | 0.046 | 0.001 | 0.001 | 0.006 | 0.001 | 0.000 |
| Seeds | 0.125 | 0.563 | 0.318 | 0.263 | 0.017 | 0.513 | 0.151 | 0.203 |
| Working capital for poultry farming | 0.536 | 0.719 | 0.887 | 0.819 | 0.471 | 0.929 | 0.483 | 0.095 |
| Working capital for dairy farming | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Working capital for livestock | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Working capital for fisheries | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Others | 0.702 | 1.215 | 2.470 | 1.198 | 1.056 | 3.234 | 2.308 | 1.999 |
| Total | 112.751 | 157.738 | 139.094 | 60.964 | 45.529 | 107.635 | 67.495 | 61.595 |

| Table 68: Total credit disbursed & farmers served | | | |
|---|---|---|---|
| Years | During the year | Since inception up to 30th June | |
| | Farmers served (No.) | Farmers served (No.) | Disbursement (Rs. In million) |
| FY 1986 | 1,372 | 5,549 | 91.500 |
| FY 1987 | 1,310 | 6,859 | 127.289 |
| FY 1988 | 1,587 | 8,446 | 178.528 |
| FY 1989 | 1,615 | 10,061 | 238.110 |
| FY 1990 | 1,175 | 11,236 | 284.521 |
| FY 1991 | 1,415 | 12,651 | 332.566 |
| FY1992 | 1,104 | 13,755 | 369.875 |
| FY 1993 | 1,718 | 15,453 | 431.470 |
| FY 1994 | 2,797 | 18,270 | 498.965 |
| FY 1995 | 2,868 | 21,138 | 606.600 |
| FY1996 | 1,036 | 22,174 | 652.129 |
| FY 1997 | 1,511 | 23,685 | 713.093 |
| FY 1998 | 3,231 | 26,916 | 852.9187 |
| FY 1999 | 3,421 | 30,337 | 1,009.925 |
| FY 2000 | 2,521 | 32,858 | 1,122.676 |
| FY 2001 | 3,274 | 36,132 | 1,256.565 |

- The existing levels of loans for the development of uncultivated land are insufficient to meet the expenses even for one kanal. Thus it is suggested that at least Rs. 100000/= be fixed for NA farmers community. NA has a great potential for food, fruits and other high value cash crops, medicinal plants, etc. But the farmers are very poor to adopt new options and technologies due to lack of financial resources. Thus majority of the farmers are reluctant to obtain the loans due to high interest rate.
- Keeping in view the backwardness, remoteness and potential of the area special concession in the interest rate may be granted to the progressive farmers of the NAfor prosperity of the nation.
- The existing credit ceiling for establishment of fish farms, etc is Rs. 50000/- per acre, while the land holdings in NA are only 1-2 kanals, which does not make the most people eligible for grant of loan. The amount of loan does not fulfil the requirement for the establishment of fish farm. Thus it is suggested that Rs.40000/- per kanal may be fixed for granting loan.
- Strong linkages are needed between key stakeholders, registered progressive farmers, association for utilization of credit facility for commercial farming.
- There is a strong need for strengthening existing capacity of the bank by inducting agricultural graduates as MCOs, etc.

## 2.18. Post Harvesting, Storage and Marketing

Marketing of fruits and vegetable is highly inefficient. Small volumes are sold to itinerant dealers, assemblers and retailers through personal contacts and negotiations, evidently at low prices, in the absence of proper marketing system. The aggregated volumes are transported to down country markets notably Islamabad, Gujranwala, Lahore, Faisalabad and Swat. The distantly located

wholesale markets combined with high transportation charges, weak liquidity position of small farmers and lack of business contacts in down-country markets tend to impede efficient disposal of produce. The potato especially seed-potato marketing is relatively better. Private seed companies and individual traders are quite active. They often get into contractual arrangements with the farmers. The Aga Khan Rural Support Programme (AKRSP) has organized special interest groups. These groups have helped in improving competition and producers bargaining power vis-à-vis traders.

**Table 69: Crop harvest calendar in NA**

| Fruit/Vegetable | Harvest Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | F | M | A | M | J | J | A | S | O | N | D |
| Apple | | | | | | | | | | | | |
| Apricot | | | | | | | | | | | | |
| Almond | | | | | | | | | | | | |
| Cherry | | | | | | | | | | | | |
| Grape | | | | | | | | | | | | |
| Peach | | | | | | | | | | | | |
| Plum | | | | | | | | | | | | |
| Carrot | | | | | | | | | | | | |
| Cabbage | | | | | | | | | | | | |
| Chinese cabbage | | | | | | | | | | | | |
| Capsicum | | | | | | | | | | | | |
| Cucurbits | | | | | | | | | | | | |
| Egg Plant | | | | | | | | | | | | |
| Okra | | | | | | | | | | | | |
| Peas | | | | | | | | | | | | |
| Potato | | | | | | | | | | | | |
| Radish | | | | | | | | | | | | |
| Spinach | | | | | | | | | | | | |
| Sonchal | | | | | | | | | | | | |
| Tomato | | | | | | | | | | | | |

It is apparent from the above that production of fruits and vegetables in the Northern Areas is Concentrated in August – October. The surplus production unless moved out of the production area tends to depress prices to the disadvantage of small farmers.

The Northern Areas being deficit in basic food and consumer goods, these have to be brought in from down country. The predominant form of transport is by road along the KKH. Local distribution is mostly by private traders working from the larger towns, such as Gilgit or Skardu. At village level, local shops are few in number but provide a wide range of basic supplies ranging from textiles to sugar and salt. Trucks often return to down country empty and are prepared to offer

heavy discounts on freight charges. This combined with favourable agro-climatic conditions, has led to a significant export in late maturing varieties of fruit and vegetables. This trade is dominated by traders from Rawalpindi Islamabad who buy products "on- the-ground". They then organize their own harvesting, packing and transport. The main centres for sale are Rawalpindi/Islamabad. Some of the high value fruit such as cherries are transported air at as far as Karachi, but again this is mainly done by outside traders.

In some areas a number of seed companies from Pakistan have contract growers. There are usually in more remote/isolated areas, where risk of contamination and cross-pollination is limited.

Marketing Information Services may be strengthened through the establishment of Marketing Information unit within the Department of Agriculture NA. A whole sale market may be established at least one each in Gilgit and Skardu for easy approach and disposal of farm products.

### 2.18.1. Researchable Themes in Marketing

- Production economics and marketing research in almost all the crop and livestock commodities is needed.
- Fruit and vegetable research should be expanded to increase supply for improved diets and as potential export crops.

## 2.19. Agricultural Research

Research initiatives in Pakistan as a matter of policy, have been driven towards development of technologies which will results in higher production per unit if cropped area. However, this may hold good for certain areas, but not for all parts of the country where the formers have different priorities and options, for example, in areas where crop agriculture, livestock, rangelands and forests are interdependent for sustainable land-based resources utilization: here, farmers will require technologies which will meet their household food security, including cereals and fodders. Scientists in Pakistan have successfully developed high grain yielding improved varieties of cereals which instead of improving the sustainability of the farming systems, have reduced the fodder and roughage availability through introduction of dwarf semi-dwarf varieties in livestock dependent areas. Essentially, it will appear that research initiatives are primarily not focused on location-specific, farmer-need related technologies.

The Karakoram Agricultural Research Institute for the Northern Areas (KARINA) is part of the Pakistan Agricultural Research Council (PARC) and is the only research in NA. KARINA was established in 1984 . It is located in Juglot near Gilgit and has three substation in Chilas, Astore and Skardu, KARINA occupies new buildings and is expected to be fully operational after the equipment of the laboratories . It has a staff of 13 researchers working in the fields of agronomy, fodder crops, cereals, pulses, vegetable varieties imported from other parts of Pakistan or from other countries with similar ecological conditions and has released some suitable varieties of wheat (KARINA-87, KARINA-92) and maize (Composite-15) It is dealing mainly with on-station research and is expected to start on-farm adaptive research to investigate major

constraints identified by the rural population such as fertilizer dosage and application, plant protection, etc.

- The Existing Agriculture Extension Department Northern Areas should be re-organized according to the Organizational set up in other provinces.
- A Research and Development Institution may be established on NA level for proper investigation/research and development in various fields of Agriculture.
- An Out-Research/On-Farm Demonstration unit within the Department of Agricultural Research may be established for confirmation of the results obtained on experiment station on the fields of representative farmers under their prevailing circumstances. A sub-office of Agriculture Census Department should be established in Gilgit for carrying out necessary activities of Agricultural statistics in NA.
- A Coordination and Information Technology Cell may be made operational at Gilgit for Coordination among the scientists of KARINA. Agricultural Extension, Agricultural Research, farmers, down country Research Institutes/Organizations, NGOs etc who are involved in Agriculture Development.
- A well-equipped Training Centre should be established at Gilgit in NA. level to impart training to lower field staff and farmers in modern techniques of agriculture for over all development of agriculture.
- Capacity Building facilities may be made available in down country National Training Institutes or abroad for training of Subject Matter Specialists in their relevant subjects of specialization.

### 2.19.1. Linkages

Linkages between research, extension and education are usually talked about. In NA it is extension and farmers linkages, which are weak due to wide scatter and limited manpower. Even whatever manpower is available cannot cope with the highly complex nature of problems. The research and education systems for NA is virtually non-existent. However several international, national and NGOS operate which can be brought on one table to coordinate and collaborate. This will help avoid wastage of resources and duplication of efforts. Every organization working in the NAmust be mandated and a coordinated approach be developed by ranking the various issues according to prevalence, frequency, severity and probability of successful solution. Keeping in view the resources, capability and capacity of each organization, tasks should be assigned. An impartial committee may monitor and evaluate performance of each partner. Thus each organization, whether public, private or NGO will have a shared programs, independent implementation style and reporting as its primary responsibilities.

A careful organizational management needs to be developed in creating the conditions for effective linkage with other related organization A joint outreach Research Collaboration program be developed and executed providing the details of work plan, job description for personnel involved in the agricultural development and extension project command area.

For immediate improvement of the existing research system a memorandum of understanding (MOU) between NA and PARC/NARC and other institutions like NIAB, NIBGE Faisalabad be signed and executed.

For the present situation, the roles of extensionists and researchers are beginning to change. Each organization whether it is a research or extension has to develop its own roles and responsibilities to link with other organization to fulfil the common goal for serving the farmers and clients (Zuidema, 1989).

## 2.20. Conservation Strategy

History of crop improvement show that breeders are usually on look for gene pool in the wild plants that confers advantages such as:

- Pest, disease and drought resistance
- High yield, early maturing, less lodging varieties
- High vigour, environmental adaptation and stress tolerance
- High nutrition value, easy to harvest, minimum post harvest losses like shredding,
- Long shelf life or storage life

The use of such gene pools and their supply resources is expected to continue and is likely to increase as there is need to cope to with new ecological adversities/conditions (e.g. reduce ( water availability alkalinity, salinity ) water logging , etc new virulent diseases , more tedious pests, fluctuations in climate and changing economic demands. NA are blessed with a variety of wild plants, variety of whose relatives have been domesticated as crops.

