Draft

Technical Report
on

# THE CHARACTERIZATION OF THE AGRO ECOLOGICAL CONTEXT IN WHICH FAnGR (FARM ANIMAL GENETIC RESOURCE) ARE FOUND

# DEVELOPMENT AND APPLICATION OF DECISION SUPPORT TOOLS TO CONSERVE AND SUSTAINABLY USE GENETIC DIVERSITY IN INDIGENOUS LIVESTOCK AND WILD RELATIVES

By

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# 1. INTRODUCTION

## 1.1. BACKGROUND AND JUSTIFICATION

Agriculture in Pakistan dates back to **Neolithic** times. It formed the base of the well-known **Indus Valley Civilization.** Of late, its contribution to the Gross Domestic Products (GDP) decreased from 52 percent in 1950-51, to just about 21.9 percent in 2001-02. This is primarily because of higher growth rates registered by other sectors, particularly, the manufacturing.

The economy of Pakistan has undergone considerable changes and diversification in the past, however, the agriculture sector still remains the largest sector as it played an important role in the national economy by contributing about 23.3 percent to the total GDP. This accounts for 42.1 percent of the total employed labor force in the country. Moreover, it is the largest source of foreign exchange earnings by serving as the base sector for the major industries like textile and sugar (Economic Survey, 2003-04). During the last decade (1990-2000), agriculture grew at an annual growth rate of 4.5 percent per anum, however, this growth rate was uneven and volatile as there was an annual increase of as high as 11.7 percent and decline by as much as 5.3 percent. Trends of contribution of agriculture to total GDP during the last almost seventeen years have been shown in table-1.

**TABLE 1 TRENDS OF AGRICULTURAL CONTRIBUTION TO GROSS DOMESTIC PRODUCTS (GDP)**

| Year | Total GDP | Agriculture GDP | Total Agriculture of GDP | Agriculture Contribution to GDP | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Major Crop | Livestock | Minor crops | Fishery | Forestry | |
| | Billion Rs. | | Percent | % share of total agriculture | | | | | |
| 1985-86 | 342.2 | 93.4 | 27.3 | 49.5 | 27.7 | 17.9 | 3.8 | 1.1 | 100 |
| 1990-91 | 446.0 | 114.5 | 25.0 | 47.8 | 29.8 | 17.3 | 3.9 | 1.2 | 100 |
| 1995-96 | 577.1 | 148.8 | 25.8 | 41.8 | 36.4 | 17.9 | 3.3 | 0.6 | 100 |
| 1999-00 | 619.1 | 158.8 | 25.7 | 40.6 | 36.4 | 19.2 | 3.4 | 0.4 | 100 |
| 2000-01 | 665.6 | 164.0 | 24.6 | 40.9 | 37.7 | 16.82 | 3.5 | 1.09 | 100 |
| 2001-02 | 689.6 | 150.8 | 21.9 | 40.1 | 38.37 | 16.75 | 3.7 | 1.08 | 100 |

- Source: Economic Survey, 1993-94, 1999-2000 and 2001-02
- GDP in billion Rs. at constant factor

The share of agriculture sector to the overall economy has observed decreasing trend as compared to the industries, which is progressing gradually, during the last couple of years. The contribution of the major crops in the total agricultural GDP is the highest, however, its contribution is decreasing slightly for the last few years. The share of minor crops during the last 3-4 years is also showing the declining trends. However, fishery contribution to the agriculture sector has increased during 2001-02. The share of livestock in the total agricultural GDP has shown a linear upward trend but slow and gradual increase during the last two decades and during 2001-02 it accounted for about 38.37 of the total agricultural GDP.

In Pakistan, livestock is an important sub-sector of agriculture as it contributes about 49.1 percent of agriculture value added and 11.4 percent of the total GDP. The role of livestock in the rural economy may be realized from the fact that 30-35 million rural population is engaged in livestock raising and having household holdings of 2-3 large ruminants and 5-6 small ruminants per family. This helps them to derive 30-40 percent of their income from livestock rearing (Economic Survey, 2003-04). During 2000-01, livestock's net foreign exchange earnings were 53.0 billion, which were almost 12.34 percent of the overall export earnings of the country (Economic Survey 2000-01).

Pakistan is endowed with diversified domesticated farm animal genetic resources (FAnGR) such as buffalo, cattle, sheep, goat, poultry, camel, horses, and donkeys. Farm animal genetic resources commonly referred as livestock have their economic importance, which goes beyond direct food production such as milk, meat and eggs. Skins, fibers, manure (fertilizer or fuel), draught power and capital are also livestock benefits.

In Pakistan, the livestock is an integrated part of agriculture; therefore, most of the livestock are reared under the agro-livestock production system in irrigated and non-irrigated agriculture production system. Pastoral livestock production system is also prevalent in the country and most of the small ruminants are reared under this production system. Moreover, agro-pastoral livestock production system is not

uncommon in the country. Poultry production system comprises of the rural poultry and the commercial poultry.

During 1981-2000, the production of livestock products i.e., milk, beef and mutton increased with an overall annual growth rate of 4.68, 4.18 and 4.28 percent .In case of poultry, meat and egg production during, the same period, growth rate of 10.92 and 8.07 percent per anum was observed. The poultry production has given an appreciably high growth rate during the last two decades. Annual per capita consumption of milk, all type of meat and eggs was 82.4 kg, 14.23 kg and 61.54 numbers in year 2000. During 1981-2001, the overall increase in the per capita consumption of animal food products was 2.5 percent per anum.

There is a general perception that due to population growth, increase in per capita income and socio-economic behavior, there will be a change in dietary pattern particularly in favor of livestock dietary products in South Asia. Rosegrant et al. (1995) and Vercoe et al (1997) suggested that Asian countries will consume more milk, meat and eggs. They predicted that these countries may face deficiency of meat production and hence effort should be made to produce more animal products through either expanded or increased production.

To coupe with the challenge for ever-increasing demand of animal food products; the identification of the priority species of FAnGR, their breeds and their breeding and management exploitations are needed on priority basis. Livestock production systems and their changing scenario have to be understood properly to make the appropriate and cost effective intervention and also to make these systems efficient and production oriented. Since, the livestock production system of Pakistan are in continuous shift from the conventional to semi-commercial or commercial systems particularly in case of milk production, therefore, it is presumed that exclusively livestock or agro-livestock production system will expand in future. Hence, it is of great importance to examine the farm animal genetic resources in conjunction with their species, breeds and production system coupled with agriculture production system and agro-ecological context which is envisaged in this study.

## 1.2. OBJECTIVES

The present study entitled, **"The Characterization of the Agro-ecological Context in which FAnGR (Farm Animal Genetic Resources) are found"**, is a part of larger study of the project entitled, **"Development and Application of Decision-Support Tools to Conserve and Sustainably Use Genetic Diversity in Indigenous Livestock and Wild Relatives"**. This project has been initiated by the GEF-UNDP Project 2715-03-4709 under which this study is carried out with the main objective to describe the main agro-ecological zones in term of bio-physical characteristics, operative agriculture and livestock production system, FAnGR and their species and breeds.

# 2. AGRO-ECOLOGICAL ZONES OF PAKISTAN

Pakistan is a land of diverse ecologies. In the north there are high mountains interspersed with valleys. Southwards there is the Pothwar Plateau followed by fertile Indus Plain, which is 1287 km long and 322 km wide, with a 1.0 percent gradient from north to south. The western part mainly comprises Baluchistan Plateau, bordered by high to low mountains on the north-east. There are two sandy deserts in the Indus Basin; the Thal desert in the upper part and the Thar desert in the south-east. Marshy areas occur in the Rann of Kutch, along the southern most border of the country.

## 2.1. AGRO-ECOLOGICAL ZONES BASED ON PHYSIOGRAPHIC CHARACTERISTICS

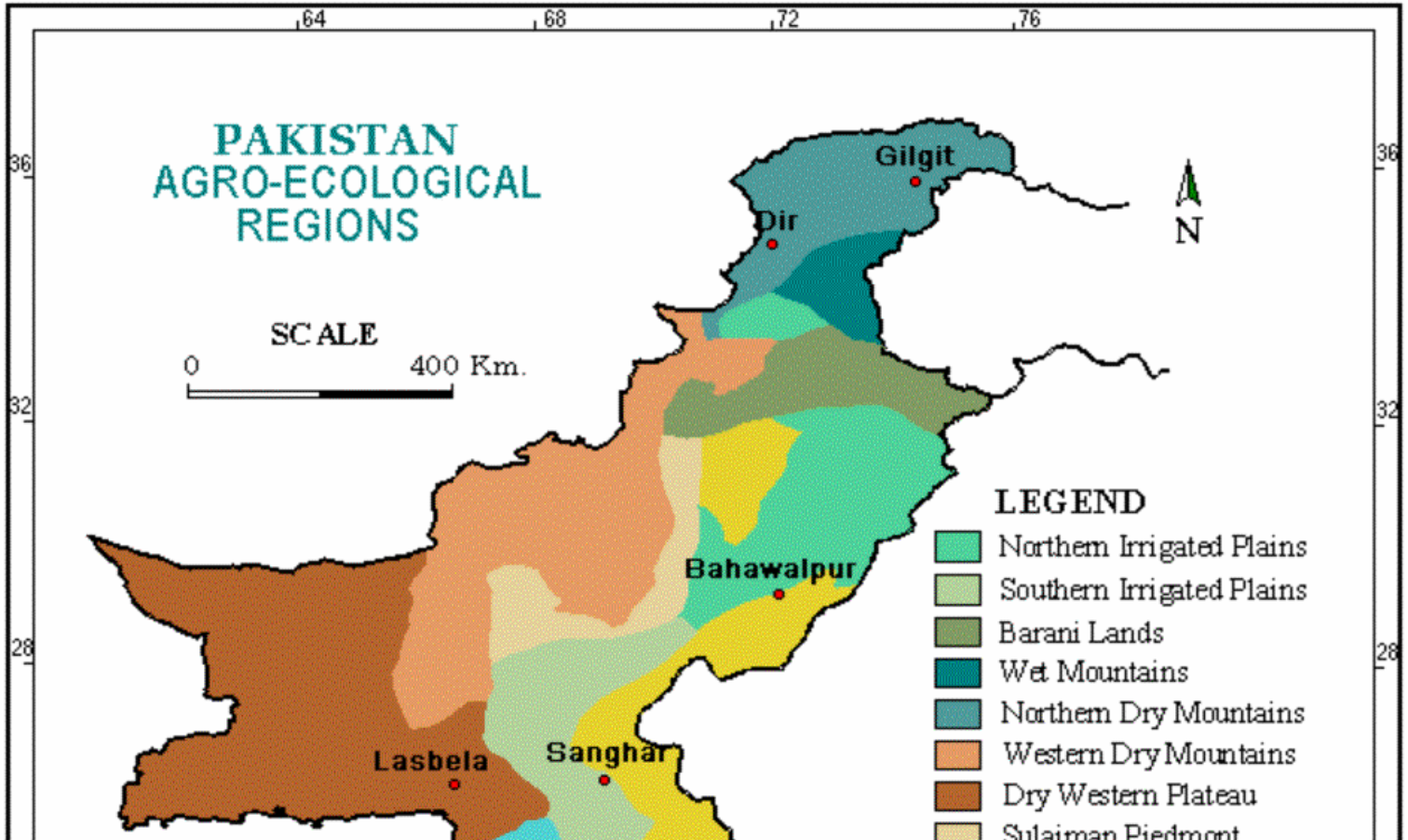
PARC (1980) and Muhammad (1986) have delineated the country into ten agro-ecological zones/regions of Pakistan mainly on the basis of physiographic and on climate, soil type and agricultural land use.

The main agro-ecological zones of Pakistan are the following;

1. Indus Delta
2. Southern Irrigated Plain
3. Sandy Desert
4. Northern irrigated Plain
5. Barani (rainfall)
6. Wet Mountains
7. Northern dry mountains
8. Western Dry Mountains
9. Dry western Plateau
10. Sulaiman Piedmont

These agro-ecological zones of Pakistan are depicted in map no. 1.

.


PAKISTAN
AGRO-ECOLOGICAL
REGIONS
SCALE
0
400 Km.
N
64
68
72
76
36
32
28
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
Northern Irrigated Plains
Southern Irrigated Plains
Barani Lands
Wet Mountains
Northern Dry Mountains
Western Dry Mountains
Dry Western Plateau
Sulaiman Piedmont

The physiographic, climatic characteristics, soil and land use of the various agro-ecological zones are summarized in table 2.

**TABLE 2 AGRO-ECOLOGICAL ZONES OF PAKISTAN**

| | |
|---|---|
| **1- Indus Delta** | This zone comprised Thatta district and parts of Badin and Hyderabad districts.<br><br>**Physiographic and Climatic Characteristics**<br><br>Represents the Indus delta. Climate is arid tropical marine; mean daily max. summer temp. ranges between 30-40$^{o}$C; and winter temp. between 19-20 $^{o}$C; mean monthly summer rainfall is 75 mm and winter is less than 5 mm ; relative humidity 67-68 percent in the morning and 30-35 percent in afternoon.<br><br>**Soil and land use**<br><br>Two types of soils; clayey and silty; clay soils found in shallow basins and silty soils in nearly level flat areas; strongly saline-alkaline soils are barren and parts of clayey soils are under cultivation.<br><br>The main Kharif crops include rice, sugarcane and cotton, whereas the major Rabi crop is wheat, however, other crops like millet, maize, barley, rape and mustard, gram, fodder, pulses and vegetable crops are also common. |
| **2- Southern irrigated plain** | The zone includes lower Indus Basin covering districts of Dadu, Larkana, Jaccobabad, Sukhur, Sibi, Shikarpur, Badin, Tharparkar, **Sanghar**, Khairpur, Nawabshah, parts of Hyderabad and Rahim Yar Khan.<br><br>**Physiographic and Climatic Characteristics**<br><br>Represents lower Indus Plain formed by meandering of Indus river. Climate is arid subtropical continental with hot summer and mild winter; mean daily max. temp. is 40-45$^{o}$C and min. temp. is 8.5$^{o}$C in the northern areas, and 38-43$^{o}$C and 8-12$^{o}$C in the southern areas, respectively; mean monthly summer rainfall is 18mm in the north and 44-55 mm in the south; winter is practically dry. |

| | |
|---|---|
| | **Soils and land use**<br><br>Soil is silty and sandy loam associated with the active flood plain, upper areas of the flood plain is calcareous, loamy and clayey.<br><br>Crops grown: cotton, wheat, mustard, sugarcane, berseem on the left bank of Indus and rice, wheat, gram and berseem on the right bank; sorghum is the main crop in Southern Dadu. |
| **3- Sandy Desert** | This zone comprises **Bahwalpur**, Tharparkar (partially), Khairpur, Nawab Shah, Sanghar, Rahim Yar Khan and Bahwalnagar districs. Parts of Muzaffargarh, Mianwali and Sargodha districts constitute this zone.<br><br>**Physiographic and Climatic Characteristics**<br><br>a. Sandy desert with xerophytic vegetation; central part occupied by salt lakes; southern part rainfall 300 mm.<br>b. Area covered with various forms of sand ridges and dunes and sand sheets with profuse short trees and vegetation; northern part rainfall 300-350 mm.<br><br>**Soils and land use**<br><br>a. Sandy soils and moving sand dunes, undulating sand ridges 20-25 m high and 1-3 m long; western part has strips of clayey soils.<br>The major Rabi crops are millet, wheat, rape and mustard and fodder whereas the major Kharif crops are cotton, fodder, sugarcane and remaining crops are millet, sorghum, rice, maize, pulses etc.<br><br>b. Sandy and loamy fine sandy soil, stable ridges; moderately to strongly calcareous.<br>The major crops in Kahrif are cotton, sugarcane and rice and in Rabi are wheat and gram. The other crops include rice, maize, sorghum and millet, pulses and vegetable. |
| | This zone comprises Multan, Vehari, Sahiwal, Lahore, Kasur, Faisalabad, Jhang, Shiekhupura, Gujranwala and parts of Bhawalnagar, Rahim Yar Khan, Muzaffargarh, Sargodha and Gujrat districts. Furthermore districts of Peshawar and Mardan are |

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|---|---|
| **4-Northern Irrigated plain** | also part of this zone.<br><br>**Physiographic and Climatic Characteristics**<br><br>Areas between Sutlej and Jhelum rivers; different flood plains and bar upland; Climate semi-arid to arid (east to south west) subtropical continental; max. (summer) and min. (winter) temp. is 39.5 $^{o}$C and 6.2 $^{o}$C respectively; in the east and 41-42 $^{o}$C in the south west; mean annual rainfall 300-500 mm in the east and 200-300 mm in the south west.<br><br>Alluvial valleys of Peshawar and Mardan plains Climate semi-arid subtropical continental; mean daily max. (summer) and min (winter) temp. 43-44 $^{o}$C and 5 $^{o}$C respectively, mean monthly rainfall range 20-32 mm both in winter and summer<br><br>**Soils and land use**<br><br>Soil sandy loam-clay loam; southern and central part calcareous silt loams and about 15 percent saline-sodic; northern part loam and clay, calcareous, saline sodic in local areas.<br><br>Canal irrigated agriculture; crops: wheat, rice, sugarcane, oilseeds and millets in the north and wheat cotton, sugarcane, maize as well as citrus and mangoes in the central and southern parts. |
| **5. Barani (rainfall)** | The parts of D.I. Khan, Banu, Mianwali, Abbotabad, Rawalpindi, Gujrat, Gujranwala, Attock, Jhelum and Sialkot are included in this zone.<br><br>**Physiographic and Climatic Characteristics**<br><br>Covers the salt range, Potowar Plateau (generally open and undulating) and the Himalayan Piedmont plains.<br><br>Narrow belt along the foot of mountains nearly humid mean daily max. (summer) temp. 38.5 $^{o}$C; mean monthly rainfall 200 mm in summer and 36-50 mm (Jan-Feb).in winter.<br><br>Southwestern part is semi-arid and hot; mean daily max. (summer) temp. 38 $^{o}$C and min. (winter) temp. 4-7 $^{o}$C; mean monthly rainfall is 85 mm in summer and 30-45 mm in winter. |

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|---|---|
| | **Soils and land use**<br><br>Eastern part dominantly non-calcareous to moderately calcareous silt loams; west southern part mainly calcareous loams.<br><br>Rainfed agriculture is the main land use. The major Kharif crops are rice, sorghum, millet, maize, pulses, groundnut and sugarcane, whereas main Rabi crops are wheat, gram, rape seed and mustard and barley. |
| **6. Wet Mountains** | This zone includes Mansehra district and part of Rawalpindi and Hazara districts.<br><br>**Physiographic and Climatic Characteristics**<br><br>Covers high mountains (intervented by wide and narrow valley plains) and plateaus.<br><br>Eastern part is humid with mild summers and cold winters; mean daily max. (summer) temp. 35 $^{o}$C and min. (winter) temp. 0-4 $^{o}$C; mountain tops covered with snow in winter and spring; mean monthly rainfall 236 mm in summer and 116 mm in winter.<br><br>Western part is sub humid Mediterranean, with dry summer; rainfall confined to winter and spring.<br><br>**Soils and land use**<br><br>Soil is silt loam to silty clays, non-calcareous to slightly calcareous (pH 7.5-8.1); organic matter 1 percent in cultivated fields and 2-4 percent in forest areas.<br><br>Only 25 percent of the area under rainfed agriculture, the rest under the forest; main crops maize and wheat (rice grown in small areas irrigated from springs and streams); fruits (mainly apples) in areas at more than 1500 m altitude; olives grown in low hills; on 1500-5000 m altitude coniferous forests and scrub vegetation and about 5000 , permanent snow |
| | This zone comprises Chitral, Dir, Swat, Tribal areas of Peshawar and Kohat and some of the agencies. |

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|---|---|
| **7. Northern dry mountains** | **Physiographic and Climatic Characteristics**<br><br>Includes Gilgit, Baltistan, Chitral and Dir valleys irrigated by glacier-fed streams; climate is undifferentiated; tops of high mountains covered with snow, greater part of the year; mild summers and cold winters; mean monthly rainfall 25-75 mm in winter and 10-20 mm in summer.<br><br>**Soils and land use**<br><br>Soils in valleys is deep and clayey and on mountain slopes shallow; non-calcareous acid (pH 5.5-6.5) above 2100 m altitude and calcareous at lower altitude<br><br>Most of the area is used for grazing; a part under scrub forest. Wheat and maize grown rainfed in valleys and lower mountain slopes and rice irrigated in local areas; fruits grown in flank streams. |
| **8.Western dry mountains** | The districts of Kohat, Zohb, Loralai, Kallat, Sibhi, Quetta; part of Karachi, Banu and its tribal areas and agencies.<br><br>**Physiographic and Climatic Characteristics**<br><br>Composed of barren hills (1000-3000 m) with steep slopes. Climate is undifferentiated; greater part is semi-arid highlands with mild summers and cold winters. Southern areas mean daily max. (summer) temp. 30-39 $^{o}$C and min. (winter) temp. -3-7.7 $^{o}$C mean monthly rainfall 30-35 mm.<br><br>Extreme north western area sub humid, mean daily max. (summer) temp. 32 $^{o}$C and min. (winter) temp 2 $^{o}$C; mean monthly rainfall 95 mm in summer and 63-95 mm in winter.<br><br>**Soils and land use**<br><br>Soils in valleys are loamy, deep and strongly calcareous; mountains have shallow soil.<br><br>Major land use is grazing; part of the loamy soils grown to wheat with the flood water; very small portion is irrigated and fruits (apples, peaches, plums, apricots, grapes) wheat and maize are grown. |

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|---|---|
| **9. Dry western plateau** | The district of Karachi, Makran, Kharan, Chagai, Lasbella and Mehal Kohistan tehsil of Dadu district are included in this zone.<br><br>**Physiographic and Climatic Characteristics**<br><br>Mountainous areas with inter-mountain basins and plateaus, steep and rugged with narrow valleys between.<br><br>Climate is arid (desert) tropical; mean daily max. (summer) and min. (winter) temp. 40.5 $^{o}$C and 3-6 $^{o}$C respectively; in the north and 33-34 $^{o}$C and 11.5-15 $^{o}$C respectively along the coast; mean monthly rainfall 36-37 mm in summer in the southeast and other parts 2.4 mm. Coastal belt receives sea breeze.<br><br>**Soils and land use**<br><br>Soils in plains are silt loams, deep and strongly calcareous, and hill slopes are shallow. The lower regions have xerophytic vegetation and grasses and higher altitudes have juniper forests and wild olives.<br><br>Land use is mainly grazing; melons and sorghum quite extensive; fruits, vegetables and wheat grown where spring or "Kareze" water is available. |
| **10. Sulaiman Piedmont** | This zone comprises districts of D.I. Khan and D.G. Khan, Dhadar, Bagh tehsil of Kacchi District.<br><br>**Physiographic and Climatic Characteristics**<br><br>Comprises piedmont plains of Sulaiman Range and alluvial fans built by streams. Climate is arid and hot, subtropical continental; mean daily max. (summer) temp.40-43 $^{o}$C and min. (winter) temp. 5.8-7.6 $^{o}$C; mean monthly rainfall 13 mm in summer.<br><br>**Soils and land use**<br><br>Soils are loams in gently sloping areas but clayey further away; strongly calcareous, with narrow strips of salinity sodicity at the junction of piedmont plain and river flood plain.<br><br>Torrent-watered cultivation is the main land use, and wheat, millets and some gram and rice main crops. |

## 2.2. AGRO-ECOLOGICAL ZONES BASED ON ARIDITY

According to FAO (2001), Pakistan has been divided into five agro-ecological zones which have been given as under;

1 Desert
2 Arid
3 Semi-arid
4 Dry Sub-humid
5 Moist Sub-humid

The above mentioned agro-ecological zones and respective densities of human population and of total livestock units, large ruminants (cattle and buffalo), small ruminant units (sheep and goats) and poultry units per square kilometer are given in fig. 2 and fig. 3.

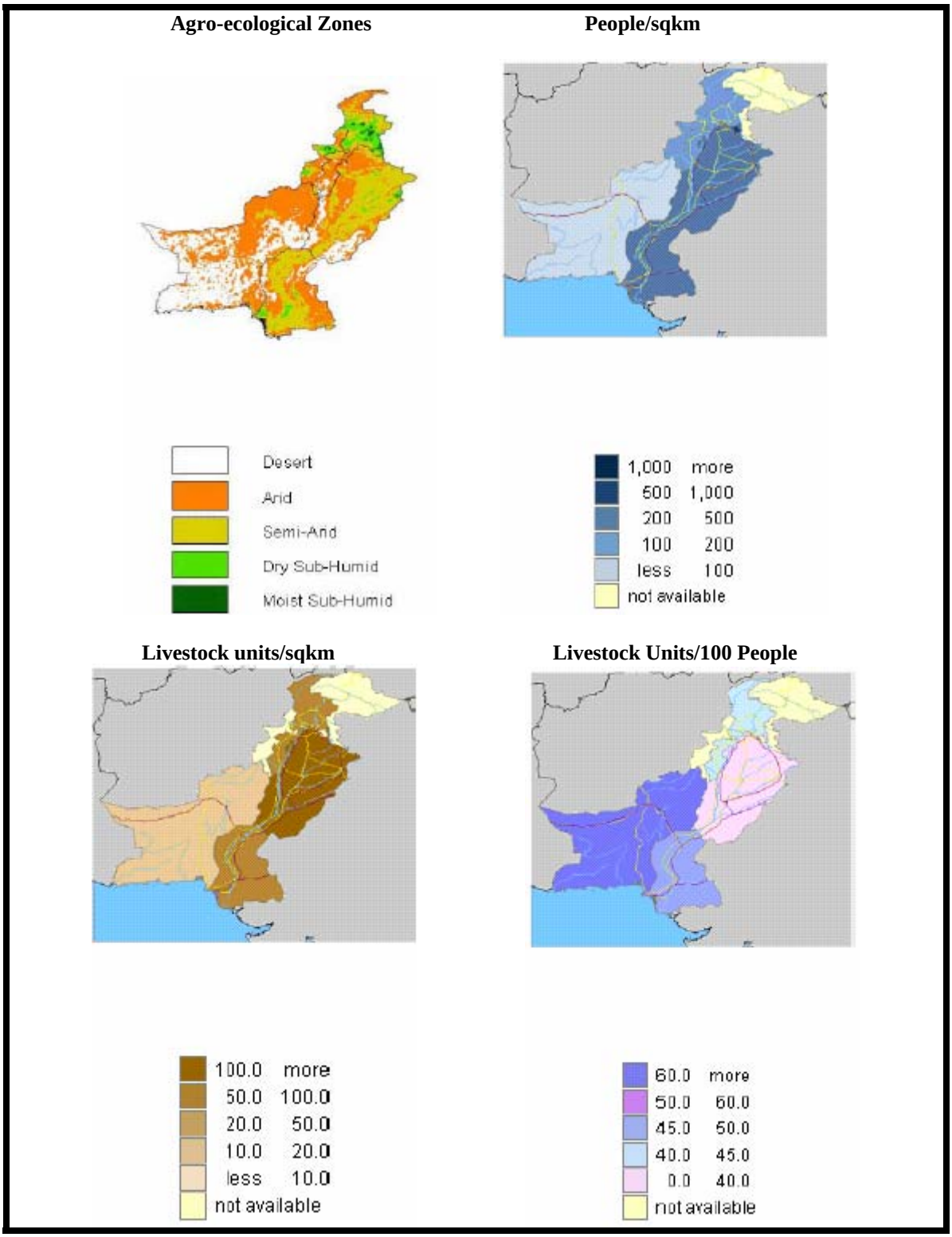



**Fig. 1 Agro-ecological Zones of Pakistan, Human and Livestock Population Density**

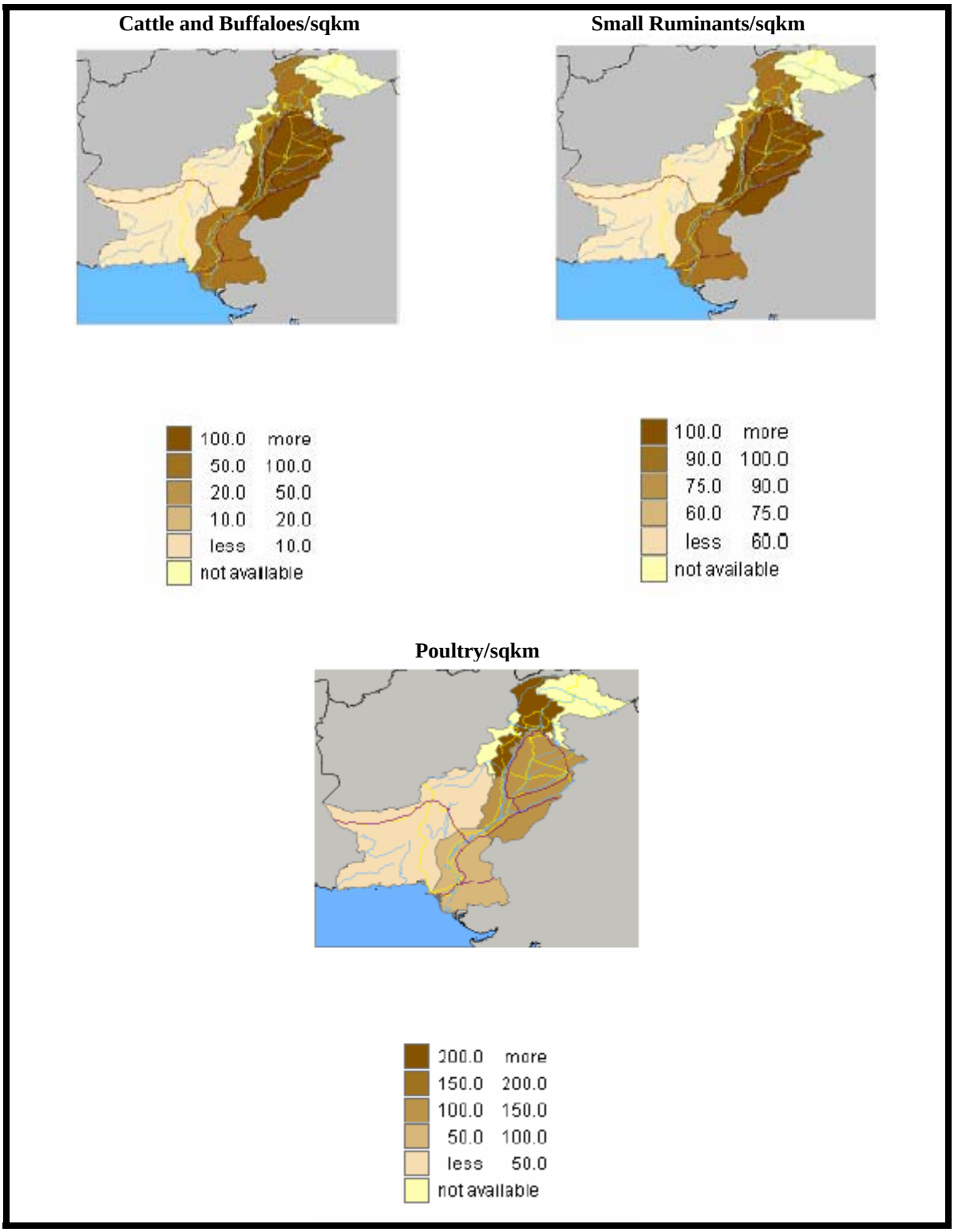



**Fig. 2 Small and Large Ruminant Population Density**

## 2.3. Land Use Pattern

Pakistan has been divided into five major categories of land; ***reported area, forest area, cropped area, cultivable waste and unreported area***. The data has a time interval of 52 years sufficient to determine the change in land use pattern if any during 1947-48 to 1999-2000. The land use pattern is indicated in table 3.

**TABLE 3. LAND USE PATTERN OF PAKISTAN (million ha)**

| Category | 1947-48 | 1999-2000 | % Change |
|---|---|---|---|
| **Geographical Area** | 79.61 | 79.61 | 00.00 |
| **Reported Area** | 47.43 | 59.28 | + 24.98 |
| **Forest Area** | 2.84 | 3.66 | + 28.87 |
| **Cropped Area** | 14.60 | 22.76 | + 55.89 |
| **Cultivable Waste** | 11.50 | 9.13 | - 20.60 |
| **Unreported Area** | 32.18 | 20.33 | - 35.82 |

Source: Several issues of Agriculture Statistics of Pakistan.

During the last 52 years, there had been a considerable change in the cropped and forest area. The cropped area has increased to the tune of 55.89 percent during 1947-48 to 1999-2000. Annual growth rate of cropped area remained 0.30 and 0.40% for 1980-90 and 1990-2000 respectively (FAO, 2003). Out of the total cropped area about 18 million hectares are irrigated while the remaining 4.76 million hectares is rainfed. The area under forest represents about 3.66 million hectares which is about 4.5 percent of the total geographical area. During the last 52 years, forest area has increased from 2.84 to 3.66 million hectares with a change of 28.87 percent. A significant size of waste land has converted to productive land and the level of waste land conversion into productive land was observed as 20.60 percent during the last 52 years. Consequently, the unreported area has reduced. (Agricultural Statistics of Pakistan, 1999-2000)

Generally, Pakistan is defined as an arid and semi-arid country where rainfall is not sufficient to support agriculture production and hence needs to be supported with canal, tube well and well irrigation etc. To support the canal water irrigation, Pakistan has the largest network of canals in the world and highly productive land comes under the canal command areas. Tube wells and wells are the other means for irrigating the land where the sub soil water is suitable for irrigation. Along with these irrigation systems, run-off water is also harvested for sowing and irrigating the crops.

## 2.4. CLIMATE

Depending on the topography, there is an extreme variation in the temperature of Pakistan. The country is essentially arid except for the southern slopes of the Himalayas and the sub-mountainous tract where the annual rainfall varies between 760 and 1270 mm. This area has humid sub-tropical climate. In the extreme north - because of great heights - Highland climate prevails. The controlling factors of the climate are:

1. The sub-Tropical location of Pakistan that tends to keep the temperature high, particularly in summer.

2. The oceanic influence of the Arabian Sea that keeps down the temperature contrast between summer and winter at the coast.

3. Higher altitudes in the west and north that keep the temperature down throughout the year.

4. The Monsoon winds that bring rainfall in summer.

5. The Western Depression originating from the Mediterranean region and entering Pakistan from the west that brings rainfall in winter. These cyclones make a long land journey and are thus robbed of most of the moisture by the time they reach Pakistan.

6. A temperature inversion layer at a low elevation of about 1,500 m in the south during the summer, that does not allow the moisture-laden air to rise and condensation to take place.

### 2.4.1. Temperature

Pakistan can be divided into four broad temperature regions:

1. Hot summer and mild winter: $32^{o}$ C or more in summer and 10 - $21^{o}$ C in winter.

2. Warm summer and mild winter: 21 - $32^{o}$C in summer and 10 - $21^{o}$C in winter.

3. Warm summer and cool winter: 21 - $32^{o}$C in summer and 0 - $10^{o}$C in winter.

4. Mild summer and cool/cold winter: Summer temperature between 10 and $21^{o}$C and winter temperature between 0 and $10^{o}$C.

Data regarding 10 years (1974 - 1983) and 14 years (1984-98) for the mean maximum and mean minimum temperatures at some selected meteorological centers is presented in table 4:

**TABLE 4. MAXIMUM AND MINIMUM TEMPERATURES ($^{o}$C)**

| Station | 1974-1983 | | 1984-98 | |
|---|---|---|---|---|
| | **Mean Maximum** | **Mean Minimum** | **Mean Maximum** | **Mean Minimum** |
| 1. Quetta | 24.3 | 7.4 | - | - |
| 2. Zhob | 25.6 | 12.1 | - | - |
| **3. Khuzdar** | **28.1** | **14.2** | **30.5** | **14.3** |
| 4. Panjgoor | 29.5 | 15.0 | - | - |
| 5. Dalbandin | 31.0 | 13.5 | - | - |
| 6. Rawalpindi | 28.4 | 14.1 | - | - |
| 7. Peshawar | 29.7 | 15.8 | - | - |
| 8. Jhelum | 31.2 | 13.4 | - | - |
| 9. Lahore | 30.7 | 18.0 | - | - |
| 10. Sargodha | 31.9 | 16.6 | - | - |
| 11. Faisalabad | 30.8 | 16.2 | - | - |
| 12. D.I. Khan | 31.3 | 16.8 | - | - |
| 13. Multan | 33.0 | 18.1 | - | - |
| **14. Bahawalpur** | **32.6** | **18.0** | **32.9** | **17.9** |
| 15. Jacobabad | 33.6 | 20.1 | - | - |
| 16. Nawab Shah | 35.0 | 18.1 | - | - |
| **17. Hyderabad** | **34.4** | **21.3** | **34.1** | **21.1** |
| 18. Karachi | 31.7 | 20.4 | - | - |

Time series (1974-98) data analysis of mean maximum and mean minimum temperature revealed that there is wide variation in mean maximum and minimum temperature among the different districts/locations in Pakistan. However, analysis further revealed that mean maximum and minimum temperature did not undergo major changes during the last twenty years (1974-98).

### 2.4.2. Rainfall

The major part of Pakistan experiences dry climate. Humid conditions prevail but over a small area in the north. The whole of Sindh, most of Baluchistan, the major part of the Punjab and central parts of Northern Areas receive less than 250 mm of rainfall in a year. Northern Sindh, southern Punjab, north-western Baluchistan and the central parts of Northern Areas receive less than 125 mm of rainfall. True humid conditions appear after the rainfall increases to 750 mm in plains and 625 mm in highlands.

There are two sources of rainfall in Pakistan: the **Monsoon** and the **Western Depression,** the former takes place from July to September and the latter, December to March.

Based on the average rainfall (in mm) between 1974-1983 and 1984-98, table 5 attempts to give a picture of the quantity of precipitation received in Pakistan.

**TABLE 5. MEAN ANNUAL RAINFALL (mm)**

| **Station** | **Mean Annual Rainfall** | |
|---|---|---|
| | **1974-83** | **1984-98** |
| 1. Quetta | 378 | - |
| 2. Sibi | 217 | - |
| 3. Kalat | 274 | - |
| 4. Chaghi | 148 | - |
| 5. Zhob | 297 | - |
| **6. Khuzdar** | **272** | **315** |
| 7. Panjgoor | 128 | - |
| 8. Dalbandin | 125 | - |
| 9. Rawalpindi | 1364 | - |
| 10. Peshawar | 441 | - |
| 11. Kohat | 593 | - |
| 12. Bannu | 416 | - |
| 13. D.I. Khan | 327 | - |
| 14. Jhelum | 960 | - |
| 15. Sialkot | 1186 | - |
| 16. Sahiwal | 109 | - |
| 17. Lahore | 729 | - |
| 18. Sargodha | 526 | - |
| 19. Faisalabad | 485 | - |
| 20. Multan | 225 | - |
| **21. Bahawalpur** | **266** | **177** |
| 22. Jacobabad | 135 | - |
| 23. Nawab Shah | 162 | - |
| 24. Rohri | 174 | - |
| **25. Hyderabad** | **193** | **158** |
| 26. Karachi | 265 | - |

Rainfall pattern and moisture regimes are subject to limitations: there is no clear altitudinal trend of precipitation. As an example, the Dry Temperate Zone in the north of Pakistan and to the west of Baluchistan (bordering Afghanistan) are highlands and

mountainous regions but do not receive even a fraction of the precipitation of what the Moist Temperate Zone or even the sub-Tropical areas receive.

The data revealed that there is a decline in annual rainfall at most parts during the last twenty five years.

# 3. AGRICULTURE PRODUCTION

Agriculture sector is the largest sector of the economy of Pakistan as it played an important role in it by contributing about 23.3 percent of the total GDP. This accounts for 42.1 percent of the total labor force in the country. Moreover, it is the largest source of foreign exchange earning by serving as the base sector for the major industries like textile and sugar (Economic Survey, 2003-04).