These wild plants and their closely related domesticated races occur at different attitudes and have stood the test of harsh environment through centuries. The wild and domesticated plants together provide a wealth of information about patterns of genetic and pheno typic diversity so dear to biodiversity and conservation strategy. There exists a vast literature on genetic diversity, gene flow in domesticated and wild relatives and in- heritance of domestication syndrome. The new molecular analytical techniques such as molecular markers, DNA sequencing etc when combined with phenotypic and ecological data give birth to huge reservoir of genetic resources. Which should be conserved for future generations. Lists of land races of different crops, fruits and vegetable are provided below in tabulated form to indicate the wide spectrum of genetic resources available in the NAwhich call for a concerted effort to conserve these for food security, environmental safety, biodiversity, genetic richness and availability of options for human safety, the species kinds, varieties that are domesticated in NA are listed in different commodities and male categories. Conservation implies preservation or prevention of losses/Waste. To achieve this we have to devise and adapt different ways and means.

| Table 70: Land races of wheat being grown in Northern Areas | | |
|---|---|---|
| **Land Races** | **Characteristics** | **Origin** |
| Halter | Grain medium and light coloured, high yield, early | Halter |
| Hamochali | Grain small and light coloured, medium yield, a week late maturity | Hamochal in Sher Qila |
| Jutil | Grain small and light coloured, low yield, a week late maturity | Jutil near Naltar |
| Mulau | | Bagrote |
| Samato | After the name of a person from Bagrote | Bagrote |
| Safadak | Grain medium and whitish coloured, low yield, late maturity | |
| Sharoti | Grain medium, yield medium, early maturity | Shrote |
| Bashgalian | Light red colour, high yield, high straw yield | |
| Teef goom | White grain, high yield, low straw yield | |

| Table 71: Land races of barley being grown in Northern Areas | | |
|---|---|---|
| **Land races** | **Characteristics** | **Origin** |
| Dugolo/Neelo You | Tall, dark green, no disease attack, grain size medium, high yield | |
| Ishperoseri/ shayo yuo | Tall, white, high yield, early maturity, grain size medium | |

| Table 72: Land races of maize being grown in Northern Areas | | |
|---|---|---|
| **Land races** | **Characteristics** | **Origin** |
| Khanie makie | Grain white, stalk medium, early maturity, low yielding (40 maunds/ha) | Not known |
| Shaie makie | Shaie means white, stalk tall, maturity late, high yielding (56 maunds/ha) | Not known |
| Kachar makie | Kachar means crossed, stalk tall, late, colour red and white, yield (60md) | Not known |
| Halizi | Halizi means Golden, stalk medium, early, high yield (55mds/ha) | Not known |
| Shatui loli | Means Cob pith red, grain red, stalk medium, late, low yielding | Not known |

| Table 73: Land races of pulses | | |
|---|---|---|
| **Land races** | **Characteristics** | **Origin** |
| Kinie Balie | Means mash bean, grain size medium, black, early,yield,50mds/ha | Not known |
| Bookuck | Means Faba beans, Grain black, yield 20mds/ha,late maturity | Not known |
| Kulth | Soybeans, grain black, grain yield 28, mnds/h, late maturity | Not known |
| Mazur | Means lentils, seed size small, brown, yield,35 mnds/ha, early | Not known |
| Nili balei | Means mung beans. Grain green. medium Yield like mash beans, early | Not known |
| Dareli Balei | Means cow peas, Grain off white, dark brown and black | From Darel, Chilas |
| Matar | Peas, small size, grain green, shriveled, low yield. | |

| Table 74: Local apricot varieties grown in the Northern Areas | | | |
|---|---|---|---|
| **Local Variety Skardu** | **Characteristics** | **Local Variety Hunza/Gilgit** | **Characteristics** |
| Marpho choli | Red apricot | Shikanda joo | |
| Karfoo choli | White Apricot | Brum joo | White |
| Warfo choli | Pith used for oil | Surasune joo | Good quality |
| Bro choli | Late maturing | Duda-sanag joo | -- |
| Khakas choli | Pith partially split | Koropiam joo | -- |
| Cho choli | Juicy | Ali shah kakas joo | -- |
| Apo choli | Large | Habib joo | Very late |
| Beru choli | Small | Khanemish joo | |
| Blafo choli | Small, red | Kartachi joo | Very early |
| Odoumer choli | Partly red | Dudur joo | |
| Chun choli | Sweet pith | Ghulam joo | |
| Yakar choli | Reddish | Rashikin joo | Early |
| Gurdalo cloli | Like peach | Alman joo | Good quality |
| Pharang choli | For drying | Koropian joo | Early |
| Kartaksha choli | Early, juicy | Gakateenan joo | |
| Sara choli | -- | Kaka shikanda joo | |
| Kacha choli | Hard, good to keep | Moen joo | |
| Halman choli | Best quality | Ghaka joo | |
| Kazangi choli | Sweet | Mamoori joo | |
| Khashanda choli | Good taste | Brun joo | |
| Kho choli | Bad taste, sour | Gario joo | |
| Shikanda choli | Sticky | Loli Peeban | Orange, med |
| Tacho choli | | Neeli Peeban | Orange, med |
| Marghalam choli | Early, good quality | Jangeer | Orange, big |
| Shanda choli | Small, early | Habbi | White med |
| Stun choli | Late maturing | Chuni Neeli | White, small |
| Mamoor choli | | Chusangney | White Big |
| Ghom choli | | Khurma | White Med |
| Sara karfo choli | Early | Bidiri | White, Med |
| Stun kuban choli | | | |
| Khustar choli | | | |
| Sapasten choli | Sour, pith used for oil | | |
| Miting choli | Sour, pith used for oil | | |
| Shakar choli | Sweet | | |
| Hongool choli | | | |
| Brook choli | | | |
| Halwar choli | | | |
| Duspaong choli | | | |
| Yakab yak choli | | | |
| Snaircholi | | | |

| Table 75: Pear varieties grown in Northern Areas | | | |
|---|---|---|---|
| **Variety** | **Characteristics** | **Variety** | **Characteristics** |
| Parao | Large, pear shape | Batang | Large, pear shape, sweet |
| Sur Tango | Small, round | Nap tango | Large, apple shape, hard |
| Shin Kulay | Medium,Apple shape | Nak | Oblongto pear shape |
| Spin Tango | Small, Round | Shaltango | |
| Mamusay | Small to medium, round, early | Khar Nak | Large in size and hard texture |
| Shakar Tango | Sweet, Medium size | Gadaray tango | |
| Nashpati | Medium, to large, sweet | Bap Tango | Early in maturity |
| Tang | Large, pearshape | Khawaga | Small, round, sweet |
| | | Maiwa | |
| Khan Tango | Small round | Khapa | Sour |

Other fruit plant occurring found in wild are as under:

| | | |
|---|---|---|
| Pome fruits | Pyrus pashia (wild pear), | |
| | Malus domestica (domestic apple) | |
| | Cydonia oblonga (quince) | |
| | Sorbus lanata (sorbus) | |
| | Cartaegus songarica (cartaegus) | |
| | Cotoneaster nummiliria | |
| | C.offins | |
| Stone fruits | C.integersma | |
| | Prunus cerasioides (cherry)NA | P.jacquernontii |
| | P.prostrata | P.cerasus |
| | P. avium(sweet cherry) | P. mahaleb |
| | P. tomentosa | p.cerasifera |
| Other fruit trees | iospyros lotus | Ficus carica |
| | Prunus pedis | Prunus pedis |
| Small Fruits | Duchesnea indica | Fragaria nubicola |
| | Ribes alpestre | R.orientale |
| | Rubus anatolicus | R. Ellipticus |
| | R. hoffineisterianus | R. Ierritones |
| | R. macilantus | R.nivens |

| Table 76: Land races of vegetables | | |
|---|---|---|
| **Land Races** | **Characteristics** | **Origin** |
| Hazigar | China Cabbage like characteristics , palatable | Unknown |
| Kaam | Cabbage, palatable | Unknown |
| Kaam Gaie | Knol kohil. Palatable | Unknown |
| Sumachal | Malva Species, palatable culinary use | Local |
| Onion (Kashu) | Small size, white colour | Local |
| Garlic (Gupka) | Variety unknown, contain 8-12 cloves | Unknown |
| Carrot Chatoon | Variety unknown, colour orange yellow, branched | Unknown |
| Radish Chutmooli | White colour, small size, variety unknown | Unknown |
| Tomato (Balugan) | Red coloured, round shaped, medium sized | Unknown |
| Brinjal | Round and medium size, purple coloured | Unknown |

One of the principle objectives of nature conservation is the preservation of species as the extinction of species would have a great influence on the earth's ecosystem. Besides, it gives a number of other benefits including natural balance of the environment, stabilization, protection of soil, stability of climate, protection of genetic resources, preservation of breeding stocks, conservation of renewable harvestable resources, promotion of tourism, creation of employment opportunities, provision of educational and research facilities, and provision of recreational facilities to name just a few. It is obvious that Pakistan has the potential resources to maximize benefits from all these. The degradation of mountains is because of lack of control over live stock numbers, grazing intensity, land tenure issues.

We have to dedicate ourselves to protecting the natural integrity of our mountains in the Northern Areas, so that we may bestow upon our future generations this natural legacy. And this can be done at by the active collaboration of Public and Private Sectors, NGOs as well as local populations besides the general awareness.

It is deplorable that farmers in quest for yield increase, have ignored biodiversity in cultivation. They now cultivate only a few crops and use fertilizers rather than using dung. The idea of bio-gas plants has been there for quite sometimes.

There is need to establish priority conservation area by focusing on the habitat requirement for the key species such as snow leopard and mountain ungulates. These wide-ranging species can serve an umbrella role for conservation of the overall biodiversity (Wikramanayake et al 1998) This approach has been adopted under the Mountain Areas Conservancy project being implemented in NAover the much larger landscape of this temperate region.

**Table 77: Diversity in fruit species (both indigenous and introduced)**

| Fruit species | Number of varieties/cultivars |
|---|---|
| Apple | 17 |
| Apricot | 28 |
| Pear | 14 |
| Plum | 8 |
| Cherry | 13 |
| Grape | 8 |
| Peach | 5 |
| Almond | 3 |
| Walnut | 15 |
| Mulberry | 4 |
| Olive | 6 |

Source: Doolan (1993)

| Table 78: Status of livestock biodiversity in NA | | |
|---|---|---|
| **Species** | **Breeds in Pakistan** | **Breeds in NA** |
| Yak | 1 | 1 |
| Cattle | 12 | 1 |
| Goats | 32 | 7 |
| Sheep | 37 | 4 |
| Horses | 4 | ? |
| Donkeys | ? | ? |
| Chicken | 3 | |

- NA. is a home of Biodiversity where thousands of biotypes are existing and dominating any part of the world, which need preservation otherwise these species /biotypes are depleting due to over exploitation and in this way the humanity will be loosing valuable asset of bio-diversity from the area. In view of the situation a Germplasm Bank may be established in NA. for the preservation and conservation of these bio-types, which will not only attract the National biotype experts but also International Donor Agencies will be attracted for donation so as to preserve the precious biotypes which will contribute in future for sustainable Agriculture development not only in NA but also on National and International level.
- Hygienic storage facilities in Gene Bank may be provided in for conservation of indigenous and exotic biotypes for utilization in future plant breeding programme.
- Artificial propagation should be promoted for maintaining indigenous / native cultivars for sustenance and continuous availability of gene pool.
- The local knowledge with people that has been gained through decades of experience needs to be documented, preserved and conserved rather than verifying it again through experimentation. We can save time, and money.

## 2.21. Medicinal Plants

Aussain and Sher (1998) listed the following as important medicinal plants, which occur in sub-alpine forest, are of high commercial value and over exploited. Some of these species are becoming rare and endangered due to deforestation, overgrazing, over collection and conversion of land due to urbanization,. The most serious problem is when plants are uprooted, because their roots are to be utilised in drugs or medicine preparation. Species are:

- Paeoni emodi
- Valeriana wallachii
- Viola serpens
- Bergenia cilliata
- Dioscorea dettiodea
- Polygonum amplexicaule
- Colchichum luteum
- Podophyllum emodi
- Morchella esculenta
- Cumimum cyminum

These species have been recorded in places in high elevation ranges from 4000 ft to 9000 ft which are relatively rich in diversity and density of medicinal plant species. Apparently they cover all slopes, aspects and altitudes . All these species show trends towards increasing in protected area but declining in unprotected area. Species at serial No. 1,2,4,5,7 and 8 cannot be cultivated as cash crops in the farm lands. The other three species might be economically profitable compared to cash and cereal crops.

Rasool (1998) listed the following important medicinal and aromatic plants of NA.