The agriculture of Pakistan is characterized by two main cropping seasons namely the kharif (summer crops-April to September) and Rabi (winter crops-October to March). Rice, sugarcane, cotton, maize, sorghum and millet are kharif crops whereas wheat, gram, tobacco, barley and rape and mustard are rabi crops. Wheat, rice, cotton and sugarcane account for 91 percent of the value added in major crops. The value added in major crops accounts for 34.2 percent of the value added in overall agriculture. However, the four major crops (wheat, rice, cotton and sugarcane) on an average contribute 31.7 percent to the value added in agriculture, whereas, the minor crops account for only 12.4 percent of the value added in agriculture.

## 3.1. AREA, PRODUCTION AND FARM STRUCTURE OF MAJOR CROPS

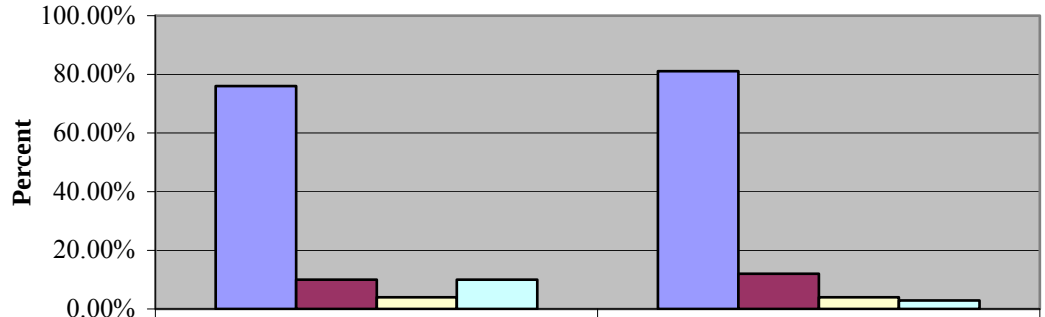
Agricultural production i.e., area cultivated, total production and farm structure of crops, will be discussed in the proceeding paragraphs in detail for the four major crops i.e., wheat, rice, cotton and sugarcane. Furthermore, fodder production will also be explained because of its importance as a major feedstuff for the livestock production area.

### 3.1.1. Area, Production and Farm Structure of Wheat

Wheat is the major Rabi crop in Pakistan. It is the staple food of the people and thus occupies a central position in agriculture. Wheat contributes 13.8 percent to the value added in agriculture and 3.4 percent to GDP (Economic Survey, 2003-04). Wheat share of total cropped area is about 40 percent, the largest area under single crops. It is

cultivated both in irrigated and rain fed areas. Share of provinces i.e., Punjab, Sindh, NWFP and Baluchistan in total area under wheat and its production is given in fig. 3.

**Fig. 3 Provincial Share of Wheat Area and Production in Pakistan**




| | Area | Production |
|---|---|---|
| Punjab | 76.00% | 81.00% |
| Sindh | 10.00% | 12.00% |
| Baluchistan | 4.00% | 4.00% |
| NWFP | 10.06% | 3.00% |

Area, production and farm structure of wheat for the year 2000 is given in table 6.

**TABLE 6. AREA, PRODUCTION AND FARM STRUCTURE OF WHEAT**

| Size of Farm | Total Farms (000) | Farms under Wheat (000) | Area (000 ha) | Production (000 tons) |
|---|---|---|---|---|
| **All Farms** | 6620 | 5330 | 9468 | 20763 |
| Small Farms | 3815 | 3074 | 2058 | 4520 |
| Medium Farms | 2437 | 1986 | 4990 | 10928 |
| Large Farms | 368 | 270 | 2420 | 5315 |

Farms Sizes: Small Farm = 0.5 to >2.0ha, Medium Farms = 2.0 to >10.0 ha,

Large Farms = 10-60 and above

Source: Agriculture Census, 2000

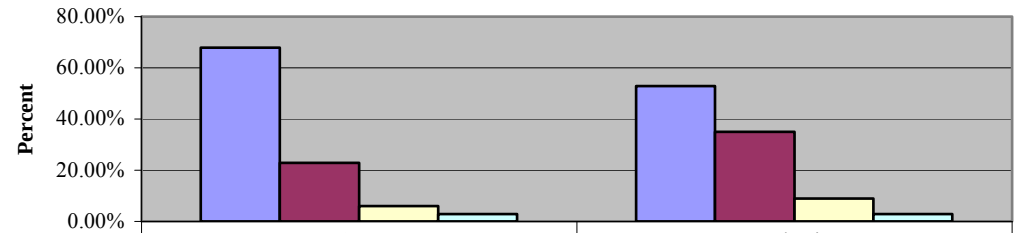
In year 2000, the total number of agricultural farms in Pakistan was 6620 thousands and out of these total farms, 5330 thousand farms were involved in wheat production, which were about 80 percent of the total farms. Total production of wheat was 20763 thousand tons and the area under wheat production was 9468 thousand hectares. The contribution of small, medium and large farms was 21.77, 52.63 and 25.60 percent, respectively in the total wheat production. This showed that contribution in wheat production was maximum (52.63 %) by the medium farms (Agriculture Census, 2000).

During 2001-02, the wheat production was 18227 thousand tons which was increased to 19183 thousand tons in 2002-03 with an increase of 5.2 percent. Subsequently, in 2003-04, wheat production was less by 1.2 percent than the target of 20 million tons set by the government. This comparatively low production was mainly because the crop was affected by low rainfall in the month of April (Economic Survey, 2003-04).

### 3.1.2. Area, Production and Farm Structure of Rice

Rice is a highly valued cash as well as food crop that earns substantial foreign exchange for the country. It accounts for 5.4 percent of value added in agriculture and 1.3 percent in GDP. Rice share of total cropped area is 12 percent of the total cultivated area (Economic Survey, 2003-04). Share of each province of Pakistan in total area under rice and its production is given in fig. 4.

**Fig. 4 Provincial Share of Rice Area and Production in Pakistan**




| | Area | Production |
|---|---|---|
| Punjab | 68.00% | 53.00% |
| Sindh | 23.00% | 35.00% |
| Baluchistan | 6.00% | 9.00% |
| NWFP | 3.00% | 3.00% |

Area, production and farm structure of rice for the year 2000 is given in table 7.

**TABLE 7. AREA, PRODUCTION AND FARM STRUCTURE OF RICE**

| Size of Farm | Total Farms (000) | Farms under Rice (000) | Area (000 ha) | Production (000 tons) |
|---|---|---|---|---|
| **All Farms** | 6620 | 1613 | 2918 | 5983 |
| Small Farms | 3815 | 760 | 522 | 1071 |
| Medium Farms | 2437 | 759 | 1636 | 3354 |
| Large Farms | 368 | 94 | 760 | 1558 |

Source: Agriculture Census, 2000

In year 2000, the number of agricultural farms involved in rice production was 1613, which was about 24.37 percent of the total farms. The total production of rice was 5983 thousand tons and the area under rice production was 2918 thousand hectares. The contribution of small, medium and large farms in rice production was 17.90, 56.06 and 26.04 percent, respectively. This showed that contribution in rice production was maximum (56.06 %) by the medium farms followed by large and small farms.

During 2001-02, the rice production was 3882 thousand tons which was increased to 4478 thousand tons in 2002-03 with an increase of 15.3 percent. Subsequently, in 2003-04, rice production was further increased by 8.3 percent. This higher production of rice is due to improved water availability and better price incentives in the market (Economic Survey, 2003-04).

### 3.1.3. Area, Production and Farm Structure of Cotton

Cotton is not only an export-earning crop but it also provides raw material to the local textile industry. It accounts for 8.2 percent of the value added in agriculture and about 2 percent to GDP (Economic Survey, 2003-04). Share of each province i.e., Punjab, Sindh,

Baluchistan and NWFP in total area under cotton and its production was 81.00, 17.89, 0.58 and 0.00 percent and 79.58, 19.75, 0.03 and 0.00 percent, respectively. Area, production and farm structure of cotton for the year 2000 is given in table 8.

**TABLE 8. AREA, PRODUCTION AND FARM STRUCTURE OF COTTON**

| Size of Farm | Total Farms (000) | Farms under Cotton (000) | Area under (000 ha) | Production (000 bales) |
|---|---|---|---|---|
| **All Farms** | 6620 | 1627 | 3201 | 12071 |
| Small Farms | 3815 | 798 | 586 | 2209 |
| Medium Farms | 2437 | 727 | 1707 | 6435 |
| Large Farms | 368 | 102 | 909 | 3427 |

Source: Agriculture Census, 2000

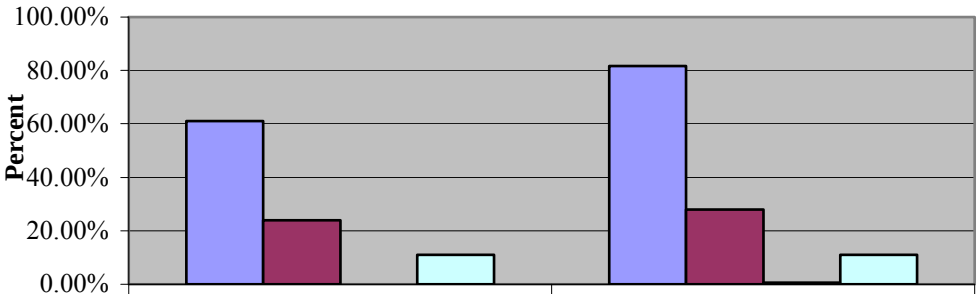
In year 2000, the total numbers of agricultural farms involved in cotton production were 1627 thousand representing about 24.58 percent of the total farms. The total production of cotton was 12071 thousand bales and the area under cotton production was 3201 thousand hectares which was 14 percent of the total cropped area. The contribution to total cotton production by small, medium and large farms was 18.30, 53.31 and 28.39 percent, respectively. The above data indicate that the medium farms contribute more than 50 percent in the cotton production (Agriculture Census, 2000).

During 2001-02, the cotton production was 10613 thousand bales which was 10211 thousand bales in 2002-03 with a decrease of 3.8 percent. Subsequently, in 2003-04, cotton production was less by 1.6 percent than the previous year and also below the target of 10048 thousand bales set by the government. This comparatively low production of cotton was mainly because the crop was affected by pest attack in the early Kharif season of the year (Economic Survey, 2003-04).

### 3.1.4. Area, Production and Farm Structure of Sugarcane

Sugarcane is a cash crop and serves as a major raw material for the production of white sugar or gur and molasses as a by-product. Its share in value added of agriculture and GDP is 4.2 percent and 1.0 percent, respectively. The share of each province in total area under sugarcane and its production in Pakistan is given in fig 5.

**Fig. 5 Provincial Share of Sugarcane Area and Production in Pakistan**




| | Area | Production |
|---|---|---|
| Punjab | 61.00% | 81.68% |
| Sindh | 24.00% | 27.89% |
| Baluchistan | 0.07% | 0.59% |
| NWFP | 11.00% | 10.97% |

Area, production and farm structure of sugarcane for the year 2000 is given in table 9.

**TABLE 9. AREA, PRODUCTION AND FARM STRUCTURE OF SUGARCANE**

| Size of Farm | Total Farms (000) | Farms under Sugarcane (000) | Area under (000ha) | Production (000 bales) |
|---|---|---|---|---|
| **All Farms** | 6620 | 839 | 884 | 40530 |
| Small Farms | 3815 | 296 | 142 | 6472 |
| Medium Farms | 2437 | 469 | 464 | 21298 |
| Large Farms | 368 | 74 | 278 | 12760 |

Source: Agriculture Census, 2000

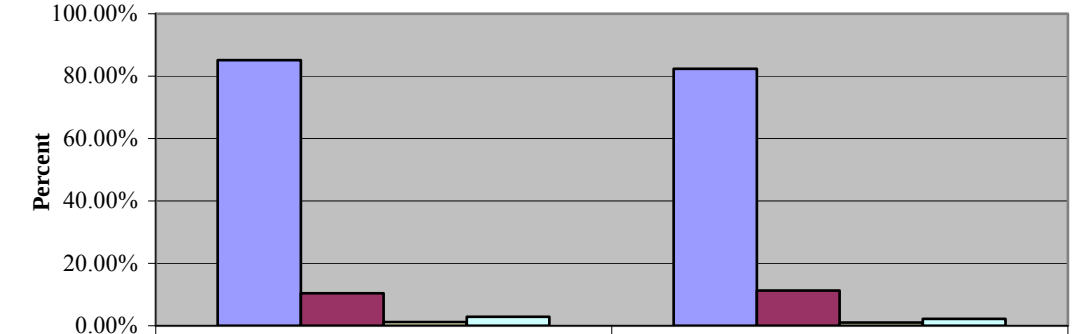
In year 2000, the total number of agricultural farms in Pakistan was 6620 thousand and out of these total farms, 839 thousand farms were involved in sugarcane production, which was about 12.7 percent of the total farms. Total production of sugarcane was 40530 thousand tons and the area under sugarcane production was 884 thousand hectares. The contribution of small, medium and large farms was 15.97, 52.55 and 31.48 percent, respectively in the total sugarcane production. This shows that maximum contribution in sugarcane production (52.55 %) is by the medium farms (Agriculture Census, 2000).

During 2001-02, the sugarcane production was 48042 thousand tons, which was increased to 52056 thousand tons in 2002-03 with an increase of 8.3 percent. Subsequently, in 2003-04, good sugarcane production was harvested and 2.5 percent higher production was noticed than the target of 53419 thousand tons set by the government. This comparatively higher production was mainly due to sufficient availability of water which helped in improving the yield of the crop. (Economic Survey, 2003-04).

### 3.1.5. Area, Production and Farm Structure of Fodder

In Pakistan, fodder crops during winter (rabi) include berseem, lucerne, oats, barley and mustard; while during summer (kharif) these comprise maize, sorghum, and millets. Share of each province in total area under fodder and its production in Pakistan is given in fig. 6.

**Fig. 6 Provincial Share of Fodder Area and Production in Pakistan**




| | Area | Production |
|---|---|---|
| Punjab | 85.21% | 82.44% |
| Sindh | 10.48% | 11.31% |
| Baluchistan | 1.27% | 1.11% |
| NWFP | 2.99% | 2.21% |

Area, production and farm structure of fodder for the year 2000 is given in table 10.

**TABLE 10. AREA, PRODUCTION AND FARM STRUCTURE OF FODDER**

| Size of Farm | Total Farms (000) | Farms under Fodder (000) | Area under (000 ha) | Production (000 bales) |
|---|---|---|---|---|
| **All Farms** | 6620 | 2573 | 2481 | 56811 |
| Small Farms | 3815 | 1179 | 571 | 13070 |
| Medium Farms | 2437 | 1215 | 1386 | 31731 |
| Large Farms | 368 | 179 | 524 | 12010 |

Source: Agriculture Census, 2000

In year 2000, the total number of agricultural farms in Pakistan was 6620 thousand and out of these total farms 2573 thousand farms were involved in fodder production, which were about 38.86 percent of the total farms. Total production of fodder was 56811 thousand tons and the area under fodder production was 2481 thousand hectares. The contribution of small, medium and large farms was 23.00, 55.85 and 21.14 percent, respectively in the total fodder production. The above figures showed that the medium

farms contributed more than 55 percent of the total fodder production (Agriculture Census, 2000).

Subsequently, in 2001-02, fodder production was less by 10 percent than the last year production. This comparatively low production was mainly due to the pressure of the cultivated land for production of cereal and cash crops thereby reducing available land for fodder production (Economic Survey, 2003-04).

## 3.2. TRENDS OF AGRICULTURE PRODUCTION

### 3.2.1. Share of Area of Major Crops

The total cropped area of Pakistan was 19332, 21358 and 23440 thousand hectares in 1980, 1990 and 2000, respectively. The total cropped area was linearly and significantly increased during the last twenty years. The share of major crop area in total cropped area is shown in table 11.

**TABLE 11. CROPS AND THEIR PERCENT SHARE IN TOTAL CROPPED AREA IN PAKISTAN**

| Crops | Year of Census | | |
|---|---|---|---|
| | 1980 | 1990 | 2000 |
| Cropped area (000 ha) | 19332 | 21358 | 23440 |
| Wheat | 38 | 38 | 40 |
| Rice | 12 | 11 | 12 |
| Maize for grain | 3 | 4 | 4 |
| Jawar/Bajra | 4 | 6 | 2 |
| Barley | 1 | 1 | 1 |
| Cotton | 12 | 13 | 14 |
| Sugarcane | 3 | 3 | 4 |
| Oil seeds | 3 | 2 | 2 |
| Fodder | 14 | 13 | 11 |
| Orchard | 1 | 2 | 2 |

Source: Agriculture Census, 1980, 1990 and 2000.

Proportion of wheat cropped area in total cropped area was 38.0, 38.0 and 40.0 percent in 1980, 1990 and 2000, respectively. Rice cropped area in the total cropped area shared 12.0, 11.0 and 12.0 percent in 1980, 1990 and 2000, respectively. Proportion of

sugarcane cropped area in total cropped area was 3.0, 3.0 and 4.0 percent in 1980, 1990 and 2000, respectively. Cotton cropped area in the total cropped area shared 12.0, 13.0 and 14.0 percent in 1980, 1990 and 2000, respectively. Proportion of fodder cropped area in total cropped area was 14.0, 13.0 and 11.0 percent in 1980, 1990 and 2000.

In summary, it is concluded that over the period of twenty years wheat, cotton, sugarcane and maize cropped area has increased, whereas, rice cropped area remained constant during the last twenty years. However, during the same period, cropped area under fodder was gradually decreased.

### 3.2.2. Trend of area, production and farm structure of wheat

In 1980, the total number of agricultural farms in Pakistan was 4069 thousand, which was increased to 5071 thousand in 1990 and 6620 thousands in 2000. The increase in the number of total farms was 62.69 percent during the last twenty years.

**TABLE 12. TREND OF AREA, PRODUCTION AND FARM STRUCTURE OF WHEAT**

| Farm Size | Total Farms (000) | | | Farms under Crops (000) | | | Area under Crops (000 ha) | | | Production (000 tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **All Farms** | 4069 | 5071 | 6620 | 3418 | 4183 | 5330 | 7255 | 8165 | 9468 | 10501 | 14476 | 20763 |
| Small Farms | 1386 | 2404 | 3815 | 1099 | 1927 | 3074 | 725 | 1296 | 2058 | 1050 | 2297 | 4520 |
| Medium Farms | 2308 | 2322 | 2437 | 2009 | 1979 | 1986 | 4314 | 4517 | 4990 | 6247 | 8008 | 10928 |
| Large Farms | 375 | 345 | 368 | 310 | 277 | 270 | 2216 | 2352 | 2420 | 3204 | 4171 | 5315 |

Source: Agriculture Census, 1980, 1990 and 2000

In 1980, the number of agricultural farms under wheat was 3418 thousand, and these were increased to 4183 thousand in 1990 and 5330 thousand in 2000. The increase in the number of total farms under wheat was 55.94 percent during the last twenty years.

Wheat was cultivated on 7255 thousand hectares in 1980 whereas the area under wheat was increased to 8165 and 9468 thousand hectares in 1990 and 2000, respectively. The percentage increased was 12.54 and 15.96 during the 1980-90 and 1990-2000, respectively. Wheat production was 10501 thousand tons in 1980 which increased to 14476 and 20763 tons in 1990 and 2000, respectively. During 1980-2000, wheat production was increased by 97.72 percent.

In 1980, the contribution in total wheat production was 10.0, 59.0 and 31.0 percent by the small, medium and large farms, respectively. However, in 2000 these farms contributed 21.77, 52.63 and 25.60 percent in total production of wheat. This shows that from 1980 to 2000, contribution in wheat production by small farms increased from 10.00 to 21.77 percent whereas the contribution of medium and large farms decreased from 59.00 to 52.63 percent and from 31 to 25.60 percent, respectively.

### 3.2.3. Trend of area, production and farm structure of rice

Rice was cultivated on 2235 thousand hectares in 1980 whereas the area under rice was increased to 2420 and 2918 thousand hectares in 1990 and 2000, respectively and the increase in area under wheat was 8.28 and 20.57 percent during these periods. Rice production was 3577 and 3659 thousand tons in 1980 and 1990 respectively, whereas, rice production was increased to 5983 thousand tons in 2000. During 1980-2000, the rice production was increased by 67.26 percent.