**Table 81: Important medicinal and aromatic plants of NA**

| Scientific Name | Local Name | Distribution in NA |
|---|---|---|
| Artemisia mantimia | Afsantin | Sub Alpine regions inmost part of NA |
| Sausstia lappa | Kuth | Astore and Minimurg areas and around Kalapani & kamari |
| Piciothiza kurroa | Karru(katki) | Alpine meadows around kamari& Burzil passes and Deosaipaleatu |
| Podophyllum emodi | Bankakri | Astore and Minimurg |
| Glycynhiza glabra | Mulathi | Gilgit region,Punyal |
| Aconitum heterophyllum | Atees | Sub-alpineand alpine zones of upper Astore |
| Ferula foetida | Hing | Upper Astore, Bunji and Harcho area |
| Onosma spp | Goazaban (Ratanjot) | High altituderegions in upper Astore |
| Rheum emodi | Revand-chini | Upper Astor, Gilgit, and Nagar areas |
| Thymus serpyllum | Tumuro | Upper Astore, Gilgitand Baltistan |
| Valeriana wallich | Mushbala | Nagar and Astore regions |
| Hippophae thamnoides | Buru (See Buckthorn) | Baltistan, upper Gojal& Gilgit region |
| Ephedra spp | Som (Asmanibuti) | Upper Gojal, Astore and Gilgit region |
| Carum spp | Zeera Saffed | Rattu Valley Astore and Shihar Valley Baltistan |
| Cumium cyminum | Kamsal Zeera | Astore, Kargah, Naltar and Harcho |

Source: Rasool (1998)

**Table 82: Some of the plants reported to occur in Gilgit**

| Species | Flowering Period |
|---|---|
| Achillea millefolium L. | August-March |
| Achyranthes aspera L. | September-April |
| Artemisia maritime L. | August-September |
| Cymbopogon jwarancusa Schult | July-October |
| Mirabilis Jalapa L. | November-January |
| Rervoskia abrotanoides Karel | September-October |
| Trifolium pratenseo. L | February-April |
| Xanthium strumarium L. | July- August |

## 2.21.1. Recommendations

- To provide on the spot training in ex-situ cultivation and in-situ management / conservation of the preceding and other medicinal plants.
- To create awareness among the communities concerning sustainable exploitation of medicinal plants.

- To conserve the rare or scarce plants in their native habitat or natural place.
- To document and conserve the indigenous knowledge system associated with various medicinal plants.
- To explore the possibilities for conservation/sustainable development of rare and endangered medicinal plants by involvement of rural communities in their native habitat
- To assess and identify the factors affecting biodiversity of medicinal plants and indigenous knowledge system for mountain natural resource utilization and conservation.
- Several of the medicinal plants having curative or therapeutic effects can be exploited through collaborative efforts with Pakistan Tibb Council and Hamdard Foundation of Pakistan

## 2.21.2. Collaboration with CSC and ICUC

The Commonwealth Science Council (CSC) and International Centre for Under-utilised Crops (ICUC) have been promoting indigenous plants for food and industrial uses. Their activities have focused on dissemination of information on germplasm conservation, plant improvement programs and national capacity building. Both of these organizations continue to promote and strengthen national capacities to the indigenous crops of importance for food security and industry. The essence of their programs is identifying, evaluating and conserving the genetic variability of crop and wild species with the aim of its utilization and adaptation to a country needs. Post harvest processing and marketing aspect that will assist, the farming and rural communities are also domain of their activity. NAcan collaborate with these organizations. Some wild medicinal plants species like Bergenia ciliata, Condonopsis clematidea, Paeonia emodi, Nepeta sp. Ferula narthex, Juniperus excelsa and Inula racemosa are endangered, due to overuse of hill side areas/ pastures and by the local villagers (due to lack of knowledge about conservation measures like controlled grazing, proper harvesting and proper time to harvest). ERP and AKRSP (Skardu) have attempted to cultivate some of medicinal plants but there is urgent need to motivate farmers towards this end.

Seabuck thorn (Hippophae rhamnoidies) locally called mirghinz is found abundantly in the Northern areas and Chitral. There are more than 80 factories in China which process this specie into a number of different marketable forms making of over 100 different products such as drinks, jams, sweets, medicines, etc. This is elaborated in a box. By establishing small processing units in different areas, it can be utilized for various income generation purposes. There are also many other wild/ medicinal plants, which are very important. The NA forest Department in collaboration with ERD, IUCN, AKRSP, ICIMOD, WWF, etc should concentrate on this important issue for the conservation of economical medicinal plants.

## 2.21.3. Researchable Themes

- Participatory varietal development
- Multiple cropping system
- IPM
- Soil conservation/Fertility
- Oil crops

## Box 1: Seabuck thorn – AMagic Plant for Dry Mountains

Seabuck thorn (Hippophar rhannimoides) is a deciduous shrub, widely distributed throughout the temperate zone of Asia and Europe and subtropical zone of Asia at high altitudes. Asub-species Hippophar rhaninosdes is found in the northern part of Pakistan. It is spread throughout the Karakoram at altitudes of 2000-4000 in (Chitral and Gilgit) with a pH of 9.5 even in soil that contain 1.1 % salt. It has highly developed root system and is excellent for holding soils on a fragile slope. It has ability to take root even in poor soils because of its ability to fix nitrogen directly from the air through the nodules in its roots,. A natural sea buckthorn forest can yield 750 to 1500 kg of berries per hectare. Its fruit is a rich source of vitamin. Oil of pulp and seeds is regarded to be very important for its medicinal value.

Seabuck thorn is described as the most appropriate multipurpose option for mountain areas. Its fruit can be used for making more than 100 products such as soft/hard/powered drinks, jams, sweets, cosmetics and medicines. Despite the scientifically proven potential of sea buckthorn for manufacturing several high value product for human consumption, its harvesting is constrained by the lack of appropriate technologies and facilities to process the same. China and the former USSR have very effectively used it in industries relating to food and medicine.

**Use in food industry**

At present many factories are producing sea buckthorn food, beverages and other products such as jam , Jelly, Juice, and syrup. Along with the traditional foods, some new ones such as condensed juice, mixed juice, sea buckthorn carrot jam, candied fruit, sea buckthorn cheese, sea buckthorn butter, tea and health protection drinks are also being produced.

**Use in medicinal industry**

Some ten varieties of sea buckthorn drugs have been developed and are available in the form of liquids, powders, plaster, film pastes, pills and aerosols etc. These drugs are used for treating burns, gastric ulcers, chilblains, scalds, oral mucositis, rectum mucositis, cervical erosion, radiation damage, skin ulcers caused by malnutrition and other skin damages. The most important pharinacological function of sea buckthorn oil is diminishing inflammation, disinfecting bacteria, relieving pain and promoting generation of tissues.

**Use in cosmetics**

Many kinds of seabuck thorn cosmetics have been developed and tested in hospitals. It is proved that sea buckthorn beauty cream has positive therapeutic effects on molasses, skin wrinkles, keratoderma, keratosis, senile plaque, xeroderma, face-acne, recurrent dermatitis, chemical corrosion and inchthyosis, as well as freckles, Other sea buckthorn extracts can improve metabolism and retard skin maturation. In China, it has been found that sea buckthorn cosmetic can cure 16 tropical diseases.

**Use of leaves and residues**

The leaves of sea buckthorn have been proven to contain many nutrients and bioactive substances. Leaves and fruit residues used as supplementary food can promote the growth of animals and poultry. There is no toxicity, no carcinogenesis.

**Use as food additive**

The pigments of sea buckthorn are widely used as food additive. Seabuck thorn yellow pigment consists of flavours, carotene and Vitamin E. Its physio-chemical properties such as appearance, solubility, colour value, heat and light stability, effect of pH and metabolic ions make it very useful food additive.

**Role in maintaining ecological balance**

It has been observed that a number of wildlife species depend on sea buckthorn stems. Leaves., flowers, roots, fruit and seed. In Loess plateau, China 51 bird species are entirely dependent upon sea buckthorn for food and 80 are relatively dependent. In winter, the importance of food increases, as it is almost only food available to birds. Seabuck thorn provides long-term benefits in terms of maintaining ecological equilibrium.

**Use as fuel wood forest**

In the Hindu Kush Himalayan region, plant biomass is the most important source of energy. Seabuck thorn has proved to be a popular green energy plant because of its quality biomass. The calorific value of dry sea buckthorn wood is 4785.5 calories per kg. It is a good source of firewood. In a six-year old sea buckthorn forest, a hectare can produce 18 tons of firewood, equal to nearly 12.6 tons of standard coal.

## 2.22. Non-Government Organizations (NGOs)

Besides the very little public sector involvement in extension activities, the Aga Khan Rural Support Programme (AKRSP) is actively involved in the agricultural development in the four districts of Gilgit , Skardu, Ghanche and Ghizar and in the sub-division of Astore of the Diamir districts. As of end 1995, AKRSP had established some 1950 Village Organizations (VOs) in its area of operation out of a potential of 2100. It is pursuing a three part model of rural development comprising an economic or incentives model, a technical or production model and a social/institutional model. The technical model is a means to find new appropriate technologies, adapt them to the working environment and convey them to large number of smallholders. The agricultural development under the technical model consists of improved crop technology dissemination, promotion of forage and fodder production, horticulture development, and animal production and health. The main thrust of this model is to organize village groups, assess their needs on a participation-response basis and provide related services to the VOs by AKRSP staff, thus by-passing the various line departments. This approach is certainly very efficient in delivering services but not sustainable in the long term as AKRSP is to terminate its intervention some time in the future.

## Box 2: Aga Khan Rural Support Programme (AKRSP)

Transformation of the Backward Northern Areas through village organizations.

**Indicators of success**

Overall improvements, both in quantity and quality, of the natural resources base (e.g. cultivated land through increasing the area under irrigation, forests through afforestation/ reforestation, rangeland through plantation of forage grasses, etc) improvement in the living conditions of the people, minimization of food shortages, reduced dependence on food grains from outside and greater and more diverse employment opportunities both in the farm and off-farm sectors. Besides these the biggest success of the AKRSP is in the level of mass participation (73% of the total rural population are actively engaged in the AKRSP programmes) and in local, financial resources mobilization (more than 118 million rupees have been deposited through the rural saving programme)

**Central focus and underlying processes**

Institutional reforms have been introduced by establishing village organizations and enabling them to develop managerial and technical skill to identify, plan, implement, and maintain rural development programmes in a sustainable, equitable and productive manner,. One of the central and unique focuses of the AKRSP has been on the effective mobilisation of half of the total population i.e. women in development activities through the establishment of women's organizations.

The development process begins with the introduction of productive physical infrastructure e.g. link roads, trails, bridges, irrigation, land development, etc. This is following by the implementation of various productive farming activities e.g. crops, livestock, forestry and other sideline activities based on the suitability of different areas such as crop development in the valley and on gentler sloppy lands, livestock at higher altitudes, orchards, pasture development of steep slopes, etc

**Individual components of the strategy**

**Diversification**

Emphasis has been placed on improved livestock farming through improved forage and fodder production and breeding. This system has improved both the animal feed situation and soil fertility. Cultivation of cash crops e.g. vegetables, dry fruits and cereal crops including potatoes have been emphasized based on their comparative advantages. Potato seeds produced in such a cool and pristine environment fetch a premium price in the market. Agro-forestry and timber production are other important activities. In forestry development, fodder tree plantation receives prime consideration.

**Intensification**

Areas under double cropping are increased because of the introduction of short maturity crops and an increase in areas under irrigation. Because of the adoption of crops with high ratio of grains and crop residue, animal production is also intensified. Degraded land and other unutilised/or abandoned lands are now being used for pasture and orchard.

**Specific resource focus**

Human resource development is a key principle of the AKRSP initiatives, which again

**Specific resource focus**

Human resource development is a key principle of the AKRSP initiatives, which again deviate from the conventional approach by providing managerial and technical skills to promote sustainable development. The production cantered strategy is another specific focus of the AKRSP. Farmers have discarded several newly introduced high yielding varieties because of low ratios of crop residues but, they have adopted varieties with high stalk-grain ratios.

**Integration and inter-systemic linkages**

The improved physical infrastructure has meant that the compulsion to grow food grains exclusively is minimized and this has developed to divert scarce resources towards more productive activities based on their comparative advantages. Food grains have been imported from outside areas. Economic activities are not only limited to primary production but have also shifted to the secondary and tertiary sectors. Sulphuring apricots before drying has improved their colour and quality for export to foreign markets. This is an example of transformation of a subsistence economy into a commercial economy.

**Management of demand pressure**

Improvement and diversification of farming with the focus on biomass, accompanied by improvement of external linkages due the improved roads and trails have taken place facilitating easy access and availability of fertilizer and other necessary inputs required from outside. Improved situations for other productive physical infrastructures like irrigation have helped to manage the increased demand for food and fodder without degrading the natural resources.

Effective mobilization of women in direct productive activities such as poultry farming and nursery development has helped generate cash income which is again used to purchase food grains and other productive inputs for farming.

Fencing for pastureland for rotational grazing, silage making and introduction of fodder banks to encourage stall-feeding have brought distinct improvements in environmental protection.

Limitations: Subsidized farm production inputs may pose a constraint for its replication elsewhere. This raises the question where external funding are always crucial to introduce development initiatives like those of the AKRSP.

## 2.23. Induction of Private Sector for Development in Agriculture

Agriculture is the largest sector of Pakistan's economy contributing over 25% in the GNP and employing more than 54% of the country's labour force. This sector accounts for over 70% of the foreign exchange earnings of Pakistan but despite agriculture being the back bone of the country's economy, it was never given due priority in the national planning. As a policy, resources from agriculture have been shifted to industry in the effort to industrialize the country. Unfortunately development in agriculture has been left to the Department of agriculture with all

the usual deficiencies and handicaps of the official system. This has resulted in the state of affairs that despite having vast alluvial plains served by the largest irrigation system in the world supplemented by thousand of the tube wells, crop yields in this country are among the lowest in the world as is evident from the yield figures given below:

**Table 79: Yield in kg per hectare**

| | Wheat | Rice | Seed Cotton | Maize |
|---|---|---|---|---|
| United Kingdom | 7,700 | | | |
| France | 6,640 | | | |
| Mexico | 4,550 | | | 18,463 |
| China | 4,090 | 6,331 | 2,829 | 15,350 |
| All India | 2,670 | 2,915 | 931 | 9,800 |
| East Punjab | 4,179 | 3,407 | | |
| Egypt | | 8,567 | 2,355 | |
| USA | | 6,609 | 1,989 | 23,789 |
| Japan | | 6,416 | | |
| Bangladesh | | 2,769 | | |
| Turkey | | | 2,785 | |
| Indonesia | | | | 9,325 |
| Pakistan | 2,050 | 2,805 | 1,583 | 1,445 |

Source: US Department of Agriculture, FAO/Director, Crops Reporting Services, Punjab.

Pakistan's production of wheat/hectare is very low as compared to other wheat growing countries of the world including India. In Indian Punjab yield of wheat/hectare is more than double the yield obtained in Pakistan. Almost the same situation is in rice, maize and seed cotton. In cotton crop Pakistan has increased her production to a level that is slightly better than India, but it is much lower than other cotton growing countries.

Low yields make crop production un-economical with consequent poverty. Our cost of production is also much higher than other countries in the world. It can be said without fear of contradiction that poverty in Pakistan is primarily due to mismanaged agriculture.

## 2.23.1. Causes of Low Productivity

Now many people realize that agro-climate in Pakistan is not conducive to high crop production. All the crops in Pakistan are grown out side their natural habitats. It is common knowledge that rice and sugarcane are crops of humid tropics that are grown in dry sub-tropics, where it takes 8 tons of water to produce one kilo gram of rice. Sugarcane stops its growth during hot, summer and cold winter months, consequently our yields have to be low. Similarly, cotton plant does not from bolls under high night temperature that prevail in Pakistan till 15th of September while the bolls formed after 15th October are liable to be damaged by frost. Thus we have only one month of fruiting period in cotton. Potato and maize are summer season crops is their natural habitats but if we grow them in the summer season both these crops fail to give any yield. We have to plant them early in spring or late in autumn.

Even wheat which is our major crop is out of its natural habitat. We are growing spring wheat in the winter season. This crop is also subject to low temperature in winter and high temperature in spring that often affects normal grain development in this crop.

Other adverse agro-environments for crop production in Pakistan are water logging and salinity in the soil that hampers normal crop growth and affects fertilizer use efficiency of the crops very adversely. Since, crop production in Pakistan is entirely dependent on artificial irrigation, water supply is also a limiting factor. Efforts made to supplement the canal irrigation system by tube wells has further deteriorated the soil fertility because of the marginally fit or unfit sub soil water. Inadequate supply of irrigation water compels the farmer to spread available quantity of water over larger area. This shallow irrigation results in accumulation of salts in the top layer of soil that adversely affects the crop yields.

Land tenure system in Pakistan is such that more than 81% of the farmers own less than 5 hectares of land, who do not have the resources to adopt modern crop production technology and consequently obtain much low production. Absentee land owners are also cause of low production in this country.

## 2.23.2. Production Potential

As a result of sustained research efforts carried out by the agricultural scientists it has been proved that the potential of crop yields is very high as can be seen from the following table.

**Table 80: Yield potential of different crops in Pakistan (Kg/hectare)**

| Crop yields | Wheat | Rice | Cotton | Maize |
|---|---|---|---|---|
| Yield potential as per experiment station results | 6,425 | 6,850 | 2,527 | 6,042 |
| Yield obtained by progressive farmers | 3,029 | 3,047 | 1,731 | 2,700 |
| Yields of traditional farmers | 1,440 | 1,246 | 937 | 1,570 |
| National average | 1,880 | 1,918 | 1,248 | 1,350 |

Notes: National average is lower because large area of maize is grown under rain fed conditions.
APCOM (1993) as quoted in National Commission Agriculture report 1988.

The yield potential of different crops demonstrated by our research scientists on their experiment stations is 2-4 times higher than the national average. The achievable potential yield that is being obtained by the "progressive farmers" on large scale is more than 50% higher than the national average and is double the yield obtained by the farmers who have not adopted the package of technology developed by the research workers. These farmers are the cause of low crop production in the country and pull down the National average yields. From the figures given in the above table, it appears that the area under crops grown without using the recommended package of production technology is well over 50% of the total areas. For lapses in the production process farmers are penalised heavily by reduction in yields because of harsh agro. climate.

It has also been demonstrated by PARC, Islamabad in their crop maximization projects on rice, wheat and cotton over several thousand acres that yields of these

crops can be raised from 2 to 3 times as compared to the average yields obtained by the farmers out side the project areas in the same locality, provided all the inputs are applied as per recommendations.

This is admitted fact that crop production if carried out according to the recommended technology, can be raised substantially but the problem is who is to venture the implementation of such a programme . This is possible only through agricultural service corporate bodies set up in the private sector, who will provide complete package of services to the farmers including land preparation, providing seed and fertilizer, weed control threshing and marketing. All the services will be on loan, cost to be recovered at harvest without interest. The details are at Annexure I.

# 3. ISSUES AND TRENDS

The stakeholders in their meeting desired that the background paper on Agriculture and Food Security beside s covering the stipulated objectives of NACS should also serve as a reference for them. They desired an up to date statistics, constraints that have hampered progress in their discipline and relevant researchable themes to put them on the right track of thinking for future progress. They wanted to use this opportunity for administrative reforms and as a tool for the advancement of their career as well. An isolated, neglected, suppressed and oppressed community of scientists, researchers and field workers desired that their accomplishments should also be reflected in the paper. Consequently while focussing on sustainable development of NA, conservation of bio diversity and protection of environment paper was forced to digress and serve much broader spectrum of interests than an ordinary background paper would do. It surfaced that in the conservation strategy of NA perhaps human happiness under the fast changing environment resource poor, unskilled, uneducated, highly conservative society may be the most wanted element. IUCN deserves credit for taking a note of it, although AKRSP has been in the system for a long time

Issues that emerged related to agriculture and food security are described below:

- Increasing productivity per unit area or per animal of the existing resources to make the NAself sufficient in food grains, meat, beef, eggs, milk, fuelwood, etc.
- Increasing proficiency of various inputs/outputs e.g. available land use, irrigation system, fertilizers, pesticides, marketing of produce and by products
- Increasing profitability of the various farming systems in food crops, horticultural crops, fodder, cash crops, livestock, fisheries, poultry, mixed cropping, crop-animal, pastures, etc.
- Participation of communities in the decision making for sustainable development, conservation of natural resources, creating awareness for food, environment, health and ecological security.
- Human resource development and gender integration. The research scientists and lower staff has no elements of competition, no career planning and training facilities to update their knowledge, skills and delivery system in extension, etc.
- People are immune to change, they stay static, joint family system reinforces conservatism and immunity to change.
- The state of environment can be improved and the unrealised potential in various commodities can be realized through social support and technical input.

Other issues related to conservation aspect are as under.

## 3.1. Habitat Loss

Various ecosystems and community structures function in unison if remain undisturbed. Human activities for improvement in agriculture output and food security lead to changes in landscape, natural water flows, composition of flora

and fauna resulting in loss of bio-and genetic diversity. With expansion in cultivated area, deforestation, increased cropping intensity there occurs a change in pattern of snowfall and rainfall. Associated with changes in habitat, many species are becoming rare. For example, woolly flying squirrel, musk deer, black bear and monal pheasant are becoming rare in Diamir district where deforestation has taken place.

## 3.2. Endangered Species

The human population explosion has led to unwise use of natural resources at a rate much faster than their regeneration. Hilton Taylor (2000) listed several threatened species on account of depletion of natural resources, that also occur in Pakistan. Some of these also inhabit NA. These are(a) Mammals-snow leopard, flare-horned markhor, Marco Polo sheep, Ladakh urial, musk deer, brown bear, woolly flying squirrel, blue sheep, Hima layan bex(b) Birds- snow cock, monal pheasant.

Medicinal plants like kuth (Saussria lappa ) and Karru (*Picrorhliza kurroa*) are near extinction due to over harvest in Astore, s alpine meadows.

Some areas of Gilgit and Diamir district are subject to heavy grazing and fuel wood collection. These two activities pose a threat to many of the rare plant and animal species that inhabit places at different altitudes in these two districts.

## 3.3. Degradation of Agra-ecosystems' Homeostasis

In our efforts for enhancing agricultural production, we have introduced high yielding crop, vegetable and fruit varieties, stepped up use of fertilizers, pesticides, water regimes, intensive agriculture, etc.

Agri-ecosystem homeostasis is faced with degradative trends in the form of the following:

- Loss of topsoil
- Loss of local crop varieties.
- Loss of indigenous knowledge
- Climatic change
- Loss of soil's water holding, micro organisms and productivity capacity
- Loss of floral and faunal genetic diversity
- Loss of adaptive capacity of mono cultural crops to changed environmental conditions such as water stress, extreme temperature fluctuations, changed intensity of sun light.
- Loss of air, water and soil environmental health. Due to pollution, contamination and changed food chain. fisheries is at risk.
- Unplanned and over grazing has led to degraded pastures and breakdown of sustained traditional grazing system.
- The homeostasis of crop-human/animal- posture is at risk.

## 3.4. Lack of Awareness

A large number of development projects have been going on in NA for transformation of communities, improvement of agriculture and economic conditions of population. Although people like the change for betterment of their life, can identify plants and animals, they deal with, are aware of habitat and seasonal history of many organisms in the villages and accessible mountains, however, most of the people are unaware of the value of these resources, and the consequences of their loss in terms of biodiversity, environmental degradation and aesthetics. Unless and until they are knowledgeable about the general fauna and flora the questions of sustainability and conservation remain unattended. The possible contribution of conserving biodiversity for economic development and poverty alleviation at the community level needs to be attended by planners, policy makers , educationists, etc in the NA.

Several NGOs, like World Wide Fund and IUCN have initiated awareness campaigns, but these are limited in coverage vis-à-vis the task in the NA

## 3.5. Lack of Biodiversity Inventories and Monitoring Systems

Historically some information about wildlife, forests, fisheries and agriculture has been collected by the concerned departments in NA. Even this is not readily available to every one. There is no regular agency or department to prepare inventories of flora, fauna and micro-organisms occurring in NAand to monitor the trends or displacement of the various species. Because of difficulties in accessibility to rugged mountains, very little quantitative and even qualitative information about animals, plants, arthropods, bacteria, fungi, viruses, and soil micro organisms is available in published or even unpublished form. Therefore the genetic richness, resource sharing ability in diverse ecological habitats and impact of human activities and interventions has remained and is still a neglected aspect. Therefore, whatever efforts are made for natural resources conservation will lead to partial achievements. Likewise with out a regular monitoring system, proper assessment of trends becomes impossible. Only guestimates come to our rescues.

## 3.6. Institutional Capability, Capacity and Resources

The departments of agriculture, fisheries, forestry and livestock are responsible for sustainability, conservation and management of components of biodiversity in NA. However, by nature of their training there is generally a lack of conservation attitude. The employees of these departments mostly adhere to concepts of exploitation of resources for economic benefits and satisfying human needs. It is also partly true that funds, transport for mobility, equipment and on the job training for enhancing their capability and capacity to meet the challenges under the changing environment is lacking. To most employees, concepts of conservation biology, carrying capacity of different habitats, sustainable productivity, species displacement, etc are not known. Perhaps roster of their duties needs redefinition to suit the modern requirements.

Another setback in the NA is, there is no research as for as most departments are concerned. They consider policing the resources their prime job and are least bothered even if the entire resource is eroded. Agencies such as IUCN, WWF, AKRSPand Himalayan Wildlife Foundation (HWF) have taken up steps to promote concepts of conservation and sustainable use of biodiversity. This will change the style of management of natural resources and lead to critical assessment of trends, which are virtually non-existent now.