**TABLE 13. TREND OF AREA, PRODUCTION AND FARM STRUCTURE OF RICE**

| Farm Size | Total Farms (000) | | | Farms under Crops (000) | | | Area under Crops (000 ha) | | | Production (000 tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **All Farms** | 4069 | 5071 | 6620 | 1334 | 1355 | 1613 | 2235 | 2420 | 2918 | 3577 | 3659 | 5983 |
| Small Farms | 1386 | 2404 | 3815 | 333 | 496 | 760 | 210 | 350 | 522 | 337 | 524 | 1071 |
| Medium Farms | 2308 | 2322 | 2437 | 881 | 766 | 759 | 1449 | 1454 | 1636 | 2318 | 2180 | 3354 |
| Large Farms | 375 | 345 | 368 | 120 | 94 | 94 | 576 | 616 | 760 | 922 | 955 | 1558 |

Source: Agriculture 1980, 1990 and 2000

In 1980, the number of agricultural farms under rice was 1334 thousand, and these were increased to 1355 thousand in 1990 and 1613 thousand in 2000. The increase in the number of farms under rice was 20.91 percent during 1980-2000.

In 1980, the rice produced by small, medium and large farm was 337, 2318 and 922 thousand tons, respectively. The contribution in total rice production was 9.42, 64.80 and 25.78 percent by small, medium and large farms in 1980. However, in 2000 the contribution of small, medium and large farms was 1071, 3354 and 1558 thousand tons, respectively. These categories of farms contributed 17.90, 56.06 and 26.04 percent in total production of rice in 2000. The contribution of small and large farms increased from 9.42 to 17.90 and from 25.78 to 26.04 percent whereas the contribution of medium farms decreased during 1980 to 1990 and increased during 1990 to 2000.

### 3.2.4. Trend of area, production and farm structure of cotton

In 1980, the total number of agricultural farms in Pakistan was 4069 thousand, which were increased to 5071 thousand in 1990 and 6620 thousand in 2000. The increase in the number of total farms was 62.69 percent during 1980-2000.

**TABLE 14. TREND OF AREA, PRODUCTION AND FARM STRUCTURE OF COTTON**

| Farm Size | Total Farms (000) | | | Farms under Crops (000) | | | Area under Crops (000 ha) | | | Production (000 bales) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **All Farms** | 4069 | 5071 | 6620 | 1506 | 1311 | 1627 | 2319 | 2679 | 3202 | 4615 | 9671 | 12071 |
| Small Farms | 1386 | 2404 | 3815 | 306 | 457 | 798 | 162 | 314 | 586 | 322 | 1134 | 2209 |
| Medium Farms | 2308 | 2322 | 2437 | 1037 | 742 | 727 | 1381 | 1443 | 1707 | 2750 | 5209 | 6435 |
| Large Farms | 375 | 345 | 368 | 163 | 112 | 102 | 776 | 922 | 909 | 1542 | 3328 | 3427 |

Source: Agriculture Census, 1980, 1990 and 2000

In 1980, the number of agricultural farms under cotton was 1506 thousand, and these were decreased to 1311 thousand in 1990 and increased to 1627 thousand in 2000. The increase in the number of total farms under cotton was only 8 percent during the twenty years.

Cotton was cultivated on 2319 thousand hectares in 1980 whereas the area under cotton was increased to 2679 and 3202 thousand hectares in 1990 and 2000, respectively and the percentage increased was 38.07 during the twenty years. Cotton production was 4615 thousand bales in 1980 whereas the cotton production was constantly increased to 9671 and 12071 thousand bales in 1990 and 2000, respectively. During the twenty years, cotton production was increased by 161 percent.

In 1980, the contribution in total cotton production was 6.97, 59.58 and 33.45 percent by small, medium and large farms, respectively. However, in 2000 these farms contributed 18.30, 53.30 and 28.40 percent in total production of cotton. This shows that contribution in cotton production by small farms increased from 6.97 to 18.30 percent

whereas the contribution of medium and large farms decreased from 59.58 to 53.31 and from 33.45 to 28.39 percent, respectively from 1980 to 2000.

### 3.2.5. Trend of area, production and farm structure of Sugarcane

In 1980, the number of agricultural farms under sugarcane was 1122 thousand, and these were decreased to 862 thousand in 1990 and 839 thousand in 2000. The decrease in the number of total farms was 25.22 percent during the twenty years.

**TABLE 15. TREND OF AREA, PRODUCTION AND FARM STRUCTURE OF SUGARCANE**

| Farm Size | Total Farms (000) | | | Farms under Crops (000) | | | Area under Crops (000 ha) | | | Production (000 tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **All Farms** | 4069 | 5071 | 6620 | 1122 | 862 | 839 | 652 | 719 | 884 | 25894 | 29254 | 40530 |
| Small Farms | 1386 | 2404 | 3815 | 201 | 213 | 296 | 58 | 82 | 142 | 2288 | 3363 | 6472 |
| Medium Farms | 2308 | 2322 | 2437 | 790 | 563 | 469 | 422 | 427 | 464 | 16759 | 17362 | 21298 |
| Large Farms | 375 | 345 | 368 | 131 | 86 | 74 | 172 | 210 | 278 | 6847 | 8529 | 12760 |

Source: Agriculture Census, 1980, 1990 and 2000

Sugarcane was cultivated on 652 thousand hectares in 1980 whereas the area under sugarcane was increased to 719 and 883 thousand hectares in 1990 and 2000, respectively and the percentage increased was 10.27 and 22.80 from 1980-90 and 1990-200, respectively. Sugarcane production was 25894 thousand tons in 1980 whereas the sugarcane production was increased to 29254 and 40530 thousand tons in 1990 and 2000. During the twenty years sugarcane production was increased by 56.52 percent.

In 1980, the contribution in total sugarcane production was 8.84, 64.72 and 26.44 percent by small, medium and large farms,` respectively. However, in 2000 these farms

contributed 15.97, 52.55 and 31.48 percent in total production of sugarcane. This shows that contribution in sugarcane production by small and large farms increased from 8.84 to 15.97 percent and from 26.44 to 31.48 percent, respectively, whereas the contribution of medium farms decreased from 64.72 to 52.55 percent from 1980 to 2000.

### 3.2.6. Trend of area, production and farm structure of Fodder

In 1980, the number of agricultural farms under fodder was 2487 thousand, and these were 2439 thousand in 1990 and 2573 thousand in 2000. The increase in the number of total farms was only 3.46 percent during the twenty years.

**TABLE 16. TREND OF AREA, PRODUCTION AND FARM STRUCTURE OF FODDER**

| Farm Size | Total Farms (000) | | | Farms under Crops (000) | | | Area under Crops (000 ha) | | | Production (000 tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **All Farms** | 4069 | 5071 | 6620 | 2487 | 2439 | 2573 | 2711 | 2748 | 2481 | 51239 | 56068 | 56811 |
| Small Farms | 1386 | 2404 | 3815 | 627 | 866 | 1179 | 255 | 408 | 571 | 4811 | 8317 | 13070 |
| Medium Farms | 2308 | 2322 | 2437 | 1595 | 1362 | 1215 | 1690 | 1632 | 1386 | 31955 | 33304 | 31731 |
| Large Farms | 375 | 345 | 368 | 265 | 211 | 179 | 766 | 708 | 524 | 14473 | 14446 | 12010 |

Source: Agriculture Census, 1980, 1990 and 2000

Fodder was cultivated on 2711 thousand hectares in 1980 whereas the area was increased to 2748 in 1990 and then decreased to 2481 thousand hectares in 2000. During 1980-2000, the decrease in fodder cultivated area was 8.48 percent. In 1980, the total fodder production was 51239 thousand tons which increased to 56068 and 56811 thousand tons in 1990 and 2000, respectively. During 1980-2000, the increase in fodder production was only 10.87 percent. Contribution in total fodder production was 9.39, 62.36 and 28.25 percent by small, medium and large farms, respectively. In 2000, the contribution of small, medium and large farms in the total fodder production was 23.0, 55.85 and 21.14

percent, respectively. This showed that the contribution by small farms was increased from 9.39 to 23.0 percent while the contribution in fodder production by medium and large farms decreased from 62.36 to 55.85 (1980-90) and from 28.25 to 21.14 percent (1990-2000), respectively.

# 4. DOMESTICATED FARM ANIMAL GENETIC RESOURCES (LIVESTOCK)

Livestock is an important and integral part of agriculture and it contributes about 49.1 percent of agriculture value added and 11.4 percent of the total GDP. Livestock has special role in our rural economy, which can be recognized from the fact that 30-35 million rural population is engaged in livestock raising and having holdings of 2-3 large ruminants and 5-6 small ruminants per family. This helps them to derive 30-40 percent of their income from livestock rearing (Economic Survey, 2003-04). Livestock net foreign exchange earnings were 53.0 billion, which is almost 12.34 percent of the overall export earning of the country in 2000 (Economic Survey, 2000-01).

## 4.1. LIVESTOCK RESOURCES AND POPULATION

Pakistan is endowed with diversified domesticated farm animal genetic resources (FAnGR), which are buffaloes, cattle, sheep, goats, camels, horses, donkeys, mules and poultry. FAnGR commonly referred as livestock have their economic importance, which goes beyond direct food production such as milk, meat and eggs. Skins, fibers, manure (fertilizer or fuel), draught power and capital are also livestock benefits. There is pre-dominantly indigenous livestock population, which is very well adapted to local managemental and environmental conditions in various agro-ecological zones of Pakistan. There are number of large and small ruminants' breeds, which are localized under different ecologies according to their sustainability and the availability of feed resources. The world's best dairy buffalo breed i.e., Nili-Ravi and among the cows, Sahiwal breed are present in Pakistan and are said to be the best dairy breeds in Asia.

Livestock in Pakistan is an integrated part of agriculture; therefore, most of the livestock is reared under the agro-livestock production system both in irrigated and non-irrigated agricultural system. Livestock is also reared on pasture and rangelands and this system is

known as pastoral-livestock production system and most of the small ruminants are reared under this production system. In addition to these two livestock production systems, agro-pastoral livestock production system for small ruminant and cattle is also not uncommon in the country. Poultry production system comprises of the rural poultry and the commercial poultry.

In this report, only major livestock resources such as buffalo, cattle, goat, sheep and poultry having highly significant economic and food value will be discussed; Buffalo population dominantly consists of (i) Nili-Ravi which primarily belongs to Punjab and thickly present in irrigated areas and (ii) Kundi breed belongs to Sindh province and they are also mostly present in the irrigated areas. Both the buffalo breeds are mostly concentrated in and around the riverine areas and in canal command areas. However, in the recent past buffalo hs been taken to rain-fed areas of Punjab and Sindh and also to NWFP and Baluchistan provinces. Moreover, buffaloes are being kept under urban commercialized production system commonly known as buffalo colony, which are present in and in periphery of the thickly populated cities of Sindh and Punjab. Nili-Ravi buffalo breed of Punjab is purchased from its breeding areas and taken to all over Pakistan, however, Kundi buffalo breed is almost confined to Sindh and a very small number is present in the bordering area of Baluchistan like Lasbela. Practice of purchasing Nili-Ravi and Kundi from their breeding areas and shifting them to the commercial dairy farming in thickly populated cities of their originated provinces and also to other provinces is mainly triggered by liking of its milk and better economic returns. Out of the total population of buffalo 34.0 percent are Nili-Ravi, 21.0 percent are Kundi and rest are non-descript. Herd size is mainly small and about 80 percent of the buffaloes are present in the herd size of up to 10 buffaloes. Buffaloes contribute about 68 percent milk in the total milk production of large ruminants.

Cattle breeds are generally classified as dairy breeds and draught breeds, however, draught breeds are also used for milk purpose. Sahiwal, Red Sindhi and Cholistani cattle have been characterized as dairy cattle breeds and Thari is considered as dairy cum draught breed. Bhagnari, Dajal, Dhani, Lohani,, Rojhan and Kankaraj breeds are the draught breeds of Pakistan. Sahiwal cattle breed is predominantly raised in Punjab while Red-Sindhi belongs to Sindh province. Since late seventy's research and development efforts are concentrated to produce cross-bred cattle basically from Friesian semen as exotic blood for cross breeding with Sahiwal, Red-Sindhi, Cholistan and also with non-descript cows. Milk production and reproductive efficiency of cattle is increased and the cross-bred cattle are now in high demand by the commercial dairy farmers. Cattle herd size is mainly small and about 75 percent of the cattle are present in herd size of up to 10 cattle. The contribution of cattle in the total milk production of the large ruminants is about 32.00 percent.

There are about 28 indigenous breeds of sheep in the country and out of these, 12 are fat-tailed and the remaining are thin-tailed (Husnain, 1985). Following are the sheep breeds; Baluchi, Bibrik, Harnai, Rakhsani, Balkhi, Damani, Hashtnagri, Kaghani, Michi, Tirahi, Waziri, Buchi, Cholistani, Kajli, Latti, Lohi, Sipli, Thalli, Dumbi, Kachhi, Kooka, Baltistan, Gojal, Kohai Ghizer, Kail, Kali, Pahari and Poonchi. Punjab and NWFP has seven breeds of sheep each; Baluchistan and Azad Kashmir has four breeds of sheep each; and Sindh and Northern Areas have three breeds of sheep. About 48 percent of the sheep are present in herd size of up to 50 sheep.

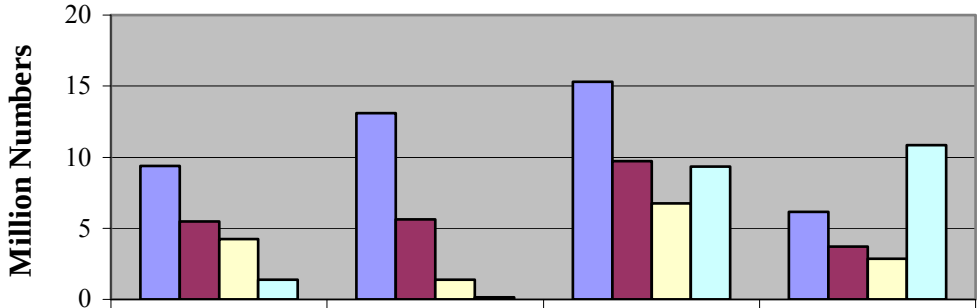
Goats have been categorized as hairy and smooth-coated goats. There are 25 breeds of goats in the country (Husnain, 1985). Following are the breeds of goats; Kajli, Khurassani, Lehri, Damani, Gaddi, Kaghani, Beetal, Nachi, Dera Din Panah, Teddy, Bardai, Chappar, Kamori, Sindh Desi, Baltistani, Jararkhiel, Kohai Ghizer, Piamiri, Beiari, Buchi, Desi, Kooti, Labri, Pothohari and Shurri. Azad Kahsmir has seven breeds

of goats; Punjab, Sindh and Northern Areas have four breeds of goats each, whereas Baluchistan and NWFP has three breeds each. About 50 percent of the goats are present in herd size of up to 15 goats.

Poultry production has two segments i.e., rural poultry and commercial poultry. Rural poultry consists of indigenous local chicken and predominantly exists in rural areas. Since mid 1970's commercial poultry came into existence by import of exotic hybrid chickens along with its management and feeding package. The commercial poultry has grown with a reasonably good annual growth rate. Commercial poultry product is basically a network of commercial hatcheries, compound commercial poultry feeds, poultry medicine and the commercial poultry farmers.

In Pakistan, livestock population of buffalos, cattle, sheep, goats, camels, horses, mules, donkeys and poultry is 24.8, 23.3, 24.6, 52.8, 0.8, 0.3, 0.2, 4.1 and 329.5 million, respectively (Economic Survey, 2002-03). However, according to Livestock Census (1996), national buffalo, cattle, sheep and goat population was 20.30, 20.40, 23.50 and 41.20 million, respectively. Contribution of provinces in the national population of the above mentioned species of livestock is presented in fig. 7.

**Fig. 7 Provincial Livestock Population (1996)**




| | Cattle | Buffaloes | Goats | Sheep |
|---|---|---|---|---|
| Punjab | 9.38 | 13.1 | 15.3 | 6.14 |
| Sindh | 5.46 | 5.62 | 9.73 | 3.71 |
| NWFP | 4.24 | 1.39 | 6.76 | 2.85 |
| Baluchistan | 1.37 | 0.16 | 9.36 | 10.84 |

Share of buffalo, cattle, goat and sheep of Punjab, Sindh, NWFP and Baluchistan was 64.00, 28.00, 7.00 and 1.00 percent; 46.00, 27.00, 21.00 and 6.00 percent; 37.00, 34.00, 16.00 and 23.00 percent; and 26.00, 16.00, 12.00 and 46.00 percent, respectively.

It can be concluded from the population of various species of livestock in different provinces that more than 90.00 percent population of buffalo is present in Punjab and Sindh. Similarly, more than 70.00 percent population of cattle is present in the same two provinces. Goats follow almost the same pattern in provincial population and more than 60.00 percent of its total population is present in Punjab and Sindh. However, sheep is mainly dominant (46.00 percent) in Baluchistan followed by Punjab (26.00 percent).

### 4.1.1. Trends of Livestock Population

The livestock population of Pakistan from 1981-2000 has been summarized in table 17.

**TABLE 17 TRENDS OF LIVESTOCK POPULATION IN PAKISTAN (MILLION NUMBERS)**

| Average of Five Years | Cattle | Buffalo | Sheep | Goats | Poultry |
|---|---|---|---|---|---|
| **1981-85** | 16.12 | 12.44 | 23.52 | 27.72 | 89 |
| **1986-90** | 17.14 | 16.54 | 24.46 | 32.8 | 140 |
| **1991-95** | 17.76 | 18.74 | 27.76 | 40.34 | 211 |
| **1996-2000** | 21.20 | 21.44 | 23.80 | 44.24 | 314 |
| **2010*** | 26.00 | 32.00 | 25.00 | 65.00 | 631 |
| **Overall Annual growth rate** | **1.68** | **3.45** | **2.43** | **3.24** | **8.39** |

* Projected population, Source: Agriculture Statistics of Pakistan, 1999-2000
Economic Survey, 2002-2003

All the growth rates and trend projections are derived by the consultant (Khan, 2003) by using the equations of Gujrati, (1992) and Akhtar, (1997). The total cattle population was 15.8 million in 1981 which was increased to 22.00 million in 2000, with an overall annual growth rate of 1.68 percent during 1981-2000. The projected cattle population will be 26.00 million in 2010. The total buffalo population in 1981 was 11.9 million and this increased to 22.7 million in 2000, with an overall annual growth rate of 3.45 percent during 1981-2000. The projected population of buffalo will be 32.00 million in 2010. The recorded growth rate of buffalo during 1981-2000 is higher than cattle mainly due to the reason that people of Pakistan prefer buffalo milk compared to cattle milk because of its high butter fat content.

The total sheep population was 22.10 million in 1981, which was increased to 24.1 million in 2000. The overall annual growth rate of sheep population was 2.43 percent during the same period. The projected population of sheep will be 65.00 million in 2010. The total population of goat was 25.8 million in 1981 and it was increased to 47.4 million in 2000, with an overall annual growth rate of 3.24 percent during 1981-2000. The projected goat population in 2010 will be 65.00 million. During the last twenty years the goat population increased on a much higher scale compared to sheep. This can be attributed to the consumer preference for goat meat compared to sheep, suitability of goat

to the changing environment and availability of more feed resources as more area is being brought under cultivation.

The population of poultry was only 67.00 million in 1981 and it increased to 282.00 million by 2000, with an average annual growth rate of 8.39 percent during this period. This good growth rate is an indicator that poultry is making progress at a significantly higher rate because of the introduction of commercial poultry and with the establishment of scientific and commercial entrepreneurship. Projected poultry population will be 631.00 million in 2010.

## 4.2. LIVESTOCK PRODUCTS, IT'S TRENDS AND PROJECTIONS

Milk, beef, mutton, poultry meat and egg production was 27811.0 1060.0, 702.0 and 370.0 thousand tons and 7860 million number, respectively. Time series data 1981-2000 for the production of livestock products is given in table 18.