## 3.7. Gaps in Knowledge

The biological, ecological, physical and even cultural diversity of NAhas remained un-mapped. Sporadic, site specific and development oriented efforts have provided us with only check lists. Many of these are just extrapolations by knowledgeable persons. Some of the taxonomic and bio-geographic information about mammals and birds are available in the works of Schaller (1977), Robberts (1991, 1992 and 1997) and a recently published report (2000) of floral and faunal joint expedition of the Oxford Univ. Museum and Pakistan Museum for Natural History. Very little is known about amphibians, reptiles and fishes.

The role of many of these taxa in the sustainability and productivity of agriculture and food security remains obscure . Even the existing associations between various biological taxa and the benefits of their interactions in terms of pollination of crops, changes in the soil texture, recycling of organic matter to enrich the soil fertility, are as less known as are the indigenous races of crops, fruits and vegetables.

## 3.8. Laws in NA

In general there are various acts and rules in NA to protect and safeguard the diversity of wildlife, fisheries and forests. This is however not linked to quarantine laws but is done through policing.

There are limited staffing and resources available to departments in NA. These short comings have led to inadequate protection of species, insufficient safeguarding against degradation and destruction of habitat, weaken forcemeat of laws, low public awareness, lack of coordination between various agencies, lack of involvement of local communities in migrating threats to these resources.

Most new initiatives diverge from traditional approach of policing natural resources and alienating local communities who traditionally depend on these resources to meet their subsistence needs

A number of organizations have been active in promoting participatory conservation and sustainable development in NA. The organizations include Aga Khan Rural Support Programme (AKRSP) IUCN , WWF and Himalayan Wildlife Foundation (HWF).

## 3.9. Side Effects of NGOs Activities

The primary objective of AKRSP is to improve the lives of mountain people by mobilizing local communities and implementing sustainable development agenda. AKRSP covers almost entire NA and operates through 1592 Village Organizations (VOs) and 930 Women's Organizations (WOs) for continuity of their program. Its programs /projects/ initiatives have also contributed to raising environmental conservation awareness among the masses. Its activities like development of land for agriculture, forest plantation, collaborative management of fisheries, irrigation system at a level lower than the irrigation channels have provided new niches and added advantage to several faunal taxa. Shifting of agricultural associated seed and foliage eating insects, birds and small animals to abodes has been made possible by such activities

Likewise the infrastructure established by AKRSP has also helped in operations of other NGOS, like IUCN, WWF & AWP. AKRSP's initiative to establish Women's Organizations is a step towards gender integration.

# 4. CONSEQUENCES OF INACTION

Agriculture is the basic source of livelihood of the entire NA. For decades, it has not crossed the threshold of subsistence despite interventions by local organizations, international donors and NGOs. There are not sufficient food grains even for the 1 million population, what to speak of a balanced diet. The population growth of NA (3%) is higher than the rest of Pakistan (2.4%) Thus in the next decade there will be about 35% increase in human population of NA.

If the existing level of productivity of crops, fruits, vegetables, livestock, fisheries, poultry does not provide food security even to 1 million, there is no hope that the continuity of existing set up will provide food security to the natives of NA in the next 10 year s. Perhaps an inaction can lead to a famine like situation.

Whatever of fruits and vegetables is produced, 30-40 %of it is wasted. And due to unawareness and poor plant protection even the quality of the horticultural produce remains substandard. Hence it does not get sold, or else fetches very low market price. In case it is neglected, the situation will further worsen.

The urbanization is on increase. The information technology has removed the distances, time saving devices and quick services are on the move. There is going to be a change in t he eating habits and dietary pattern of people of NA, such as fast food style. This will lead to higher consumption of mutton, beef eggs, chicken,, fish, potato and other vegetables. The prevailing situation where animals survive on pastures, are underfed, malnourished and sold only to overcome financial crisis, warrants special attention to initiate action for increasing productivity on all fronts.

The urbanization, modernization and changing life style puts more demand on the domestic use of water as well as on irrigation water as intensive agriculture gets promoted. There is already a global concern about water scarcity. An inaction on the conservation, management, and storage side of water can breakdown the entire set up.

The forests and pastures are under high human pressure respectively for use as firewood and for raising the cattle through grazing especially during summer. If the alternative to forest trees in terms of Agro-forestry plantation and enhanced quantity of fodder by replacing the existing cultivars is not provided, the existing strength of the livestock will diminish. The system will not be able to sustain even current animal numbers.

The present farming system for production of crops etc. is wasteful for irrigation water due to poor water conveyance, unawareness about limited quantity of fresh water and its declining quality. The use of agro-chemicals on crops, and domestic use of detergents all have negative impact on lakes, and streams. The affluent pollute and contaminate the bodies of water, which adversely affect the fish out put and ruin the quality of soil. If no action is initialised to revert the situation, things will deteriorate.

So far, the life has been very simple, people of NA appear to be contented with the agriculture profession. There is no education, no skill and no options to move away from home for employment. In such a helplessness situation, the economic crunch will adversely affect them . The 50% additional load of women who can only assist in farm operations will add to human miseries. So some efforts for human resource development through improved skills and techniques, and gender integration in economic activities is inevitable to keep the economic, health, and environment security in tact.

Some of the other consequences of in action may be:

## 4.1. Malfunctioning of Ecosystem

The unplanned and excessive interventions will disrupt the ecosystem, hence adversely affect the balancing of nature. The quality of air water and soil will be spoiled due to use of agro-chemicals without scientific and ecological justification. This will reduce fish output endanger several floral and faunal species. There will be adverse affect in biodiversity, sustainability and the very integrity of ecology Biodiversity loss will limit the quality of life in the rural landscape, particularly the potential to feed, clothe and shelter the future generations. It is difficult to estimate the cost of losing undiscovered species that may be source of foods, medicines, fuels, of aesthetic value, and even source of imagination and inspiration for human beings. NAhas no inventory of any organism and no monitoring what is being lost and how to conserve it. Loss of a functional ecosystem may affect the process of pollination, cleaning of air, water and soil through recycling of organic matter, nutrients, etc.

In an agro-pastoral farming system, there is dependency on plant biodiversity (crops, grasses, trees) for food and fodder. There has to be a multi-dimensional approaches that ensure balancing of human needs and rights with the protection of species and ecosystems, for sustainability. An inaction may badly affect this relationship.

## 4.2. Reduced Food Security

For improvement in crop yields, we go for mono culture, so the current plant diversity will be narrowed down. This diversity is source of many food items which constitute a balanced diet for the human beings. In the event of an inaction to conserve thee diverse flora by in situ or ex-situ approaches the available intra and inter-specific variation may be lost

## 4.3. Accelerated Erosion

The agriculture in NA mainly depends on water coming from glaciers, snow melt and spring. Lesser the vegetable cover, quicker the surface erosion of mountains. The eroded material silts the irrigation system which may reduce storage capacity for water. The lesser the irrigation, lesser the food production. Bigger the gap between demand and supply more the import of food items from down country. A lot of government money will go in food subsidies and concessions, which could be avoided by timely action

# 5. STAKEHOLDERS

The major stakeholders are rural communities, local institutions and CBOs, development organizations, public sector institutions including line departments and research institutions, and the global interest groups like FAO, IUCN and institutions, who have indirect interest in maintaining biodiversity of Karakoram-Hindu Kush-Himalaya. Their interests and stakes in food security agriculture and conservation of biodiversity, could be placed at different levels including local, provincial national and global

## 5.1. Local Level Stakeholders

Rural communities and their local institutions are the primary stakeholders as these people entirely rely on natural ecosystems for life and livelihood. They could be pastoralists, farmers, nomads, local shopkeepers, school teachers etc, whose life is dependent on local resources by one way or the other. They would like to see plants and animal diversity around, providing sustained food security.

There are many CBOs and village organisations, which are involved in agriculture & food security through many different ways. These include CBOs, VOs, WOs, Welfare/Zaito Committees and local jirgas in many valleys of NA. These local institutions are often involved in local decision making for protection and use of natural resources, hence they have direct stake in their respective areas. Some cluster organizations, like Khunjerab Village Organization and Shimshal Nature Trust, have been active in environmental conservation issues at much broader level. Such organizations can be the important players in promoting biodiversity conservation, while ensuring food security through promotion of agriculture.

## 5.2. Conservation and Developmental Organizations

Several development agencies are playing an active role in agriculture and food security and conservation. These include AKRSP, IUCN Pakistan, WWF, Pakistan, Himalayan Wildlife project and Belour Advisory and Social Development Organization (BASDO). These organizations are important stakeholders in development arena. BASDO is a local NGO involved in environmental conservation activities. BASDO is implementing GET/UNDP funded small plant project for the conservation of endangered woolly flying squirrel and its habitats.

## 5.3. Public Sector Institutions in NA

There are several public-sector institutions in NA, which directly or indirectly are responsible for regulating uses of resources. These institutions include:

### 5.3.1. NA Planning and Development Department

The Planning and Development of NAis responsible for preparation of annual and perspective plans for development in NA in collaboration with the line departments. All the projects are evaluated and approved by this department. They also recommend allocation and distribution of funds to various line departments for the developmental activities. The department is also responsible for monitoring implementation of the field projects and ensuring sustainability in the various initiatives

### 5.3.2. Forest Department of NA

The Forest Department is headed by a Conservator of Forests and is mandated to manage government forests, national parks and protected areas, wildlife and wetland resources of the region. They are also responsible for promoting forestry, soil conservation, watershed management, and community based conservation. A separate directorate has been created for the management of Khunjerab National Park, which is responsible for the management of this park. The Forest Department directly deals with many components of biodiversity, hence is key stakeholder for maintaining natural capital of NA.

### 5.3.3. Agriculture Department

This department is responsible for maintaining crop, vegetable and fruit biodiversity through germplasm and their use in NA. Their mandate is to provide extension services to farmers for the development of agriculture and horticulture including provision of seed and fruit plants to the farmers. The department maintains many fruit nurseries all across NA, hence is responsible for maintaining genetic diversity among crop and fruit varieties, promoting in situ and ex-situ conservation of local varieties of crops and fruit trees. The department also carries out fertilizer, pesticide and agronomic trials.

### 5.3.4. Livestock Department

Presently, a Deputy Director heads the Livestock Department and it works under the Agriculture Directorate and is responsible for maintaining livestock diversity, controlling diseases, and providing veterinary services to the farmers.

### 5.3.5. Fisheries Department

A Deputy Director heads this department and it also works under the Agriculture Directorate. Fisheries department is responsible for managing fisheries resources found in rivers, streams, and lakes of NA. It also has the mandate to promote aquaculture and regulate fishing in the region. The department maintains a number of fish farms, hatcheries, and provide fingerlings to the farmers. The department can play the key role in maintaining freshwater biodiversity in NA.

## 5.4. Federal Government Institutions

At the federal level several ministries have a stake in maintaining sustainable use of biodiversity in NA. The most relevant ministries include: Ministry of Environment, Local Government and Rural Development (MoELGRD), Ministry of Kashmir and Northern Areas Affairs (KANA) and Ministry of Food, Agriculture, and Livestock.

### 5.4.1. Ministry of Environment, Local Government and Rural Development (MoELGRD)

MoELGRD implements all the biodiversity related international conventions and agreements, except the World Heritage Convention. It would like to:

- See mountain ecosystems intact and their flora and fauna conserved, thus minimizing down stream detrimental impacts.
- Ensure implementation of international biodiversity-related conventions to which Pakistan is a party, For example, CBD, CITES, Bonn Convention, Ramsar Convention, Convention on Combating Desertification, Cartagena Protocol on Biosafety, and Convention on Persistent Organic Pollutants.

### 5.4.2. Ministry of Kashmir Affairs and Northern Areas

Its main stake is in maintaining natural capital of NA for development, well being and security of the people of NA including for poverty alleviation and improving living standard of the rural communities.

### 5.4.3. Ministry of Agriculture

Its stake is to implement agriculture policy of Pakistan and work for the food security of people of NA by conserving agriculture biodiversity of the area. A number of agriculture research institutes work under this Ministry for raising agriculture productivity through research e.g. NARC, KARINA. These institutes have been involved in ex-situ conservation of genetic material of many local varieties of crops, vegetables and fruit trees

## 5.5. Global Interest Groups and Institutions

Many international interest group and institutions would like to deliver goods and services in this unique landscape of the world. A number of international agencies and multilateral donors have been involved in agriculture and food security activities in the region. Some of these organizations are listed below:

- International Fund for Agriculture Development
- GEF/UNDP funded conservation and other projects
- European Union financed projects
- NORAD funded projects
- DFID financed projects
- Aga khan Development Network.

# 6. THE WAY AHEAD

## 6.1. Irrigation for Cultivable Waste

An intensive infrastructure system of irrigation should be developed on priority basis to bring vast cultivable wastes of about 90000 hectares under plough for poverty alleviation. Improving the performance of irrigation system and optimising the utilization of available water resources offer the best growth opportunities for agriculture in the area. The options for this include:

- improvement in the rehabilitation of infrastructure through on-farm water management and new irrigation system development.
- manipulation of crops and crop mixes to favour crops where the returns per unit volume of water are the highest;
- improving the on-farm water management capability of farms and concerned institutions;
- adequate level of funding for repair, maintenance and operation of irrigation systems and fostering policy environment conducive to the sustainable growth of irrigated agriculture. Investment in main irrigation system rehabilitation (e.g. irrigation systems rehabilitation projects) yield relatively high returns ( economic rates of returns).
- Farmers' training, technology demonstration and improved extension services for on-farms water management to increase water use efficiency and farm productivity.

### 6.1.1. Multiple Use of Irrigation Water

It is but logical to explore the opportunities for multiple use of water (e.g. combination of crop culture-fishery, livestock-fish system, water used for power generation and its reuse for irrigation, multi-cropping system e.g. raising of systematic orchards, and inter-cropping of vegetables for seed production and apiculture introduction within the orchards for pollination and honey production.

### 6.1.2. Increasing Water Supplies

Increasing utilization of surface water supplies through construction of dams at appropriate sites e.g. on banks of the rivers for storage of excess water for acute shortage period and construction of channels to barren lands. Water storage projects should be floated for approval. Diamir/Bhasha Dam, small dams on the rivers from Yasin/Khaplu to Chilas will facilitate additional water resource availability.

## 6.2. Support Services

Strengthening other essential agricultural supports services such as marketing, inputs supply and distribution and credit facilities for stimulating agricultural growth. This would initially require clear-cut policies, guidelines and legal framework on the role of the private vis-à-vis the public sector, for achieving

institutional reforms and closer collaboration among the public and private sector and farmers and fish folks.

## 6.3. Improvement in Research and Extension

The high impact research areas include development of high yielding moderately cold/frost/drought, disease resistant, short duration varieties, integrated water-soil and fertilizer-seed and pest management technologies, on-farm irrigation and productivity requirements for diversified crops; appropriate irrigation and drainage design criteria; suitable farm mechanization and post harvest technologies and basin wide approach to irrigation future planning. These researches plus productivity enhancing socio-economic and policy-oriented research on irrigated agriculture should help to close the large yield gaps.

## 6.4. Important Impact Areas in Extension

These processes include technology identification, its field verification and adaptive modification, suitability assessment, through demonstration and packaging for large scale dissemination. Technology identification should not be confined to those developed within the area. It should take full advantage of the technologies developed within the country or else where in the world. Intensive field testing and adaptive modification of new technologies in different designs or modified technologies that are attuned to specific farming conditions and the needs of specific farmers. The demonstration and packaging of tested technology would strengthen extension services and yield very high returns.

## 6.5. Minimizing Post-Harvest Losses

The thrusts in post-harvest handling and processing should be to minimize post-harvest losses in the farm products and to diversify and improve the quality of farm products and by-products by promoting suitable harvest and post harvest technologies and facilities. There is a dearth of suitable storage and processing equipment and technologies in the region. A good starting point to address this issue is to go for testing and adaptive modifications, for promising technologies and equipment developed elsewhere. The government should promote a policy environment conducive to the entry of local and foreign investors into the development of Agro-based industries. The thrust should be in processing of agricultural, livestock, forestry and fishery farm products and by-products including the medium scale food processing facilities. Increasing value added to farm products and farm by-products by processing will not only increase the farms income but will also bring the under privileged groups into the mainstream of sustainable agricultural development in NA.

## 6.6. Improving Existing Agricultural Farming Systems

There are excellent opportunities and potentials for improving the existing farming systems. Unfortunately these opportunities, potentials and advantages could not be

fully harnessed partly as a result of unfavourable policy environment, lack of full appreciation of the nature of such opportunities and inappropriate development strategies. The Northern Areas have sufficient opportunities for the production of high quality seed potato, vegetable seeds, fruit, off-season vegetables and medicinal plants for which the climatic conditions are conducive and favourable to meet the country's annual seed potato and vegetable seed requirement of 290,000 and 3000 metric tones, respectively. Similarly the conditions for medicinal plants production are also highly suited. If proper attention is given, the NA area will be able to produce enough medicinal plants material to meet the total national requirement. The growers and traders will become prosperous. The development of highly productive, intensive, extensive and diversified farming system is feasible in the region.

## 6.7. Livestock Production Strategy

Maximum opportunities exist to expand livestock production and marketing of meat, dairy and poultry products to benefit the rural resource poor farmers. The major programmes required are increasing productivity per animal through introduction of improved breeds and crossing them with local ones, improving feed and fodder availability, improving health services, nutrition, strengthening extension efforts and improving marketing. The role of government is primarily that of providing services to assist farmers and the industries to improve the availability and quality of both inputs and outputs.

There are opportunities for utilizing the vast pasture lands and open areas for sheep, goat and cattle production surrounding rural communities provided that appropriate and sustainable pasture or range management practices based on reasonable animal carrying capacity of pasture lands can be developed and implemented effectively.

## 6.8. Strategies for Sustainable Agriculture and Rural Development

It should address the following challenges:

- a. Identification of agriculture imperatives to meet the needs of rapidly growing population where by in near future an additional 1-2 lac people must be fed from a resource base, which is shrinking due to fragmentation and diverse forms of degradation. However, intensification may carry problems of pollution, contamination and waste disposal, which can affect natural resources, environment and health.
- b. Present agriculture practices do not offer sufficient opportunities for gainful employment. Due to poverty in rural areas, the people either erke out their livelihood at the expense of natural resources which are their sole means of survival or leave the area in search of employment in the other cities of the country or abroad.

## 6.9. Global Challenges

The global dimensions of a number of environmental threats such as the depletion of natural resources, climatic challenge, air and water pollution, deforestation,

desertification and loss of biological diversity depend upon:

- a. Resource endowment of the region.
- b. Existing environmental constraints.
- c. Demographic situation and trends.
- d. Available technologies and human skills.

## 6.10. Food Security

If to be sustainable, agriculture must meet the challenges of food security in quantitative and qualitative terms, provide more employment and better incomes, contribute to the eradication of poverty, while at the same time conserve the natural resources and protect the environment. The status and role given to farmers must be commensurate with their responsibilities vis-à-vis other segments of population. Agriculture sector to have better terms of trade versus industry or tertiary sectors. Similarly, the terms of trade between the agricultural producers and those who process, market and consume agricultural products, (the urban dwellers in particular), should be influenced, so as to take better account of the cost to farmers and other rural people of natural resources conservation and environmental protection for sustainable development.

## 6.11. Forest Resources

The forestry sector registered a negative growth rate for the last one and half decade due to timber mafia of illegal cutting of natural forest trees. The sustained growth of the sector and long-term benefits from the forest resources of the region can only be achieved through better conservation and management. The major constraints for realizing these are lack of coherent set of policies to address forestry management and conservation problems and political will to formulate such policies and effectively implementing them.

The forestry sector can be redeveloped by afforestation and filling up of the gaps in forest in animal prohibited blocks for 4 to 5 years to grow up the trees in a reasonable height to be saved from animal destruction. From the viewpoints of food security and poverty alleviation, development imperatives and opportunities in forestry are:

- optimising the benefits to rural communities through community based forestry, agro-forestry-livestock farming systems and sustainable production of fuel wood.
- management of critical water sheds so that the beneficial hydrologic impact of forests on stream flows, surface water quality and aquatic life are preserved. This implies that the rights and management of community forestry and agro-forestry areas are best transferred from the state to communities or individuals.

## 6.12. Human Resource Development

There is a strong need for large investment in the education sector catering to rural areas. Raising the literacy level is an essential condition for the success of rural (agricultural) development programmes. Diversification of rural economic activities also presumes that rural population possesses a minimum level of

education attainment. Nutritional improvement also requires a basic level of education especially for females. The regular schooling caters mostly to young population. Adult education programmes are also needed to target the dropouts and the older one's both the farmers and the workers in small scale rural enterprises, traders and entrepreneurs to strengthen the institutes in their efforts to produce better research and extension manpower. In agriculturally developed countries the farmers are the best researchers and extensionists for sustainable agricultural development due to high literacy rate.

## 6.13. Participatory Approach

The participation of local communities to take more responsibility in decision-making and implementing rural development programmes cannot be over emphasized. This implies delegation of more power down to local level, by providing incentives for local community initiatives and people participation. For this purpose clear rights should be allocated with regard to resource use at local level, including those related to the role of women in agriculture. Education, training and support services have to be provided to enable people to assume responsibility for managing the resources sustainable and protecting their environment. The role of voluntary organizations and communication programmes in this regard should be enhanced.

## 6.14. Marketing of Fruits and Vegetables

Both fruits and vegetables are produced in orchards or on small farmers scatteredly situated with the result the growers have neither the knowledge nor capability of improving the quality of the products essential for maintaining the standard of end products to the international requirement.

Due to rough handling, lack of storage, packing and transport facilities, considerable post harvest losses occur. At the minimum these could range 20-40 % of the produce.

To reduce losses in fruits and vegetables research must be undertaken on aspects like delayed ripening, radio-pasteurisation, waxing, control of fruit rot and dehydration.

The marketing system for fruits and vegetables is highly undeveloped. Since small farmers are located at long distances from the main marketing centres, this allows the middle man to charge exorbitant commissions which reduce the returns to farmers.

Marketing of vegetables can be partly improved by encouraging their cultivation around human dwellings (villages, Towns, cities) and in increasing farmers cooperatives to handle activities like securing inputs by obtaining credits for harvesting, storage, packing and marketing.

To protect the economic interests of growers, floor prices can be announced once a week, as is done for onion and potato in the Punjab.

A variety of vegetables are grown which are locally marketed, only a moderate quantity is marketed in the down country. The vegetables marketed locally are :

cabbage, tomato, potato , onion, spinach, Chinese cabbage, beans, peas, bell paper, chillies , cucumber(white), cucurbits, okra, and brinjal . The vegetables that are marketed down country include mainly potatoes while peas, tomato and cucurbits are also marketed in moderate quantities.

**Table 83: Sequence of availability of fruits for marketing**

| Name of Fruit | Time of Maturity |
|---|---|
| Cherries | May |
| Mulberry | End May |
| Apricot | June |
| Peaches | July-August |
| Grapes | August-September |
| Pears | September |
| Apples | October |
| Pomegranate | End August-Oct. |

The cherries, apricot, pears and apples are marketed down country. Dried fruits/nuts that are marketed in the local and down country market include apricot (dry) mulberry (dry) pomegranate, (Anardana), grapes (kishmish) almond (Badam), apricot kernel (sweat seed) apricot kernel (bitter seed for oil).

Main problem of marketing is that it is scattered and their is no organized marketing system. FAO 2001 chart of fruit & vegetable marketing reflects how month wise steps can be taken for improvement.

## 6.15. Agricultural Research and Karakoram International University

Two important events have taken place in NA. First, emergence of agriculture as priority No 1 in all the five districts of NA. Second the establishment of Karakoram International University.

The existing situation is that the infrastructure for Agricultural Extension exists. It is the extension that is also bootlegging in research as well as training-a part of education. Perhaps the University can be asked to established a full fledged Faculty of Agriculture to attend to various facets of crops, fodder, fruits vegetables, pest management livestock, poultry and fisheries. The education and research modules could be tailored to suit the diversity of situation. Research areas needing immediate attention could be advertised every year to hire competent persons. A monthly calendar of training to train farmers could be chalked out, A consultant could be hired at least for a period of two years to plan and implement the Action Plan, synthesize, the available information. Since the research part is very weak. A person having good research management and comprehensive knowledge about overall agriculture can facilitate quick take off.