**TABLE 18 TRENDS OF PRODUCTION OF LIVESTOCK PRODUCTS**

| Average of five Years | Milk | Beef | Mutton | Poultry Meat | Egg (million No) |
|---|---|---|---|---|---|
| | (000tons) | | | | |
| **1981-85** | 9898 | 469 | 414 | 74 | 3179 |
| **1986-90** | 13353 | 663 | 545 | 149 | 4074 |
| **1991-95** | 17175 | 848 | 767 | 238 | 5247 |
| **1996-2000** | 24241 | 941 | 618 | 332 | 6847 |
| **Overall Annual Growth rate** | **4.68** | **4.18** | **4.28** | **10.92** | **8.07** |

Source: Economic Survey 1993-94; 1999-2000; 2002-03.

Milk production was 9267.0 thousand tons in 1981 which increased to 25566.0 thousand tons in 2000, which was obtained with annual growth rate of 4.68 percent. Although growth rate in milk production in the country is reasonable, but Pakistan is still importing milk and milk products by spending huge foreign exchange.

Beef production was 434 thousand tons in 1981 which was increased to 986 thousand tons in 2000 and this increase was obtained with 4.18 percent overall annual growth rate. Beef is usually obtained from buffalo and cattle primarily without any feedlot fattening. Moreover, it is considered to be the by-product of dairy products. Projected beef production will be 1460 thousand tons in 2010. Sheep and goats are the source of mutton and these are usually raised on conventional production. So far, no feedlot fattening has been introduced for small ruminants for mutton production. Mutton production was 370 thousand tons in 1981 which was increased to 649 thousand tons in 2000. This production during 1981-2000 was achieved with an overall annual growth rate of 4.28 percent. Projected mutton production will be 971.0 thousand tons in 2010.

In 1981, poultry meat production was only 52.0 thousand tons which increased to 322 thousand tons in 2000. This significant increase in poultry meat production was achieved with the advent of hybrids in broiler stains coupled with balance feeding, proper management and health care. The overall annual growth rate of poultry meat production was 10.92 percent during 1981-2000. Projected poultry meat production will be 846.0 thousand tons. Egg production was 2319 million in 1981 and was increased to 8463 million in 2000. This increase was achieved with 8.07 percent growth rate during 1981-2000. Projected egg production will be 17849 million in 2010.

FAOSTAT, 2003 presented the trends of annual production of livestock products, their trends and projections which are given in table 19.

**TABLE 19 TRENDS OF ANNUAL PRODUCTION OF MILK, MEAT AND EGGS (1,000 metric tons)**

| Product | Year | | | | Annual Growth Rate (%) | |
|---|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2015 | 1980-1990 | 1990-2000 |
| **Total Meat** | 713.1 | 1,324.7 | 1,734.6 | 3,207.8 | 6.4 | 2.7 |
| **Beef and Buffalo** | 380.0 | 667.0 | 886.0 | 1,470.7 | 5.8 | 2.9 |
| **Mutton and Goat** | 275.0 | 484.0 | 506.0 | 837.9 | 5.8 | 0.4 |
| **Poultry** | 46.6 | 160.7 | 326.7 | 899.2 | 13.2 | 7.4 |
| **Total Milk** | 9,014.0 | 14,723.0 | 28,355.0 | 43,307.4 | 5.0 | 8.0 |
| **Total Eggs** | 98.3 | 224.6 | 338.7 | 823.9 | 8.6 | 4.2 |

Source: FAOSTAT (2003); FAO Country projections used for FAO (2002)

The annual growth rate (percent) given in the above table are not in total agreement with the calculation of the author and it might be due to different methodology used in these calculations. Similarly, the projections mentioned in the above table are some what different from the consultants calculations given in the preceeding paragraphs.

## 4.3. LIVESTOCK PRODUCT CONSUMPTION, IT'S TRENDS AND PROJECTIONS

Per capita consumption of various livestock products in Pakistan from 1981 to 2000 is given in table 20.

**TABLE 20 PER CAPITA CONSUMPTION OF LIVESTOCK PRODUCTS**

| Products | 1981-85 | 1985-90 | 1991-95 | 1996-2000 | 2010* |
|---|---|---|---|---|---|
| **Milk (kg)** | 54.72 | 61.86 | 63.89 | 76.31 | 101.00 |
| **Beef (kg)** | 5.25 | 6.34 | 7.16 | 7.18 | 8.80 |
| **Mutton (kg)** | 4.62 | 5.18 | 6.52 | 4.70 | 5.00 |
| **Poultry (kg)** | 0.80 | 1.42 | 2.01 | 2.53 | 4.90 |
| **Egg (no)** | 35.40 | 39.11 | 43.30 | 52.75 | 81.50 |

* Projected figure; Source: Agricultural Statistics of Pakistan 1983-1984 and 1999-2000

In 1981, per capita consumption of milk was 53.0 kg which increased to 82.4 kg in 2000, with an overall growth rate of 2.06 percent during this period. Projected per capita milk consumption will be 101.00 kg in 2010. In 1981, per capita consumption of beef was 5.15 kg which increased to 7.2 kg in 2000, with an overall growth rate of 2.08 percent during this period. Projected per capita beef consumption will be 8.80 kg in 2010. Per capita consumption of mutton was 4.39 kg in 1981 which increased to 4.7 kg in 2000 with an overall growth rate of 0.70 percent. Per capita mutton consumption is projected to be 5.00 kg in 2010.

Per capita consumption of poultry meat was only 0.6 kg in 1981 but this had increased to 2.34 kg by 2000. Per capita consumption of poultry meat will be 4.9 kg in 2010. Per capita egg consumption was 27.66 eggs in 1981, more than doubling to 61.54 eggs in 2000. The growth rate of per capita egg consumption was appreciably high and consistent throughout the past twenty years. The projected per capita egg consumption in 2010 will be 81.50 eggs.

## 4.4. LIVESTOCK PRODUCTION SYSTEMS

Livestock production is a closely integrated part of agricultural production in Pakistan. Majority of the livestock species are reared under the agro-livestock production system in irrigated and non-irrigated agriculture production systems. In the rangelands and mountains, pastoral livestock production is prevalent and mostly the small ruminants are reared under this production system. In addition to these, agro-pastoral livestock production system is not uncommon in the country. Poultry production system comprises of rural and commercial poultry. Livestock production systems are separately explained under the dairy production system and small ruminant production system.

### 4.4.1. Dairy Production Systems

FAO (1987), conducted a classical livestock sector study in which it defined the dairy production systems for buffalo and cattle. These systems are explained as under;

**Buffalo Production System**

Buffalo production systems are divided into peri-urban milk production, small holder rural milk production, small holder market milk production, small holder subsistence milk production and rural commercial units.

**Peri-Urban Milk Production System**

Peri-urban milk production system has grown in recent past in response to increasing demand and price for milk in urban markets. Production growth of milk has been supported by development of motorized road transport and an effective input supply network. However, maintenance of buffaloes under peri-urban production system and under present management systems require a regular supply of buffaloes from breeding areas. Commercial scale units located around the main cities especially in Sindh and Punjab province, have herds generally ranging from 10-200 heads (average 10-30). Almost all are adult females, 90 percent are buffaloes and 95 percent of these are actually in production. Selected third or fourth lactation females are purchased either close to calving or with calf at foot. The calf remains suckling its mother for only 4-7 days and is then sold for slaughter because of the high milk value and high level of its feeding. Replacement buffaloes are purchased according to need for milk sale contract obligations. Feed varies according to feed availability and price. Typically feed for a buffalo producing 8-10 liters of milk is usually 8-10 kg wheat straw (Bhosa), 10 kg chopped green feed and 6-8 kg home mixed concentrate consisting of wheat bran, cotton seed cake, maize oil cake, maize glutten, rice polishings and crushed wheat or maize.

Milk production under this system averages 8-10 liters per day or 2400 liters per lactation.

**Small Holder Rural Milk Production System**

Almost 80 percent of total milk supply derived from mixed crop-livestock units mostly in irrigated areas, which keep buffaloes primarily for milk production and indigenous cattle for draught purposes with milk as a by-product. Production units are small scale with about 75 percent of all buffaloes and cattle in herds of no more than six heads. Rural milk production is predominantly a subsistence activity; about 56 percent of milk is consumed on the farm. Access to milk market, however, influences consumption patterns and production methods, thus rural small holder production is broadly categorized into (a) market oriented; and (b) family subsistence.

**Small Holder Market Milk Production System**

Small holders owing buffaloes and cattle in rural areas with satisfactory milk market access and who are able to produce milk in excess of family requirements have introduced some changes in traditional production methods. The typical family production unit includes five buffaloes with three adult females, one to two female followers, occasional a male calf but rarely any adult males. Whenever available, grazing of riverine areas, canal banks, water logged areas etc. provides feed for dry buffalos and herd followers but in the main, milking animals are stall fed and feed for the herd is provided roughly as follows; straws 40 percent, green feeds 20-30 percent, grazing 10-20 percent and purchase concentrate feeds 15-20 percent on a dry matter basis. Small holders who are also land owners devote 10-20 percent of their cropped area to fodder crops production and are able to provide more of the total feed requirements for this source. Male and female claves are retained during the lactation which may last for 250-400 days, males are then disposed of for slaughter and females are kept as herd replacements with first parturition at about 4 years of age. With increased commercialization, tendency is for better nutrition, improved natality and consequently a

higher percentage of productive animals in each herd. Milk production averages about 2000 liters per lactation or 7-8 liters daily.

**Small Holder, Subsistence Milk Production System**

Small holders in rural areas with no satisfactory milk market aim to produce enough milk for family requirements at minimal cost. Generally, they don't spend cash or inputs but because milk is an important subsistence item they are prepared to allocate non-cash resources of land and labor to its production. About 70 percent of small holder's milk produces fall into this category. The average subsistence unit consists of about 3 buffaloes including up to two adult females. Grazing provides 50-60 percent of total feed requirements at zero cost, straws (Bhosa) provide about 25 percent, green feed crops provide 10-15 percent and purchased concentrates less than 5 percent and this is exclusively for buffaloes in milk. Average milk production is 4-6 liters daily or 1500 per lactation. However, with the expansion in road network and due to establishment of milk collection centers of milk processing industries this subsistence milk production system is becoming more efficient and getting more milk yield compared to the past.

**Rural Commercial Units**

The emergence of a new commercial category of dairy farm is a recent past phenomenon. Most units, recently established have entailed investments in stables, water, other facilities and equipment and the initial purchase of young buffaloes close to calving and with calf at foot. A typical unit consists of about 40 buffaloes (90 percent buffaloes and 10 percent cattle) of which 60 percent are adult females and of these about 60 percent are producing milk. These production units may be a part of a larger mixed crop-livestock farm or a specialized farm given over entirely to milk production. Fodder crops provide more than 50 percent of the total feed, straws either home grown or purchased provide about 35 percent and the remainder is purchased concentrate. In practice milk yield are satisfactory i.e., 2400 liters per lactation.

## Cattle Production Systems

Cattle production systems are divided into small holder irrigated areas, small holder rainfed (barani) areas and progressive farmers, crossbred cattle.

### Small Holder Irrigated Areas

About 55 percent of the indigenous cattle population is kept on small mixed cop-livestock production units in the irrigated areas. Out of these 60 percent are in the Punjab, 20 percent in Sindh and 14 percent are in NWFP. Traditionally, male cattle have been kept primarily to provide farm traction and the female herd needed for production of work animals and to produce some milk for human consumption as a by-product. In irrigated areas, the typical unit consists of three cattle, kept alongside the buffaloes which are raised for milk production. Most cattle are of non-descript type, but some pure indigenous milk breeds such as Sahiwal and Red Sindhi are included. On average cattle herd contains about 40 percent adult females, 20-25 percent adult males and the remainder are calves and followers. To the extent possible, feed is derived from grazing. About 25 percent of total feed comes from straws, 60 percent from fodder crop yields and less than 10 percent from purchased concentrates. The calving rate averages about 60 percent and lactation is 200-260 days. Milk production is about 850 liters per lactation exclusive that suckled by the calve.

### Small Holder Rainfed (Barani) Area

Cattle in barani areas are also raised primarily for draught use and cattle herds averaging about five head are often the only large ruminants kept. About 30 percent of the typical herds are adult females, 40 percent are adult males and the balance are calves and the followers. Grazing of stubbles, waste areas and pasture lands provides 40-50 percent of total annual feed following the onset of rains and the harvest of cereals. The remainder of the feed is provided by straws, some green fodder and a little concentrate usually for

work animals. Milk production averages only 400-500 liters in a lactation of 200-240 days.

**Progressive Farmers, Crossbred Cattle**

A few progressive farmers have developed and are developing commercial milk production units based on Al Friesian crossbred progeny. These farms may be given over entirely to milk production or may be part of a larger mixed crop-livestock unit. Units consists of 20 crossbred Friesian cattle including 12 adult females, six to seven female followers and one to two males. Investments in stables and equipment have been made. The herd is well fed, predominantly with home produced green feed. Calving rate is above 75 percent and the age at first calving has been reduced to 30 months though further reductions are possible. Cows are milked twice daily for lactation production of 2400 liters. Routine health measures are taken including vaccinations against foot and mouth and black quarter and regular control of ecto-parasites. This type of production gives satisfactory return to labor and to the land use for crop production. It involves high cash costs and could be very vulnerable to irregularities in the demand and price for cow milk Conversion of roughage feeds into milk solids (and milk fat) in this type of unit appears to be 30 percent more efficient than in a comparable commercial buffalo milk producing unit.

### 4.4.2. Sheep and Goats Production Systems

Sheep and goats productions systems are divided into nomadic, transhumant and sedentary flocks production system.

**Nomadic Production System**

Nomadic systems of sheep and goats production are found mostly in parts of Baluchistan and Sindh provinces and represent only a small part of the sheep and goat population. Nomadic flocks contain over 1200 head including up to 40 percent of goats (average 20

percent). Although nomadic sheep and goats may be owned in smaller units they are usually managed by shepherds in flocks or herds of about 200 working on behalf of the owners in return for a share of the births and wool production. Nomadic flocks have no fixed base but instead move constantly throughout the year in search of grazing. In general the higher, cooler areas are grazed during summer and the flocks are brought down to lower elevations during winter. Grazing for nomadic sheep is generally free of cost but there are causes when shepherds are obliged to pay a per head fee to the tribe for summer or more frequently for winter grazing. In times of shortage, the shepherd may also need to buy stubble grazing or may even need to purchase feed. Sheep are mostly shorn twice annually. Some sheep and goats are milked to provide for needs of the shepherd and his family.

**Transhumant Production System**

Transhumant systems are common in all provinces where the owners of sheep and goat flocks have a fixed base and move with their animals utilizing low cost range grazing. Seasonal movement can be over long distances, e.g., from northern Punjab to mountain pastures in Kashmir and Gilgit or from Kacchi plain to Kharan and Loralai. Transhumant systems are closely integrated with crop farming. About 40 percent of grazing comes from the crop area and in times of shortage, feeds are purchased from the crop sector. Transhumant flocks are generally smaller in size than nomadic flocks and usually contain a higher percentage of goats. Some transhumant shepherds who have a fixed base located in a crop producing area but do not themselves grow corps. These families depend on their livestock for their livelihood, supplemented with occasional wages from harvest and non-agriculture employment. As with nomadic flocks, these might be owned by the shepherd family or might consist of animals owned by a number of families. The average unit is thought to be of about 100 heads including 30-40 percent of goats. When stubble grazing is available, flocks are grazed in stubbles, roadsides, canal banks or riverine areas, returning each night to be penned at the owners house or enclosed in a crude thorn-wood pen constructed on the stubble land. When no feed remains in the crop areas, flocks

migrate to rangelands and flood plains. Because of more reliable feed supply lambing percentages are marginally higher than in nomadic flocks and mortality is less. Offtake rates are also higher, about 40 percent. Shepherds have ready market access for the sale of offtake and indeed sell most of the male progeny, often at light weight, before migrating to the rangelands. Some of these remain in the crop areas to be grown to heavier weight but most go directly for slaughter. Cull ewes are sold when the need for cash arises. Transhumant shepherds at times have to pay for stubble or range grazing and occasionally purchase feeds for their animals but overall production costs are low and the financial reward from a flock of 100 appears to compensate the hardships of transhumant life.

**Sedentary Flocks Production System**

Sedentary flocks and herds, i.e., sheep, goats or mixed units consists of about 20 heads and account for a large part of the sheep and goat population especially in the Punjab. Goats comprise roughly 70 percent of the animals. These units are kept mostly by crop farming families. They live in the villages and derive their feed from the grazing stubble lands, the grazing roadsides, canal banks, water logged areas and nearby rangelands. They are returned to the village each night to be penned at the owners' house. Household scraps, weeds are also important sources of feeds, but in times of scarcity feeds are occasionally purchased. Sheep and goat performance is similar to that of transhumant flocks. Milk production is more important because of the higher percentage of goats. Female offspring are retained for replacements. Most male offspring are sold at only 4-12 months of age but many are retained for family consumption usually at or about one year.

# 5. WILDLIFE RUMINANTS (WILD RELATIVES) OF PAKISTAN

Pakistan has a variety of habitat with a rich and diversified wildlife fauna. There were some 600 species of birds, more than 160 species of mammals and dozen of reptiles. However, since late 1800, most of wildlife population declined drastically. Currently, about 20 species of birds, 31 species of mammals and 5 species of reptiles have been enlisted as endangered species in Pakistan. The causes for this decline in wildlife population have been identified as human-related and include encroachment by human population, degradation of habitat, beyond controlled hunting and sometime illegal export. Majority of the wildlife particularly the small ruminants are present in Northern Areas which have Cold High Peak Desert Mountains, Alpine Meadows, sub-Alpine forests and Alpine dry forests. Major cause of decline of the large species of oriental faunal origin in mountainous regions has been reported by Muhammad and Anwar (1993) and Anwar and Ahmed (1995) as increased competition between wildlife and domestic ungulates for available range biomass. Since, wildlife ruminants are inhabitant of the rangelands/pastures and thus assume to have direct competition with domesticated ruminants particularly sheep and goats for forage consumption. However, if we take the population of domesticated small ruminant vis-à-vis the wildlife of Pakistan into account, it reveals that percentage of wildlife ruminants compared to domesticated small ruminants is very negligible. This very negligible population of wildlife does not qualify any threat for competing with domesticated small ruminants for forage utilization from grazing lands and pastures (Khan, 2003).

Various wild ruminant species of Pakistan are described individually in the following paragraphs:

## 5.1. MAMMALS (UNGULATES)

### 5.1.1. Wild Goats and Sheep

There are about eight breeds of wild goats and sheep in Pakistan (Ahmed, 2002). These breeds of wild goats and sheep are: Markhor (*Capra Falconeri*), Himalayan or Siberian Ibex (*Capra Ibex Sibirica*), Sindh Wild Goat or Persian Pasang (*Capra Hircus Aegagrus*), Chiltan Wild Goat (*Capra Aegagrus Chialtanensis*), Marco Polo Sheep (*Ovis Ammon Polii*), Urial Sheep (*Ovis Vignei*), Bharal or Blue Sheep (*Pseudois Nayaur*) and Goral Sheep (*Nemorhaedus Goral*).

Brief description of each wild sheep and goats is given as under:

#### 5.1.1.1. Markhor (*Capra Falconeri*)

There are two type of markhor, namely the flared horned markhor and straight horned markhor;

Flared horned markhor:

- *C.f. cahmirensis (Pir Panjal or Kashmir markhor)*
- *C.f. falconeri (Astor markhor)*

Straight horned markhor

- *C.f. jerdoni (Suleiman or straight-horned markhor)*
- *C.f. megaceros (Kabul or Kabal markhor)*

In Pakistan, there are four distinct sub-species of markhor and these are the Kashmir markhor (*C.f. cashmirensis*), Astor markhor (*C.f. falconeri*), Kabul markhor (*C.f. megaceros*) and the Suleiman markhor (*C.f. jerdoni*). These markhors are differentiated mainly by the shape of their horn.

Markhor usually mate during winter, with the subsequent births occurring from late April to early June. The markhor is mainly active in the early morning and late afternoon. During the spring and summer months, it is grazer while in winter it turns to browse for nourishment. Grasses and leaves are the main dietary component of the markhor.

Markhor mainly inhabits the spaciously wooded mountainous regions in the north and western Pakistan. The total world population is mainly found in Pakistan and current population of markhor is estimated to be more than 4,000.