Likewise, an Agricultural Research Centre could be established in each district to collect and collate all kinds of information, plan, implement and disseminate the

technology. The training, teaching, or extension material may be continuously updated by a good synthesizer for at least 3-4 years . KIU can hire a good consultant for this . For the sustainability of research system a Endowment Fund should be established either in KIU or in the NA Planning and Development Department, where from the researchers could benefit through short term result oriented projects.

## 6.16. Soil Degradation

There is a spreading decline in the soil quality. This will have serious consequences for NA agriculture and water quality , since the soil losses its ability to filter impurities as well as for the ecological balance in general. It is all the more worrying since natural soil regeneration occurs at a small pace. In a damp climate, it takes 500 years for a layer of soil only 2.5 centimetre( one inch') thick to form. There is a strong need to analyse the impact of government policies on farming, water management, forests and urbanization.

## 6.17. Conserving the Indigenous Materials

Conservation implies preservation or prevention of losses and wastes. NA has a spectrum of indigenous land races numbering 32in cereals and pulses, 10 in vegetable , 13 in fodder, 19 in pears, 3 in grapes , 7 in cherries one in chilghoza. Some of the interesting attributes are as below :

- Apple varieties grown in Hunza and Skardu at 2450 m altitude are winter hardy and adopted to harsh climatic conditions
- Pears show diversity in fruit size, shape, taste, sugar, content, time of maturity, fragrance. Some fruit trees are as old as 35 years
- In Apricot, due to its occurrence all over NA, there exists a plethora of names. This appears because of diversity of languages Apricot vary in size, colour, texture and sugar contents (22-35%) and seed size
- Walnut varies in size, shape, colour, skin thickness, etc. The adoptive characteristic of some of the fruit and land races of other crops must be mostly genetically determined or physiologically regulated. While various attributes have been recorded in crops, fruits and vegetables, identical information in the livestock fisheries, poultry etc is not available. Partly no research system exists in NA. However, all genes that reflect good attributes can be conserved either by establishing a gene bank, by in-situ or ex-situ approaches, emerging biotechnological approaches or establishing protected areas, providing legal protection to wet lands

## 6.18. Administrative Set-up

The existing administrative set-up of Agriculture Dept. is not very conducive. It is necessary to expand it as given below:

- A separate set-up of Agricultural Extension, headed by a DG.
- A separate set-up of Animal Husbandry headed by a DG.
- A separate set-up for fisheries headed by a Director. All sub sectors should be provided with mobility vans, liberal funding and frequent trainings, both within and abroad. Where deficient, local consultants be hired. A Charter of Duties of the various functionaries be re-defined per changing situation, every five years.

The Department of Agricultural Extension may further be strengthened by initiating the following.

- A Research and Development Institution may be established in each province for proper investigation /research and development in various fields of Agriculture.
- An Out-Research/On-Farm Demonstration unit within the Department of Agriculture be established for confirmation of the results obtained on experimental station, on the fields of representative farmers under their prevailing circumstances. A sub-office of Agriculture Census Department should be established in Gilgit for collecting necessary statistics.
- A Coordination and Information Technology Cell may be made operational at Gilgit for Coordination among the scientists of KARINA. Agricultural extension, agricultural research, farmers, down country Research Institutes/Organizations, NGOs etc who are involved in Agriculture Development. All agencies should be mandated and have a programme.
- A well-equipped Training Centre should be established in Gilgit on NA. level to impart. Training to lower field staff and farmers in modern techniques of Agriculture for over all development of agriculture in NA.
- For Capacity Building of Subject Matter Specialists down country trainings or visits abroad be made compulsory.

## 6.19. Gender Integration

Currently the involvement of women is limited to farm operations, and domestic activities. A crash programme for skill development and optimisation of human potential should be launched in NA, in the following:

- Honey bee
- Sericulture
- Poultry
- Fish farming - trout farming
- Mushroom cultivation
- Orchard maintenance
- Dairy farming
- Syrup preparation from mulberry
- Maraba, Jam and Marmalade preparation from apples, pears, plums, etc.
- Packing of fresh and dry fruits for sale, e.g. apricot, grapes, etc.
- Floriculture and cut flowers
- Preparation of pickles
- Urban agriculture, like growing green pepper in pots
- IPM in small plots
- Ex-situ & in-situ cultivation of selected medicinal plants

Similarly, the crash programmes should be initiated in each district to break down the isolated development in various communities and promote building up of certain level of confidence among even the uneducated and unskilled people to face the upcoming challenges.

Such programmes can also be used to sensitise the trainees, how to realize the unrealised potential in crops, vegetables, fruits and cash crops. How to conserve, preserve and protect the biological heritage of NAand regulate the animals grazing activities in the pastures and alpine meadows.

## ANNEX 1:

# ORGANISATION OF AGRICULTURAL SERVICE BODIES

Companies willing to under take agriculture services to small farmers in the villages will be registered as corporate bodies under Companies Registration Act.

Sufficient number of tractors are available in the country that are willing to carry out cultivation of land, trashing of produce, transport the production for marketing. These tractors can be hired to provide these services to small farmers by the service companies

Sufficient quantities of seed, fertilizer and pesticides are available with the commercial companies who will be willing to sell these items to agricultural service companies in bulk allowing them sufficient commission.

The agricultural service organization will have to prepare a contract to be signed by the beneficiary farmers that will include all terms and conditions of services rendered. One of the service condition will be that farmers will not have to pay the service charges over and above the price prevailing in the area at the time when the service is rendered.

## Unit Management

The agricultural service companies divide their area of operation into units of 1000 acres each to be managed by a Graduate Field Officer with agricultural training and provided with

- Duties of Unit Manager (Field Officer)
- To organize the farmers who are willing to obtain the services on the terms and conditions of the companies.
- Get the contracts signed by the individual farmers.
- Keep record of all the services rendered to the farmers.
- To get beneficiaries sign the service paper on completion of service by stating the cost of service.
- Arrange services of tractor and required inputs.
- Handle the accounts of individual farmers.
- Effect recovery at the time of harvest.

In case of any dispute the case will be subjected to arbitration by a non-official.

Registrar appointed by the Government for this purpose, who will coopertise the re-organization so as to facilitate the services organization on these lines has been tested on 2300 acres of wheat in the districts of Mandi Bahao-ud-Din, Sialkot and Sahiwal. And on 1679 acres of cotton in Sadiqabad area. It helped to raise the production of the farmers substantially and also yielded profit to the organizations.

## Financial

The companies engaged in agricultural services will charge actual cost of inputs and machinery services from the farmers while meet their administrative costs from rebates and commissions from the agricultural Businesses concerned.

Rebate for machinery services will be obtained from the tractor owners who will be willing to charge the company a fraction of the prevailing rate less from the company who will provide them substantial business and ensure payment to them. Similarly, seed and fertilizer suppliers will allow commission on the sales made by service organization. The pesticide companies will allow more commission, to service companies who will have plant protection operation under their supervision over large areas. Thrashing of wheat can also be done on reduced rates by the company that will add to their revenue. The companies will also get the advantage of premium on the collective marketing of the produce from the area under their control. In fact service organization will have more interest in the marketing of produce because it will facilitate the recovery of loans extended by them, The loans will be on actual costs without any interest.

## Benefits

Inducting agricultural service organization in private sector to serve small farmers will solve the time old problem of improving productivity of small land holdings in Pakistan that will cease the over all agricultural production of the country, very substantially, that is otherwise not possible through the Dept. of Agriculture.

- It will ameliorate the economic conditions of small land holders by increasing their income.
- It will provide more employment to the land less population in the villages, as it has been estimated that 5% increase in agricultural production will create 400,000 jobs to handle the additional production.
- Organizing cooperatives under non-official registrars if successful will open a new era in rural development. Cooperative Societies will under take Dairy and Poultry production for the benefit of the country and improve the economic conditions of livestock owners in the villages? Many small-scale cottage industries will be developed in the villages. Edible oil production in the rural area can be carried out to achieve self-sufficiency in this field.
- By collectivisation of small holdings, pace of agricultural improvement will be accelerated. This impossible work can be accomplished only through the services organization.

## Government Incentives

Agricultural development work through private sector will not be a burden on government exchequer. In order to encourage private companies to under take agriculture services the Government may provide incentives like:

- Income tax relief.
- Remission of duties on the import of agriculture machinery.
- Appointment of non official registrar for agricultural services companies to facilitate resolution of disputes and recovery of their loans through arbitration
- Permit direct loaning to Agricultural Services Cooperatives by the Federal Bank of Cooperatives.

## ANNEX 2:

# WILD RELATIVES AND LAND RACES OF CROP PLANTS IN NA

Past efforts in crop development show that wild plants and relatives and wild gene pool have been successfully used to our advantage in many ways. This include domestication of new crops, development of crops with disease, pest, drought resistance, high yields, vigour, environmental adaptation, high food value and adaptation for harvesting, transport, post harvest handling and quality. The use of these resources is expected to continue and will probably increase as there is need to cope with new ecological conditions (salinity, alkalinity, water logging etc.), more virulent diseases, more tedious pests, fluctuation in climate, and changing economic demands. Changes in technology and social expectations also encourage greater use of wild relatives of crop plants.

It has been reported in the literature that Increased attention is being devoted to genetic resources of wild relatives of crop plants. Wild relatives of crop plants have two major functions in genetic resources studies: (1) they provide a geographic framework of reference to elucidate patterns of genetic diversity and domestication; and (2) they constitute an increasingly important source of diversity for a wide range of traits. Examples have been given in literature on the phylogeography, organization of genetic diversity, inheritance of domestication syndrome and assessment of gene flow in some wild and cultivated legumes. In all these studies, molecular markers, including DNA sequences, have provided a wealth of data, which, together with phenotypic and ecological data have significantly increased understanding of the genetic resources of these legumes.

The present article presents an account of crop plants with their wild relatives occurring in northern areas of Pakistan. An attempt has been made to document diversity and prevalence of potentially important agricultural plants used by the inhabitants of the area. Tabulated data are presented of cultivated species and their commonly accepted wild relatives and land races.

## Wheat

### Wild relatives of wheat and their distribution

Wheat, Triticum aestivum, Common Bread Wheat (2n= 42) a genus of about 25 species is probably native to only middle east. Four species are in cultivation in Pakistan. Various forms of it are cultivated from the plains to over 4000 masl. Its common name is Kanak/Gandam. The other forms of wheat grown in Pakistan are *T. durum* (2n. = 28) and *T. turgidum* (2n= 28)

Triticum consists of a polyploid series in which there are diploid, tetraploid and hexaploid representatives with chromosome numbers of 2n= 14, 28 and 42 respectively. Genome analysis of karyotypes has shown that only the diploides are genetically true *Triticum.* The others strictly speaking, are intergeneric hybrids

between *Triticum* and certain species of *Aegilops*. The tetraploid have a *Triticum* genome plus one derived from *Aegilops speltoide*s Traush, while the hexaploides have both of these plus a third derived from *Aegilops squarrosa* Linn.

Genus Aegilops is closely related to genus *Triticum*. Although hybrids occur, nevertheless the two genera are sufficiently distinct morphologically. Three genera of Aegilops have been reported from Pakistan (A. tauschii, A. *cylindrica* and A. *triuncialis* from Baluchistan, NWFP and Kashmir) but none from northern areas.

Another wild relative is genus Secale (Rye) having 6-8 species out of which 3 occur in Pakistan including the cultivated S. *cereale* and two other namely S. *segetale* and S *montanum*. Only one, S. *segetales* occurs in northern areas in Nomal and Naltar in Gilgit District.

Another related genus *Agropyron* has been found to contain resistant genes for stem and leaf rust of wheat. .

The earliest cultivated plant forms are called land races evolved from wild populations. The land races that did not acquire broad genetic diversity, during their evolutionary process eventually succumbed to the ravages of disease, drought cold and other unfavourable environmental stresses. The land races that survived became the progenitors of the modern crop varieties.

### Land races of wheat

There is a rich genetic variation in wheat in northern areas of Pakistan. The indigenous land races are highly variable in traits such as awn, straw thickness, and grain size and colour, and spike density. All local varieties collected from the region belong to hexaploid and tetraploid wheat. Different species distributed in the region are *Triticum aestivum* (hexaploid), *T. aestivum subsp compactum* (hexaploid), *T. aestivum subsp sphaerococum* (hexaploid) and *T. durum* (tetraploid), *T. polonicum* (tetraploid) and *T. turgidum* (tetraploid). Variation in traits may have been because of differences in altitude, soil moisture regimes, cultural practices, introduction from neighbouring countries and wheat supplies to northern areas of imported wheat from down country on regular basis, and social isolation from one valley to another. So far rate of genetic erosion is low largely as a result of lack of high yielding varieties. However high yielding varieties (HYV) have replaced the traditional land races in certain locations such as Hunza where supplementary irrigation and other development facilities, are available. A list of land races found being cultivated in the region is given below.

## Barley (*Hordeum vulgare*)

Barley, *Hordeum vulgare,* a six rowed barley, is grown in the plains of Pakistan and at up to 4,700 meters above sea level.

### Wild relatives and their distribution

Hordeum, a genus of 25-30 species in temperate regions, 8 species (*H. aegiceras, H. vulgare, H. distichin, H. spontaneum, H. murinum, H. murinum sub sp gussoneanum, H. bogdanii and H. brevisubulatum*) are found occurring in Pakistan, 3 of them are

cultivated barley. Wild species, *H. bogdanii* has been reported growing from Minapin to Chalt and Nagar, and Gilgit to Imit in Ghizar district. It has also been reported from alkali plains below Shigar and Shigar in Baltistan. *H. brevisubulatum* and *H. brevisubulatum subsp. nevskianum* and *subsp. turkestanicum* have been reported growing from Ishkoman and Nubra valleys of Ghizar and Baltistan respectively.

## Rice (*Oryza sativa Linn*)

A genus of 20 species, two species, *Oryza coarctata* and *O, sativa* occur in Pakistan. No wild species have been reported from Northern Areas. Nevertheless, rice cultivation used to be common in some parts of the region like Ghizar, Ponial valley and Hunza till 1990. It disappeared after the construction of KKH perhaps due to availability of high quality rice from down country. Therefore, wild races of rice disappeared from the area. In Darel valley rice used to be cultivated in various villages especially in Phuguch village. Similarly it has been reported from village Lurk in Tangir valley. These land races have been lost due to availability of better quality rice from mainland Pakistan.

## Sorghum (*Sorghum bicolor Linn*)

Sorghum, a genus of 24 species only 4 species, *S.nitidum, S.halepense, S. arundinaceum* and *S. bicolor* which are cultivated, are found growing in Pakistan.

### Wild relatives and their distribution

Only *S. halepense* has been reported to occur in Northern Areas.

## Pearl Millet (*Penisetum americanum Linn.*)

Penisetum, a genus of about 70 species, only 6 species (P. glaucum, P. lanatum, P. orientale, P. hohenackeri, P. flaccidum and P. divisum) are reported to occur in Pakistan.

### Wild relatives and their distribution

*P. lanatum* has been reported to occur in Naltar of Gilgit District and north eastern slopes below Rama of Nanga Parbat. *P. orientale* has been reported to occur in Kargah nallah, about 7.5 km from Gilgit and 10 km east of Kiris and Shyok river in Baltistan. *P. flaccidum* is reported to occur in Nomal, district Gilgit and Satpara nallah and Shingo valley in Baltistan.

### Land races of Millet

Only one land race is reported from Ponial, Yaseen and Gupis valleys in Ghizar Districts. Needs a further exploratory survey during crop growing areas and season of the crop.

## Chick pea (*Cicer arietinum*)

It has been reported that HKH region is the main resource base for wild relatives of Chickpea. Three species *Cicer microphyllum, C. nuristanicum* and *C. macranthum* have been reported to occur in Chitral and Swat districts of NWFP and Gilgit, Skardu and Ganche districts of northern areas. The only species, *C. microphyllum*, is

reported from Gilgit Skardu and Ganche on road side slopes and pastures under thorny bushes *Rosaceae* and together with *Juniperus*, A small population of *C. microphyllum* was spotted at an altitude of 3560 m in Sust north of Gilgit.

Chickpea is not being grown in the Northern Areas.

## Bent grasses (*Agrostis Sp*)

Agrostis, a genus of about 150-200 species, only 8 (*A. viridis, A. hissarica, A. munruana, A.pilosula, A.vinealis (A. canina) A. filipes, A. stolonifera (A. alba) and A. gigantea*) occur in Pakistan. Although grown in Pakistan only on experimental basis but the genus contains several related species of agricultural value growing wild.

### Wild relatives and their distribution

Three species occur in northern areas (A. viridis in Gilgit and Shigar in Baltistan, *A. vinealis* (*A. canina*) is reported to occur in Jutial nalah, Nushkin and Naltar valley in Gilgit district, Astore valley, Minimarg in Diamir, Chatpani nalah, Satpara lake and Shingo valley in Baltistan. *A. stolonifera* (*A. alba*) was found growing in Baltit in Gilgit district and Shigar near Bandipur in Baltistan. Agrostis gigantea is reported in Naltar valley in Gilgit district and Skardu in Baltistan.

## Oat (*Avena fatua/A. sativa*)

A genus of about 10-15 species found as weed, only two, *A. sativa* and *A. byzantina* are widely grown. In Pakistan only 4 (*A. byzantina*, *A. barbata* and *A sterilis* are found one of them *A. fatua/A. sativa* is cultivated widely in Pakistan.

### Wild relatives and their distribution

Wild relatives, *A. byzantina*, *A. barbata* and A sterilis, have been reported to occur in Naltar in Gilgit and Skardu in Baltistan.

## Bromegrass (*Bromus spp*)

A genus of about 90 species, 19 species occur wild in Pakistan. Seven species are reported from northern areas. (*B. japonicus* from Skardu, *B. pectinatus* from Naltar and Nomal and Rama in Astore valley, *B. oxyodon* from Rattu and Rupal nallah in Astore valley *B. tectoram* from: Kargah in Gilgit and Shyok watershed and above Kasurmik in Baltistan, *B. gracillimus* from Dras valley in Baltistan,. *B. confinis* in Naltar, upper Astore valley, Biafo glacier in Baltistan, and one introduced *B. inermis* and also occur as wild from Chatpani nullah west of Dras, Dras valley, Shakargah near Astore Valley, Biafo glacier in Baltistan.

### Fruit Plants

Geographically, Pakistan lies between two major centres of fruit diversity, the Caucasus Mountains and China. An ancient trade route from China through Central Asia to Western Asia passes through the Northern Mountains of Pakistan. Fruit species from along the entire route were brought here and have been cultivated for centuries. These fruit species have been diversified through human selection over centuries. Farmers in the mountain areas of Pakistan are traditionally fruit growers, and fruit crops are a very important source of food and livelihoods.

Thus there is considerable genetic variability in the fruit species in the mountains (Bhatti et al. 1982). The pattern of variation and adaptation species varies greatly in different areas.

### Apricot (*Prunus armeniaca*)

Various types of apricots that belong to one species (*Prunus armeniaca*) are grown in Skardu, Gilgit and Hunza. They vary widely in fruit size, colour, and texture and sugar contents Wide variation may result from the nature of seed propagation. A wide variation exists in the seed size and taste of the fruit, which ranges from bitter to sweet. Total soluble sugar (TSS) in the local apricot varieties ranges from 22 to 36 percent. The local varieties, Halman and Marghulam, Habbi, Shakanda have the best quality for taste and Kacha choli the best keeping quality.

### Apple (*Malaus pumila*)

Apple is an important fruit crop for mountain farmers of Pakistan. Here apples are adapted to very diverse climatic conditions. All the cultivated varieties belong to *Malaus pumila*. Several local varieties of apple are grown in Skardu area such as A*mbri kusho, nas kusho, shin kusho, skuir kusho, mar kusho,* and *bong kusho*. Of these. Ambri kusho is the best apple variety for quality. A large number of local varieties are grown in Gilgit and Hunza. The most common and widespread varieties are Noor shah balt, Mamu balt, Shakar balt, Beruit Balt, Alikan Balt. Shikam Balt and Akbaraman Balt.

To a great extent, the local apple varieties in NA have now been replaced by few commercial varieties such as Golden Delicious and Red Delicious. Large-scale plantations of improved varieties in NA during the past few decades have played a vital role in improving the farm economy of these areas but also led to genetic erosion of native varieties.

The Hunza and Skardu areas have altitudes of 2,450 m and above a dry and a very cold climate. Here local apple varieties have evolved that are winter hardy and adapted to harsh climatic conditions.

The information about apricot is insufficient and scanty.

### Pear (*pyrus communis*)

The common pear (*pyrus communis*) is grown widely in this mountain area. The local pears are very diverse in terms of fruit size, shape, taste and time of maturity. There is a land race available in Shalt area that is very sweet, Juicy and beautifully fragrant. The land race fruits very late commonly when the plant reaches the age of about 30 to 35 years as reported by the local farmers. Pyrus pashia (wild pear) is also found in northern areas.

### Grapes (*Vitis spp*)

The diverse grape varieties (*Vitis spp*) found in the northern mountains of Pakistan include land races of *Vitis vinefera* and *V. jacquemontii* and a wild species, *V.parvifolia. V. vinifera* demonstrates great diversity in Skardu, Hunza, and Gilgit valleys.

### Walnut

Northern areas are major growing areas for walnuts (*Juglans regia*). The walnut land races have a range of variation of size, shape, colour, and shell thickness (varying from a very thin to a very hard shell).

### Chilgoza (*Pinus geradiana*)

Chilgoza (*Pinus geradiana*) trees grow in northern areas. The cones are collected, and the seeds extracted and sold.

Other fruit plant occurring found in wild are as under:

Pome fruits – *Malus domestica* (domestic apple); *Cydonia oblonga* (quince); *Sorbus lanata* (sorbus); *Sorbus tianshanica* (sorbus); *Cartaegus songarica* (cartaegus); Cotoneaster nummilria; C. offins; *C. integersma.*

Stone fruits – *Prunus cerasioides (cherry) NA; ; P. jacquernontii; P. prostrata; P. cerasus (pie cherry); P. avium (sweet cherry); P. mahaleb mahaleb (cherry introduced); P. tomentosa; P. cerasifera.*

Other fruit trees – *Diospyros lotus; Ficus carica; Olea ferruginea*

Tree Nuts – *Pistacia atlantica; Prunus bucharica; Prunus pedis;*

Small fruits – *Duchesnea indica; Fragaria nubicola; Ribes alpestre; R. orientale; Rubus anatolicus; R. ellipticus; R. hoffineisterianus; R. ierritones; R. macilantus; R. nivens.*

## Weeds

Weeds are also part of agro-biodiversity, but they have not usually been considered as plant genetic resources for food and agriculture. But as both crops and weeds have been subjected to the influence of domestication and have co-evolved over a long period of time, they provide an untapped reservoir of genetic diversity. Some weed species are utilized plants and some are pre- adapted to become cultivated plants. They are indicators for biodiversity. They are useful for studying the parallel effects of domestication in cultivated plants, and weeds and their evolution. Several weed species are indicators of the autochthonous (original/native) land races of crops they accompany. Several weeds with a great similarity to crop plants, so-called convergent weeds, are in danger of becoming extinct, due to intensification of agriculture and improved methods of seed cleaning (*e.g. Agrostemma githago, Bromus secalinus, Lolium temulentum*). Ex situ preservation must also be linked with the reintroduction of weed species into agro ecosystems (i.e. maintenance in situ), so that genetic diversity forms part of actively functioning and continually evolving ecosystems. Thus, it is not right to consider weeds only as crop concurrence as is usually done in an agricultural context.

The present paper presents an account of cultivated/crop plants with their wild relatives occurring in northern areas of Pakistan. An attempt has been made to document the diversity and prevalence of potentially important agricultural plants used by the inhabitants of the northern areas of Pakistan. Tabulated data of cultivated species and their putative wild relatives have been presented. Nevertheless the information provided in the paper is insufficient because of lack

of documented data. Therefore, this subject needs a thorough and comprehensive treatment to document wild relatives and land races of food crops, fodder crops, vegetables, fruits plants and pulses etc. The local land races also require a separate treatment, as there are still many land races available in the area because of old and traditional agriculture in most of the valleys. The farmers still use very old varieties of crop plants in the far-flung and comparatively isolated valleys of northern areas. like Ashkoman, Phandar, various valleys of Baltistan, Diamir, and Ghizar and Ganche district. A comprehensive expedition/survey during crop growing periods to document is needed to be conducted. It should be done as soon as possible before it is lost forever.

In developing this paper extensive use of flora of Pakistan and a few sporadic personal interviews of farmers were recorded. Nevertheless the author very strongly feels that the information provided in the paper is insufficient and reflects only a fraction of the total information that might be available.

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