### 5.1.1.2. Himalayan or Siberian Ibex (*Capra Ibex Sibirica*)

The Himalayan Ibex can be separated from the Alpine Ibex by the horn shape which, in adult males grows much longer, curving around to form three quarters of a complete arc and tapering to relatively cylinder points.

The mating starts in November or December and the young one of the Ibex are born from May or Early June.

The Himalayan Ibex is gregarious like all wild goats. Feeding activity appears to be confined largely to the early morning and late afternoon even in fairly remote areas. Winter feeding conditions are harsh due to heavy rainfall and Ibex have to dig for grasses, bushes and mosses. The Ibex is confined to relatively arid mountain ranges of the inner Himalayas. The population of the Ibex is more than 10,000 in Pakistan. The survival of the Himalayan Ibex is not so threatened in Pakistan due to inaccessibility of its habitat provided by the very extensive concentration of high mountain ranges.

### 5.1.1.3. Sindh Wild Goat or Persian Pasang (*Capra Hircus Aegagrus*)

Sindh Ibex are stocky animals with thick-set bodies and strong limbs terminating in broad hooves.

Mating takes place between October and November, with young being born from April to May. The Sindh Ibex is gregarious, and if undisturbed will congregate in fairly large

herds.

During summer, they lie up more extensively during day and may graze a considerable part of the night. They have a wonderful sense of balance and can make a standing leap up to 1.75 m (5-6 ft) upwards on a seemingly vertical rock surface. They browse for leaves and bushes as well as small shrub and forbes. As they can survive at sea level, therefore, they are found in remotest cliffs around Omara. They inhabit mountain crests up to 3,350 m. These goats are found in all the higher and more extensive mountain ranges of southern Baluchistan from Mekran coastal range at Pasni, right across Sindh Kohistan and the Kirthar range in the east. They are also found in Kalat. According to the helicopter survey conducted in 2000 by Sindh Wildlife Department, Zoological Survey Department and the University of Melbourne, the total population of Sindh Ibex is 13155 ± 2460 and according to other estimates their number is about 4000, which is highly concentrated on the Kirthar range and lower concentrations are present in Khambu and Dumbar and also present in some other areas.

#### 5.1.1.4. Chiltan Wild Goat (*Capra Aegagrus Chialtanensis*)

Chiltan wild goat is locally named as Chiltan Markhor.

The rut starts slightly earlier, however, commencing from mid-October and females probably come into estrus at the beginning of November, with young being born from the end of March to early April.

The Chiltan wild goat is gregarious and diurnal in feeding and has similar habits to straight horned Markhor. They browse the leaves and bushes as well as small shrubs and forbes (Robert, 1977). The recent population estimates done by WWF-Pakistan in 1997 has put the number of Chiltan Goat at around 800. The Chiltan wild goat is endemic to Pakistan and is listed as critically endangered species in **IUCN Red List of Threatened Animals(1990).**.

### 5.1.1.5. Marco Polo Sheep (*Ovis Ammon Poili*)

The Marco Polo Sheep, locally named as Rusch, has only subspecies of Argali within the territory of Pakistan.

The rut is well marked and of short duration as in all wild sheep. The rut takes place in late November and even extending to early December.

This is a gregarious species, generally congregating in herds of a dozen up to over a hundred individuals. These herds consist of females with their sub-adult young and immature males. They confine their feeding activity to a few hours just after dawn and again become active in the evening. The Marco Polo Sheep graze mainly on the scattered bunches of coarse grass. In the northern part of Hunza, in winter they feed on the scattered clumps of wild onions. The Marco Polo Sheep is an inhabitant of very high mountain plateau regions subject to severely cold and rather arid climatic conditions throughout the year. Currently Marco polo sheep has a very limited special and temporal distribution in Pakistan. It is confined to probably at most, three remnant populations in the northwestern part of Hunza district along the Chinese Border. Here, between spring and autumn it occupies two separate valleys in the northwestern section of Khunjerab National Park, and also inhabits the Kilik-Mintaka border Area, just west of National Park. There are about 1000 Marco polo sheep in Pakistan. Marco polo sheep is probably the most endangered of Pakistan's wild sheep and goats, and unless action is taken immediately they will probably become extinct.

### 5.1.1.6. Urial Sheep (*Ovis Vignei*)

The Urial Sheep (*Ovis Vignei*) is locally called Urial (Punjab), Gad (Baluchiistan) and Shapu (Northern Areas), which are quite similar to the Marco Polo sheep in general body proportions and coloring but averaging considerably smaller in size with shorter, less massive horns.

Single or occasional twin lambs being born in mid-April to early-May in Punjab and often as early as March in Kirthar Range in Sindh. Urials are gregarious and the biggest herds consist of associations of female with their followers and immature males. Feeding activity is confined to early morning and evening in the summer months, often commencing well before dawn. During the day they rest an overhanging bush or rock where they are well concealed. Their preferred food is grasses. They will in time of fodder scarcity, browse the leaves of Acacia Modesta and sometimes pink mucilaginous fruits. In Baluchistan and Waziristan, the Urial inhabits the gentler slopes of the higher mountain ranges and will occur up to 2750 m (9000 ft). In the Salt range and the Southern North West Frontier Province they are typically associated with lower elevation rounded stony hills dotted with wild olive. In the extreme northern and inner Himalayan ranges, the Shapu is associated with barren treeless regions in the lower foothills. In Pakistan, the Afghan urial is found in Baluchistan, North West Frontier (NWFP), and Sindh Provinces. No total population census based on surveys is available. Perhaps 2500 - 3000 animals lived in Baluchistan. The total population of Urial is about 10000 in Pakistan.

### 5.1.1.7. Bharal or Blue Sheep (*Pseudois Nayaur*)

It is locally named Bharal which is basically a Hindi name, while it is called Blue Sheep due to a bluish sheen in its coat.

Mating occurs between October and January, with young being born from May to July. They live solitary or in small groups of less than 20 animals which consists of almost entirely one sex. Bharal are active throughout the day, alternating between feeding and resting on the grassy mountain slopes. Due to their excellent camouflage and the absence of cover in their environment, bharal remain motionless when approached. Grasses, lichens, hardy herbaceous plants and mosses are their diet. Bharal inhabits the remote and inaccessible mountain ranges of the Karakoram in Northern Pakistan at 30000-5550 m / 10000-18500 ft. Blue sheep are not as agile as ibex and are typically found on more open and grassy areas. They are found in Chat Pirt and Ghujerav areas of Shimshal in Baltistan. They are also found in Khunjerab National Park. The population of Blue sheep is less than 50 animals in Pakistan and thus it is endangered species.

### 5.1.1.8. Goral Sheep (*Nemorhaedus Goral*)

Its local name is Goral and is considered to be a "**goat-elope**", sharing characteristics of both the true goats and sheep, and antelope. Its breeding may take place at any time of year; however, bucks are more active in spring and fall. Fawns are born at all seasons, but fewest births occur in winter.

Gorals are most active in the early morning and late evening, but on cloudy days roam throughout the day. They often drink after eating in the morning thereafter retiring to a rock on which to rest until evening. Gorals are extremely nimble, and can move at high speeds across inaccessible terrain. Their remarkable camouflage is extremely effective, and along with the fact that they lie motionless; gorals are difficult to spot even in plain site. Their diet consists of leaves, nuts and twigs. About 60 percent vegetation of plant species are eaten by gorals, which include *Themeda anathera, Chrysopogon aucheri,Carissa opaca, Acacia modesta, Mimosa rubicaulis* and *Ipomoea hispida*. Gorals inhabit wooden mountain slopes at elevations of 1000-4000 m / 3300-13500 ft. in the Himalayas. In Pakistan, the Goral is mainly found in Margalla National Park small populations are found further west in Swat, Dir and lower Chitral where Goral is rare.

# 6. FORESTS OF PAKISTAN

Forests have been central in human history in that they provide critical ecosystem services for climate, range and forage, wildlife habitat, biotic diversity, watershed protection, soil erosion control, etc. Humans have left an impressive mark on the world over in the past several centuries. With the dramatic growth in population pressure on the land has greatly increased, the need for greater food production has led to a massive increase in cropland. By early 1990's, almost 40 percent of earth's land surface had been converted to croplands and permanent pastures. This conversion has occurred largely at the expense of forests. Of the four forest cover percentage groups (> 70 %, 40-69 %, 10-39 %, 0-9%), Pakistan lies in the last category of 0-9% (ICIMOD,1998).

As recognition of the multiple values of forests has grown, so have concerns for their disappearance. In Pakistan, subtropical, temperate, riverine and mangrove forests are being lost because of questionable land use practices and the ever-increasing demand for timber and firewood. As a result, more responsible management approaches are being demanded that can accommodate complex economic and ecological needs. Designation of selected forestlands as national parks, area for agro-forestry practices and the development of plantations and afforestation practices are needs of the hour.

## 6.1. TRENDS OF FOREST AREAS

Forests are an essential part of our economy through their significant role in land conservation, regulation of flow of water for irrigation and power generation, reduction of sedimentation in water channels and reservoirs and maintenance of ecological balance. Eighty five percent of the total forest area is public forest, which include 40 percent coniferous and scrubbed forestation on the northern hills and mountains. The balance is made up of irrigated plantation and riverine forest, mangrove forests on Indus Delta and tree planted on farmland. Forest area of Pakistan is presented in table 21.

**TABLE 21. FOREST AREA OF PAKISTAN (million hectares)**

| Year | Pakistan | Punjab | Sindh | Baluchistan | NWFP |
|---|---|---|---|---|---|
| 1980 | 2.75 | 0.43 | 0.58 | 1.07 | 0.67 |
| 1985 | 3.16 | 0.45 | 0.66 | 1.09 | 0.96 |
| 1990 | 3.38 | 0.46 | 0.57 | 1.09 | 1.26 |
| 1995 | 3.60 | 0.50 | 0.68 | 1.08 | 1.34 |
| 2000 | 3.66 | 0.50 | 0.75 | 1.05 | 1.36 |

Source: Agriculture Statistics of Pakistan (1983-84 and 1999-2000)

Total forest area of Pakistan, Punjab, NWFP, Sindh and Baluchistan was 3.66, 0.50, 1.36, 0.75 and 1.05 million hectares, respectively in year 2000. During 1980-90 and 1990-2000, there was an increase of 22.9 and 8.28 percent in the forest area of Pakistan. However, forest area of Pakistan, Punjab, Sindh and NWFP was increased to 33.09, 16.28, 29.31 and 102.99 percent, respectively from 1980-2000. But, during the same period, forest area of Baluchistan decreased by 1.87 percent.

The per capita forest area is only 0.037 ha compared to the world average of ONE ha. Main reason for this is that more than 70 percent land area of Pakistan is Arid and semi-Arid with annual rainfall of 250-500 mm: too low and erratic to sustain natural vegetation and to plan afforestation/regeneration program.

## 6.2. TYPES OF FORESTS

Due to diverse ecological conditions, a variety of forest types exist in the country and the details of different variety of forests and rangelands are given in the table 22.

**TABLE 22. FOREST AREAS AND RANGELANDS (IN HA.)**

| Forest Type | NWFP | Punjab | Sindh | Balochistan | Northern Areas | Azad Kashmir | Total |
|---|---|---|---|---|---|---|---|
| Coniferous | 1105 | 29 | - | 131 | 285 | 361 | 1911 |
| Irr. Plantations | - | 142 | 82 | - | 2 | - | 226 |
| Riverine Forests | - | 51 | 241 | 5 | - | - | 297 |
| Scrub Forests | 115 | 340 | 10 | 163 | 658 | 1 | 1287 |
| Coastal Forests | - | - | 345 | - | - | - | 345 |
| Mazri Lands | 24 | - | - | - | - | - | 24 |
| Linear Pltns. | 2 | 4 | - | - | - | - | 6 |
| Private Pltns. | 159 | - | - | - | - | - | 159 |
| Range Lands | 150 | 2683 | 490 | 787 | 2104 | 195 | 6409 |
| TOTAL: | 1555 | 3249 | 1168 | 1086 | 3049 | 557 | 10664 |

There are natural forests growing in the moist-and-dry temperate zones and on the foothills. On the other extreme are the mangrove forests in the Indus Delta and the Arabian Sea. Irrigated plantations and to some extent, riverine forests are man-made.

Of 4.26 million hectares (of forest area), only 1.12 million hectares (26.3 %) produce timber and firewood: the rest are meant to protect the watershed areas and the erodable lands.

Besides forests, the forest departments also control 6.4 million hectares of rangelands. In fact, there are about 51.3 million hectares of rangelands in Pakistan. These ranges provide sustenance to livestock population. Being under incessant grazing pressure, these lands are producing hardly 10-15 percent of their actual potential. Over-grazing has intensified the problems of desertification resulting in accelerated soil erosion and degradation of plant communities.

# 7. PROFILE OF TARGET SITE

## 7.1. Target Sites

To assist in formulation of proposed full project on FAnGR in Pakistan, it was envisaged that four target sites in all the four provinces will be selected. Furthermore, the preliminary selected target site profile will be studied for agriculture production, livestock resources and breed diversity and pastoral resources.

National coordinator of the project under which this study is being under taken has selected the four target sites in Pakistan and one site was selected from each province.

The target sites and their respective districts and provinces are:

| **Target Sites** | **Districts** | **Provinces** |
|---|---|---|
| Hasalpur | Bahawalpur | Punjab |
| Tando Adam | Sanghar | Sindh |
| Summer Bagh | Lower Dir | NWFP |
| Doraji | Lasbela | Baluchistan |

It is worth to mention here that neither agriculture census nor livestock census was conducted in the previous years which contain the information regarding the agriculture production and livestock resources at tehsile level. However, the data on the above mentioned parameters is available on district level. Therefore, data pertaining to agriculture and livestock is taken for considering as site specific. Hence, in the forth coming paragraphs the sites will be considered as district and agriculture and livestock related activities will be defined in the same context.

As far as the locations of the target sites in different agro-ecological regions are concerned, it is given as following:

- Bahawalpur is mainly located in the northern irrigated plains.
- Sanghar is mainly located in the southern irrigated plains
- Lasbela is located in the dry western plateau.
- Dir is located in the northern dry mountains.

### 7.1.1. Target Site Specific Agriculture Production

Agriculture of Pakistan is characterized by two main cropping seasons i.e., the kharif and the rabi. Rice, sugarcane, cotton, maize, sorghum and millet are the main kharif crops and wheat, gram, tobacco, barley, rape and mustard are the main rabi crops.

The target site identified for Punjab province is **Bahawalpur** district and the total cropped area of this district is 6250 thousand hectare. In this district wheat, cotton and fodder are the major crops. Wheat, cotton and fodder are cultivated on 42, 40 and 9 percent area, respectively of the district cropped area.

The target site identified for Sindh province is **Sanghar** district and the total cropped area of this district is 383 thousand hectare. In this district wheat, cotton and fodder are the major crops. Wheat, cotton and fodder are cultivated on 39, 34 and 12 percent, respectively of the district cropped area.

The target site identified for NWFP province is **Dir** district and the total cropped area of this district is 85 thousand hectare. In this district wheat and maize are the major crops and are cultivated on 52 and 36 percent, respectively of the district cropped area. However, rice, jawar and fodder are also grown in this district but on very small area.

The target site identified for Baluchistan province is **Lasbela** district. Total cropped area of Baluchistan province is 2447 thousand hectare whereas the total cropped area of Lasbela district is 48 thousand hectares. In this district wheat, jawar, cotton, oilseed and

fodder are the major crops and are grown on 29, 17, 12, 8 and 9 percent, respectively of the district cropped area. However, barley and orchard is also grown on a sizeable area.

The area and production of major crops in Pakistan, provinces and target sites (Crops Area Production (by Districts), 2000-01 to 2002-03) are summarized in the proceeding paragraphs.

**Wheat**

Wheat was cultivated on 8180.90 thousand hectare and its production was 19023.70 thousand tons in Pakistan during 2002-03 (Agricultural Statistics, 2002-03). The share of Punjab, Sindh, Baluchistan and NWFP in total cropped area under wheat and its production was 76.00, 10.00, 4.00 and 10.00 percent and 81.00, 12.00, 4.00 and 3.00 percent, respectively.

Share of area under wheat and its production at the target districts i.e., Bahawalpur, Sanghar, Lasbela and Dir in their respective provinces i.e., Punjab, Sindh, Baluchistan and NWFP was 4.00, 13.00, 3.00 and 2.00 percent and 3.50, 15.92, 1.73 and 3.30 percent, respectively.

**Rice**

Rice was cultivated on 2376.60 thousand hectare and its production was 4802.00 thousand tons in Pakistan during 2002-03. The share of Punjab, Sindh, Baluchistan and NWFP in total cropped area under rice and its production was 68.00, 23.00, 6.00 and 3.00 percent and 53.00, 35.00, 9.00 and 3.00 percent, respectively.

Share of area under rice and its production at the target districts i.e., Bahawalpur, Sanghar, Lasbela and Dir in their respective provinces i.e., Punjab, Sindh, Baluchistan and NWFP was 0.30, 0.06, 0.00 and 24.00 percent and 0.43, 0.06, 0.00 and 24.40 percent, respectively.

**Sugarcane**

Sugarcane was cultivated on 960.80 thousand hectare and its production was 43606.30 thousand tons in Pakistan during 2002-03. The share of Punjab, Sindh, Baluchistan and NWFP in total cropped area under sugarcane and its production was 64.00, 24.00, 0.06 and 11.00 percent and 61.00, 27.63, 0.07 and 10.97 percent, respectively.

Share of area under wheat and its production at the target districts i.e., Bahawalpur, Sanghar, Lasbela and Dir in their respective provinces i.e., Punjab, Sindh, Baluchistan and NWFP was 1.54, 45.22, 33.00 and 0.09 percent and 1.48, 54.63, 41.93 and 0.06 percent, respectively.

**Cotton**

Cotton was cultivated on 2927.50 thousand hectare and its production was 10731.00 thousand tons in Pakistan during 2002-03. The share of Punjab, Sindh, Baluchistan and NWFP in total cropped area under cotton and its production was 81.51, 17.89, 0.59 and 0.00 percent and 79.58, 19.58, NA and 0.00 percent, respectively.

Share of area under cotton and its production at the target districts i.e., Bahawalpur, Sanghar, Lasbela and Dir in their respective provinces i.e., Punjab, Sindh, Baluchistan and NWFP was 11.09, 20.53, 0.47 and 0.00 percent and 13.10, 22.67, NA and 0.00 percent, respectively.

**Fodder**

Fodder was cultivated on 2485.77 thousand hectare and its production was 56924.00 thousand tons in Pakistan during 2002-03. The share of Punjab, Sindh, Baluchistan and NWFP in total cropped area under fodder and its production was 85.21, 10.48, 1.27 and 2.99 percent and 82.44, 11.31, 1.11 and 2.75 percent, respectively.

Share of area under fodder and its production at the target districts i.e., Bahawalpur, Sanghar, Lasbela and Dir in their respective provinces i.e., Punjab, Sindh, Baluchistan and NWFP was 2.81, NA, 5.32 and 2.21 percent and 2.81, NA, 1.07 and 2.21 percent, respectively.

### 7.1.2. Target Site Specific Livestock Resources

Pakistan is endowed with diversified farm animal genetic resources i.e., buffalo, cattle, sheep, goat, camel, horses and poultry. For the purpose of this report, target livestock resources are specified as large and small ruminants, which will be discussed in the context of livestock resources. There are 24.8, 23.3, 52.8 and 34.6 million numbers of buffalo, cattle, goats and sheep, respectively (Economic survey, 2002-03). However, according to Livestock Census (1996), there were 20.30, 20.40, 41.20 and 23.5 million numbers of buffalo, cattle goats and sheep in Pakistan. In view of the available data vide Livestock Census (1996), description of individual livestock resource is summarized as under:

**Buffalo**

Total buffalo population of Pakistan was 20.30 million and out of this population; 13.10, 5.62, 1.39 and 0.16 million buffaloes were present in Punjab, Sindh, NWFP and Baluchistan, respectively. Share of Punjab, Sindh, NWFP and Baluchistan in national buffalo poll was 64.00, 28.00, 7.00 and 1.00 percent, respectively. Majority of the buffalo population was present in Punjab followed by Sindh, however, very small fraction of buffalo population existed in other two provinces.

Share of buffalo population in target districts i.e., Bahawalpur, Sanghar, Dir and Lasbela in their respective provinces i.e., Punjab, Sindh, NWFP and Baluchistan was 0.46, 0.25, 0.031 and 0.005 million numbers, respectively. Percent share of buffalo in target districts in their respective provinces was 3.5, 4.45, 2.23 and 3.10 percent, respectively.

**Cattle**

Total numbers of cattle in Pakistan were 20.40 million and out of these number; 9.38, 5.46, 4.24 and 1.34 million were present in provinces of Punjab, Sindh, NWFP and Baluchistan, respectively. Share of Punjab, Sindh, NWFP and Baluchistan in national cattle poll was 46.00, 27.00, 21.00 and 6.00 percent, respectively. Synthesis of the above data revealed that maximum number of cattle is present in Punjab.

Share of cattle population in target districts i.e., Bahawalpur, Sanghar, Dir and Lasbela in their respective provinces i.e., Punjab, Sindh, NWFP and Baluchistan was 0.29, 0.35, 0.42 and 0.092 million numbers, respectively. Percent share of cattle in target districts in their respective provinces was 3.09, 6.41, 9.90 and 6.86 percent, respectively.

**Goat**

Total numbers of goat in Pakistan were 41.20 million and out of these number; 15.30, 9.73, 6.76 and 9.36 million were present in provinces of Punjab, Sindh, NWFP and Baluchistan, respectively. Share of Punjab, Sindh, NWFP and Baluchistan in national goat poll was 37.00, 24.00, 16.00 and 23.00 percent, respectively. Synthesis of the above data revealed that maximum number of goat is present in Punjab followed by Sindh, Baluchistan and NWFP.

Share of goat population in target districts i.e., Bahawalpur, Sanghar, Dir and Lasbela in their respective provinces i.e., Punjab, Sindh, NWFP and Baluchistan was 0.71, 0.70, 0.57 and 0.73 million numbers, respectively. Percent share of goat in target districts in their respective provinces was 4.64, 7.19, 8.43 and 7.79 percent, respectively.

**Sheep**

Total sheep population of Pakistan was 23.5 million and out of this population; 6.14, 3.71, 2.85 and 10.84 million goats were present in Punjab, Sindh, NWFP and Baluchistan, respectively. Share of Punjab, Sindh, NWFP and Baluchistan in national sheep poll was 26.00, 16.00, 12.00 and 46.00 percent, respectively. Majority of the sheep population was present in Baluchistan followed by Punjab, Sindh and NWFP.

Share of sheep population in target districts i.e., Bahawalpur, Sanghar, Dir and Lasbela in their respective provinces i.e., Punjab, Sindh, NWFP and Baluchistan was 0.16, 0.19, 015 and 0.27 million numbers, respectively. Percent share of sheep in target districts in their respective provinces was 2.60, 5.12, 5.26 and 2.49 percent, respectively.

**Livestock Production Systems**

In Pakistan, livestock production system can broadly be classified into three categories;

- Agro-livestock production system
- Pastoral-livestock production system
- Agro-pastoral livestock production system

However, the specified livestock production systems for dairy and small ruminants are given in table 23:

**TABLE 23 LIVESTOCK PRODUCTION SYSTEM IN PAKISTAN**

| Buffalo | Cattle | Goat and Sheep |
|---|---|---|
| • Rural – subsistence<br>• Rural – market oriented<br>• Rural - -commercial<br>• Peri - urban | • Rural – irrigated<br>• Rural - barani<br>• Progressive<br>• Peri - urban | • Sedentary<br>• Transhumant<br>• Nomadic |

Livestock production systems operating in different target site/districts are summarized for dairy and small ruminant in the following tables 24 and 25.

**TABLE 24 DAIRY PRODUCTION SYSTEM**

| **Locations/ Agro Ecological Regions** | **Cattle** | **Buffaloes** |
|---|---|---|
| Bahawalpur<br>Northern irrigated plains | Rural Subsistence (irrigated agro-livestock production system)<br><br>Progressive Farmers.<br><br>Agro-pastoral livestock production system (Transhumant)-Cholistan | Rural Subsistence (irrigated agro-livestock production system)<br><br>Rural market oriented livestock production system. |
| Sanghar<br>Southern irrigated plains | Rural Subsistence- (irrigated agro-livestock production system)<br><br>Rural market oriented<br><br>Agro-pastoral livestock production system (Transhumant)-Thar | Rural Subsistence-agro-livestock based production system<br><br>Rural market oriented livestock production system |
| Lasbela<br>Dry western plateau | Rural subsistence (irrigated agro-based livestock production system)<br><br>Barani area agro-livestock production system<br><br>Barani area pastoral livestock production system | Rural Subsistence (agro-livestock production system)<br><br>Rural market oriented livestock production system |
| Dir<br>Northern dry mountains | Barani and irrigated agro-based livestock production system<br><br>Agro-pastoral production system | Rural Subsistence agro-livestock production system<br><br>Barani and irrigated agro-based livestock production system<br><br>Agro-pastoral production system |

**TABLE 25 SMALL RUMINANT PRODUCTION SYSTEM IN PAKISTAN**

| **Locations/ Agro Ecological Regions** | **Goats** | **Sheep** |
|---|---|---|
| Bahawalpur<br>Northern irrigated plains | ● Sendentary<br>● Transhumant<br>● Nomadic | ● Sendentary<br>● Transhumant<br>● Nomadic |
| Sanghar<br>Southern irrigated plains | ● Sendentary<br>● Transhumant<br>● Nomadic | ● Sendentary<br>● Transhumant<br>● Nomadic |
| Lasbela<br>Dry western plateau | ● Transhumant<br>● Sendentary<br>● Nomadic | ● Transhumant<br>● Sendentary<br>● Nomadic |
| Dir<br>Northern dry mountains | ● Transhumant<br>● Sendentary<br>● Nomadic | ● Transhumant<br>● Sendentary<br>● Nomadic |

### 7.1.3. Target Site specific Livestock Breed Diversity

All the species of large and small ruminants are found in the target site/locations such as; Bahawalpur, Sanghar, Lasbela and Dir. Breeds of each species of livestock are discussed as under.

### Cattle

Cattle breeds found in **Bahawalpur** are given in their order of priority as far as their number is concerned and these breeds are Sahiwal, Dhamani, Red Sindhi, Bhagnari, Rojhan and Lohani. There are some cross bred animals as well as other breeds. Cattle breeds found in **Sanghar** are given in their order of priority as far as their number is concerned and they are Thari, Red Sindhi, Dhanni and Sahiwal. There are some cross bred animals as well as other breeds. Cattle breeds found in **Lasbela** are given in their

order of priority as far as their number is concerned and these breeds are Red Sindhi, Sahiwal, Thari and others. Cattle breeds found in **Dir** are given in their order of priority as far as their number is concerned and these are Dhanni, Lohani and Sahiwal, however, cross bred animals and other breeds are also present in significant numbers.

**Buffalo**

Buffalo breeds found in **Bahawalpur** are given in their order of priority as far as their number is concerned and these are Nili Ravi, Kundi and significant number of other buffaloes are also present. Buffalo breeds found in **Sanghar** are given in their order of priority as far as their number is concerned and these are Kundi and Nili Ravi. Small numbers of other buffaloes are also present. There is no major breed of buffalo present in **Lasbela**, however, there are few thousand buffaloes belonging to others are present in it. Buffalo breeds found in **Dir** are given in their order of priority as far as their number is concerned and these are Nili Ravi, Kundi and quite large population of other buffaloes are present in Dir.

**Sheep**

Sheep breeds found in **Bahawalpur** are given in their order of priority as far as their number is concerned and these are Lohi, Buchi, Kajli, Thalli and Bekaneeri. Sheep breeds found in **Sanghar** are given in their order of priority as far as their number is concerned and they are Rakshkani, Baluchi, Kajli, Kachhi, Buchi and Thalli. Sheep breeds found in **Lasbela** are given in their order of priority as far as their number is concerned and these are Baluchi, Lohi, Harnai and other breeds. Sheep breeds found in **Dir** are given in their order of priority as far as their number is concerned and these are Dhamani, Kachhi, Kaghani, Waziri and other breeds.

**Goats**

Goats breeds found in **Bahawalpur** are given in their order of priority as far as their number is concerned and these are Tedy, Beetal, Barbri, Nachi, Chappar, Kamori and

other breeds. Goat breeds found in **Sanghar** are given in their order of priority as far as their number is concerned and they are Kamori, Teddy, Barbari, Lehri, Beetal and other breeds. Goat breeds found in **Lasbela** are given in their order of priority as far as their number is concerned and they are Kamori, Teddy, Lehri, Chappar and other breeds. Sheep breeds found in **Dir** are given in their order of priority as far as their number is concerned and these are Teddy, Barbari, Beetal, Kaghani and other breeds.

### 7.1.4. Target Site Specific Pastoral Resources

Pastoral resources i.e., flora present in different target sites have been identified and are summarized as below:

**Bahawalpur**

**Vegetation**

Tree/Shrub/Grasses:

*Calligonum polygonoides, Haloxylon recurvum, Haloxylon selicomicum, Suaeda fruticosa, Aristida depressa, Cenchrus ciliaris, Cymbopogon jwarancusa, Eleusine compressa* and *Lasiurus sindicus.* (Khan, 1998)

**Sanghar**

**Vegetation**

*Eleusine flagellifera, Cenchrus biflorus, Panicum sp.* and *Aristida sp.* (Muhammad, 1989)

**Lasbela**

**Vegetation**

Tree/Shrubs/Grasses:

*Prosopis cineraria, Salvadora oleoides, Capparis aphylla, Tamarix aphylla, Suaeda fruticosa. Prosopis juliflora, Cenchrus ciliaris, Eleusine flagellifera, Pennisetum oreintale* and *Aristida adsensionis.* (Muhammad, 1989)

**Dir**

**Vegetation**

Tree/Shrub/Grasses:

*Juniperus maeropoda,Pinus gerardiana, Cedrus deodara, Pinus walliehiana, Ephedra spp., Sophora spp., Salix spp., Caragana spp., Cymbopogon spp., Dichanthium annulatum, Pennisetum orientale* and *Aristida spp.* (Muhammad, 1989)

# 8. GEOGRAPHICAL INFORMATION SYSTEM (GIS)

GIS is a special type of geographical database defined as, "a computer-based methodology including hardware, software and graphics that encodes, analyses and displays multiple data layers derived form various sources. Analysis can be expressed in tabular, graphic, and most importantly in geographically coordinated **mapping** format" (American Farmland Trust, 1985).

A GIS can: (i) retrieve all attributes at a location, (ii) identify all locations with a specific group of attributes, (iii) calculate distances between points and estimate the area within geographic boundary, (iv) analyze data with interpolation routines, (v) calculate terrain information from elevation data, (vi) perform union and multiple exclusion operations on areas with intersecting locations, and (vii) draw map overlays. (Bunting, 1996)

The consultant with the assistance of Water Resources Research Institute, National Agriculture Research Centre, Islamabad, has developed the following GIS based maps. These maps are:

1. In map no. 2, population density (persons/km.sq.) of various districts of Pakistan is depicted (Data source: Population Census of Pakistan, 1998).

2. In map no. 3, agro-ecological regions i.e., (i) Indus Delta, (ii) Southern Irrigated Plain, (iii) Sandy Desert, (iv) Northern irrigated Plain, (v) Barani (rainfall), (vi) Wet Mountains, (vii) Northern dry mountains, (viii) Western Dry Mountains, (ix) Dry Western Plateau and (x) Sulaiman Piedmont, are depicted.
   Furthermore, four target sites/locations to be included in the full project are also incorporated on their geographical locations in Pakistan (Data source: PARC, Islamabad, 1980).

3. In map no. 4, annual aridity classes with kharif (K) and rabi (R) crops are indicated. These annual aridity classes are classified as: (i) Humid (K, R), (ii) Humid (K), sub-humid (R), (iii) Humid (K), Semi-arid (R), (iv) Sub-humid (K), Humid (R), (v) Sub-humid (K,R), (vi) Sub-humid (K), Semi-arid (R), (vii) Sub-humid (K), Arid (R), (viii) Sub-humid (K), Hyper-arid (R), (ix) Semi-arid (K), Humid (R), (x) Semi-arid (K,R), (xi) Semi-arid (K), Arid (R), (xii) Semi-arid (K), Hyper-arid (R), (xiii) Arid (K), Semi-arid (R), (xiv) Arid (K,R), (xv) Arid (K), Hyper-arid (R), semi-arid (xvi) Hyper-arid (K), arid (R), and (xvii) Hyper-arid (K,R). (Data source: Pakistan Meteorological Department and WRRI, NARC, Islamabad, 1996)

4. Map no. 5 defines the landcover situation of Pakistan. The major types of landcover are defined in term of percentage coverage: (i) Snow (1.8), (ii) Water (0.03), (iii) Coniferous forest (3.5), (iv) Scrub forest (2.0), (v) Plantation (0.3), (vi) Riverain forest (0.4), (vii) Mangrove forest (0.02), (viii) Tidal delta (0.6), (ix) Irrigated agriculture (21.4), (x) Rainfed agriculture (4.2), (xi) Shrub lands (35.1), (xii) Sandy deserts (16.3), and (xiii) Rock outcrops (14.3). (Data source: NOAA image data)

5. In map no. 6, annual crop growth classes of Pakistan have been shown. The annual crop growth classes are classified as: (i) Excess (K,R), (ii) Excess (K), Adequate (R), (iii) Excess (K), Moderate-Adequate (R), (iv) Adequate (K), Excess (R), (v) Adequate (K,R), (vi) Adequate (K), Moderate-Adequate (R), (vii) Adequate (K), Deficit (R), (viii) Moderate-Adequate (K), Deficit (R), (ix) Deficit (R). (Data source: Pakistan Meteorological Department and WRRI, NARC, Islamabad, 1996)

6. In map no.7, buffalo population density has been presented. This map helps to identify the richness of the presence of buffalo in different locations/districts. The buffalo population at the sites/locations of the projects are also given and a quick appraisal of their presence can be gauged (Data source: Livestock Census, 1996)

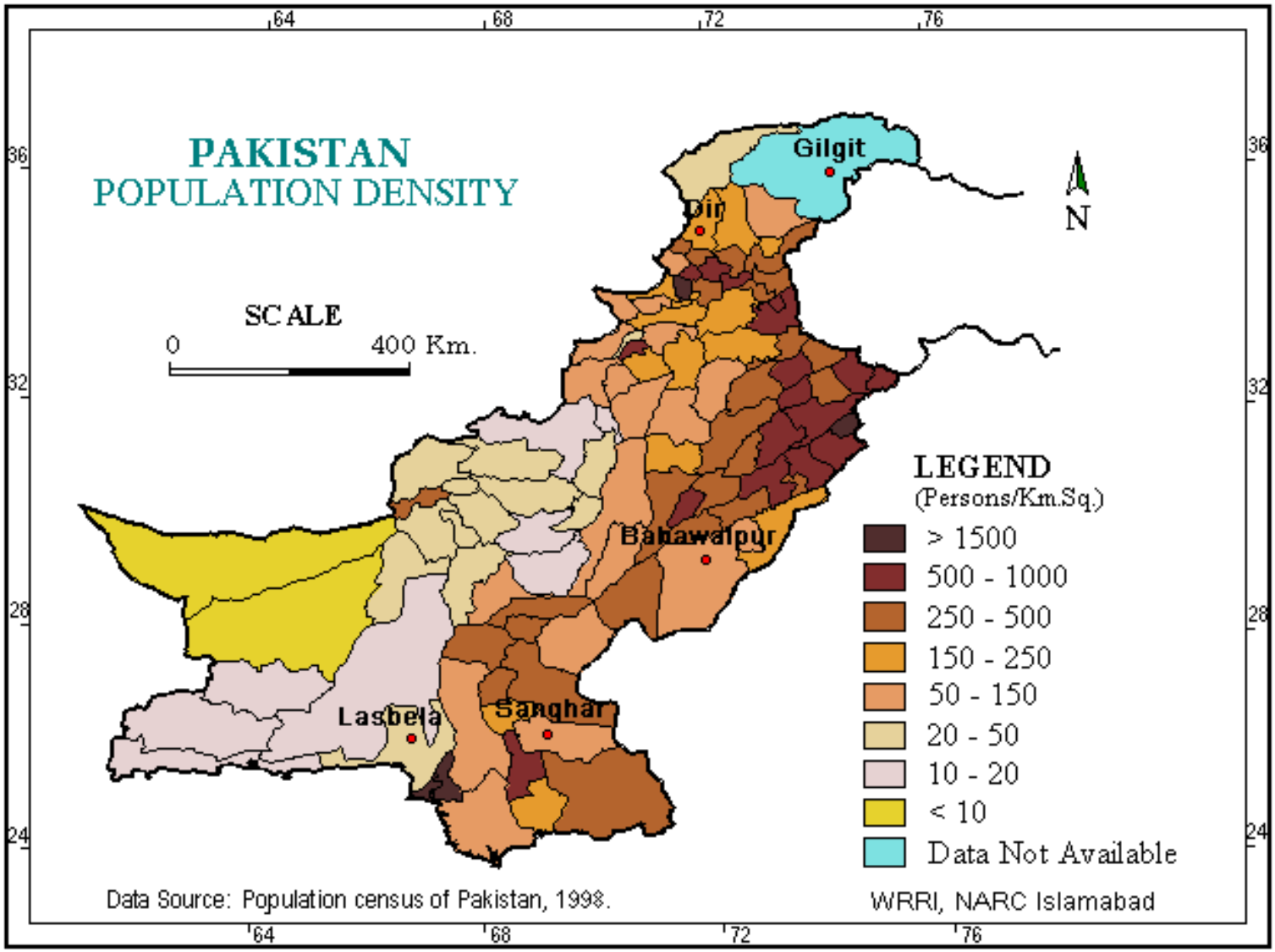
7. Map no.8 shows the cattle population density. This map helps to identify the richness of the presence of cattle in different locations/districts. The cattle population at the sites/locations of the projects are also given and a quick appraisal of their presence can be gauged (Data source: Livestock Census, 1996)

8. In map no.9, goat population density has been presented. This map helps to identify the richness of the presence of goats in different locations/districts. The goat population at the sites/locations of the projects are also given and a quick appraisal of their presence can be gauged (Data source: Livestock Census, 1996)

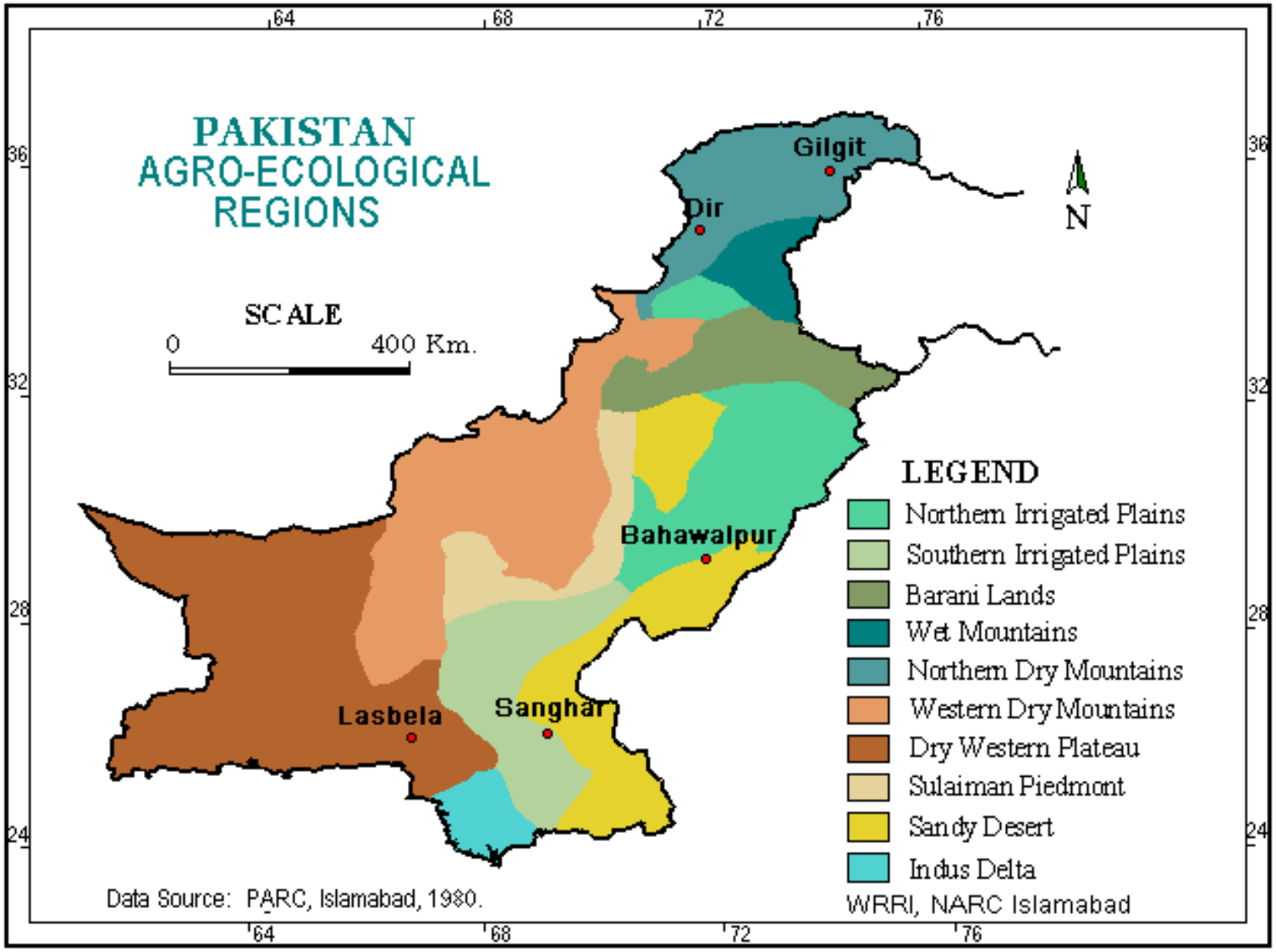
9. Map no.10 shows the sheep population density. This map helps to identify the richness of the presence of sheep in different locations/districts. The population of sheep at the sites/locations of the projects are also given and a quick appraisal of their presence can be gauged (Data source: Livestock Census, 1996)

10. In map no.11, the rural poultry population density has been presented. This map helps to identify the richness of the presence of rural poultry in different locations/districts. The poultry population at the sites/locations of the projects is also given and a quick appraisal of their presence can be gauged (Data source: Livestock Census, 1996).

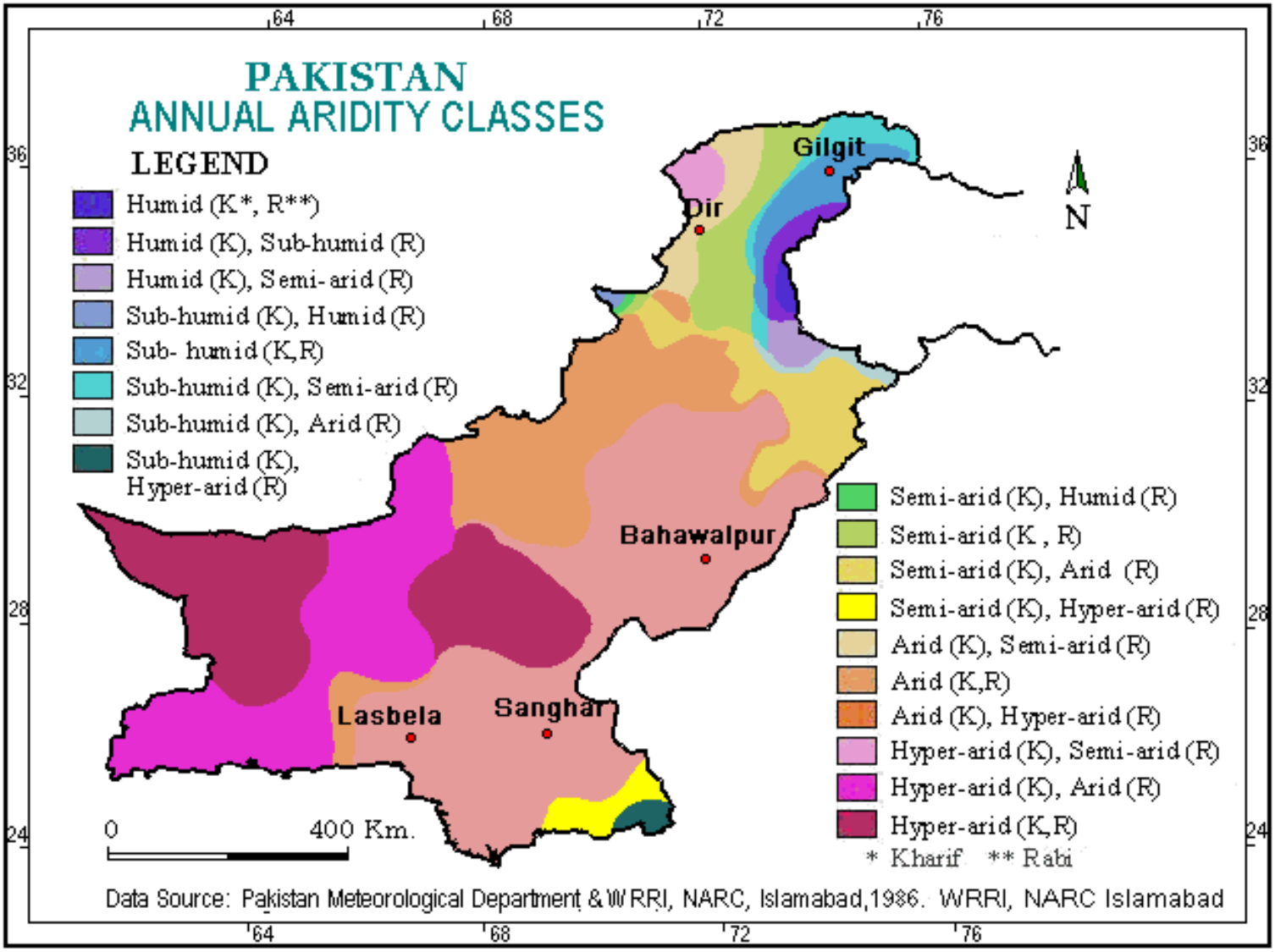
    The district wise information for commercial poultry was not available in the census, therefore, the map cannot be developed for commercial as well as for total poultry in various district of Pakistan.


PAKISTAN
POPULATION DENSITY
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
(Persons/Km.Sq.)
> 1500
500 - 1000
250 - 500
150 - 250
50 - 150
20 - 50
10 - 20
< 10
Data Not Available
Data Source: Population census of Pakistan, 1998.
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

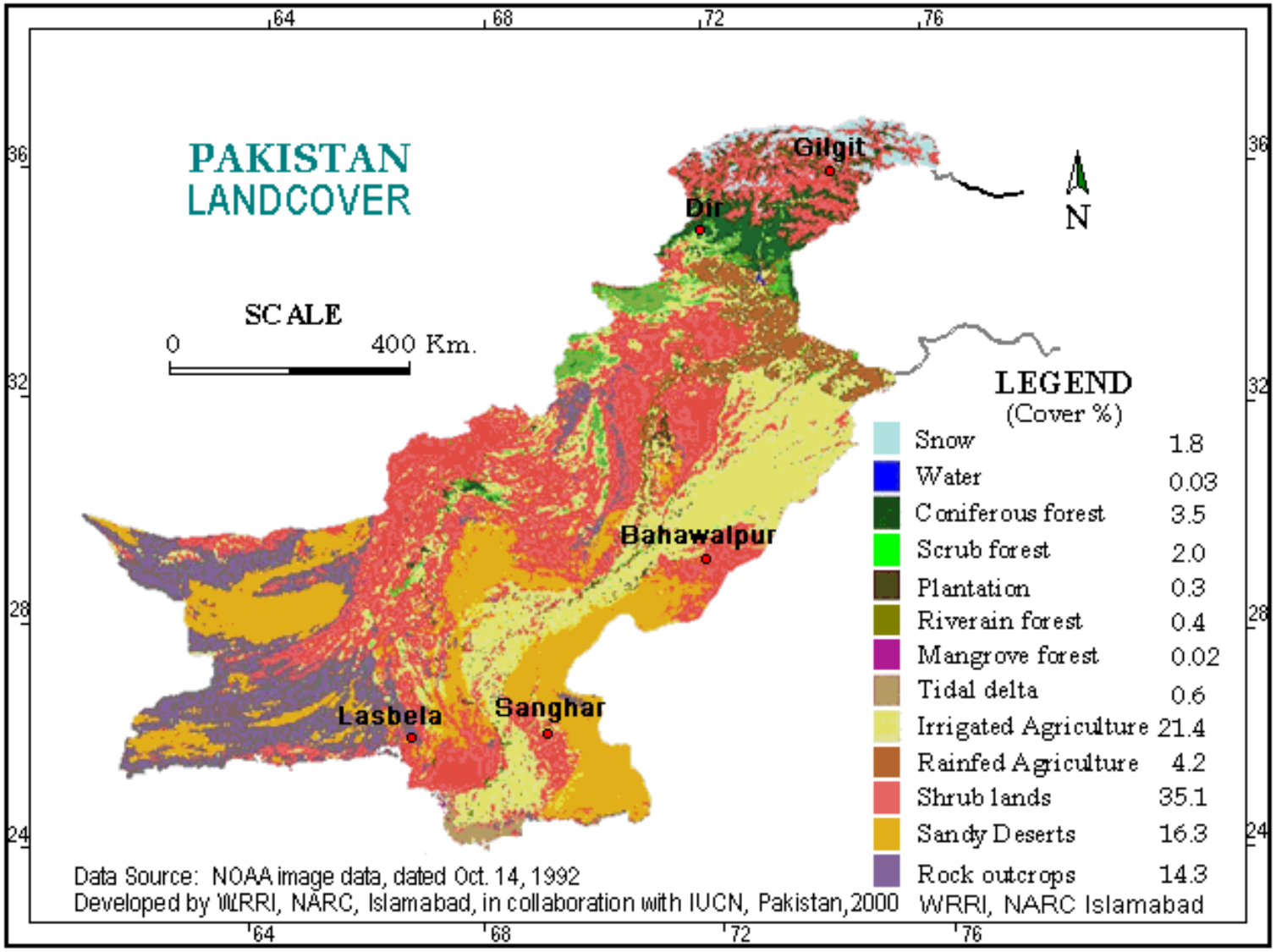
**MAP NO. 2**


PAKISTAN
AGRO-ECOLOGICAL
REGIONS
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
Northern Irrigated Plains
Southern Irrigated Plains
Barani Lands
Wet Mountains
Northern Dry Mountains
Western Dry Mountains
Dry Western Plateau
Sulaiman Piedmont
Sandy Desert
Indus Delta
Data Source: PARC, Islamabad, 1980.
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

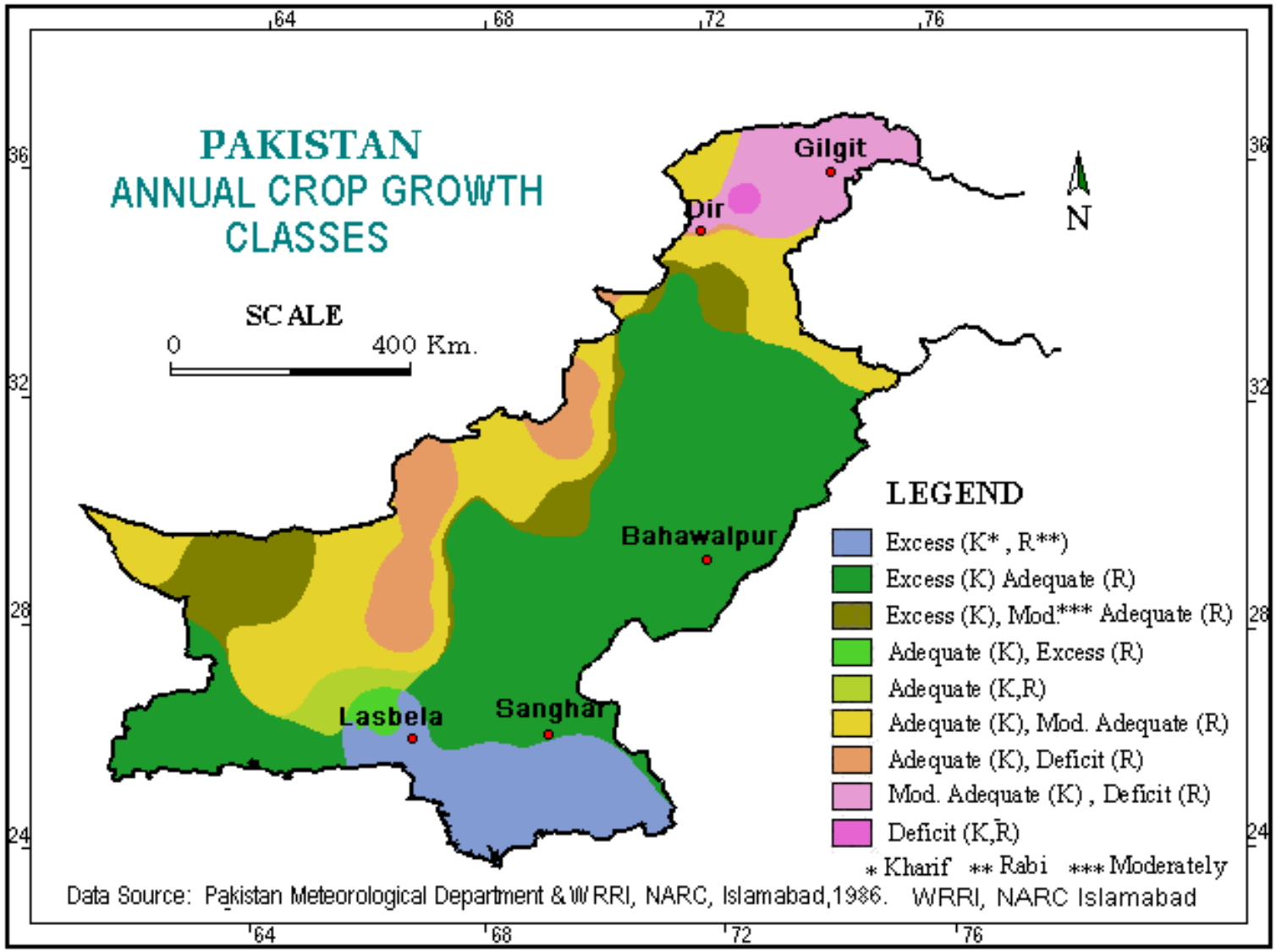
**MAP NO. 3**


PAKISTAN
ANNUAL ARIDITY CLASSES
LEGEND
Humid (K*, R**)
Humid (K), Sub-humid (R)
Humid (K), Semi-arid (R)
Sub-humid (K), Humid (R)
Sub- humid (K,R)
Sub-humid (K), Semi-arid (R)
Sub-humid (K), Arid (R)
Sub-humid (K), Hyper-arid (R)
Semi-arid (K), Humid (R)
Semi-arid (K , R)
Semi-arid (K), Arid (R)
Semi-arid (K), Hyper-arid (R)
Arid (K), Semi-arid (R)
Arid (K,R)
Arid (K), Hyper-arid (R)
Hyper-arid (K), Semi-arid (R)
Hyper-arid (K), Arid (R)
Hyper-arid (K,R)
* Kharif ** Rabi
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
N
0
400 Km.
64
68
72
76
36
32
28
24
Data Source: Pakistan Meteorological Department & WRRI, NARC, Islamabad,1986. WRRI, NARC Islamabad

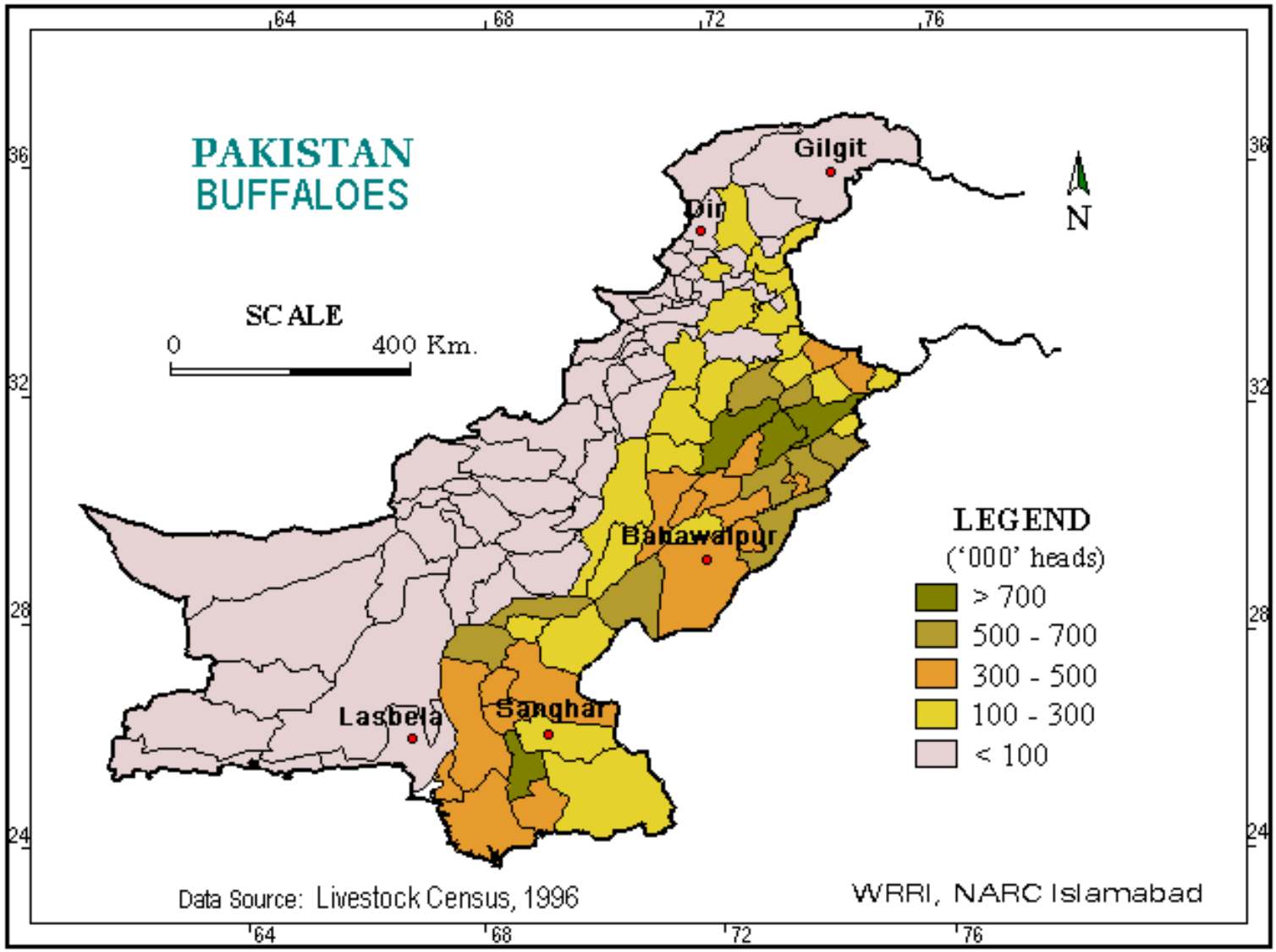
**MAP NO. 4**


PAKISTAN
LANDCOVER
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
64
68
72
76
36
32
28
24
LEGEND
(Cover %)
Snow 1.8
Water 0.03
Coniferous forest 3.5
Scrub forest 2.0
Plantation 0.3
Riverain forest 0.4
Mangrove forest 0.02
Tidal delta 0.6
Irrigated Agriculture 21.4
Rainfed Agriculture 4.2
Shrub lands 35.1
Sandy Deserts 16.3
Rock outcrops 14.3
Data Source: NOAA image data, dated Oct. 14, 1992
Developed by WRRI, NARC, Islamabad, in collaboration with IUCN, Pakistan, 2000
WRRI, NARC Islamabad

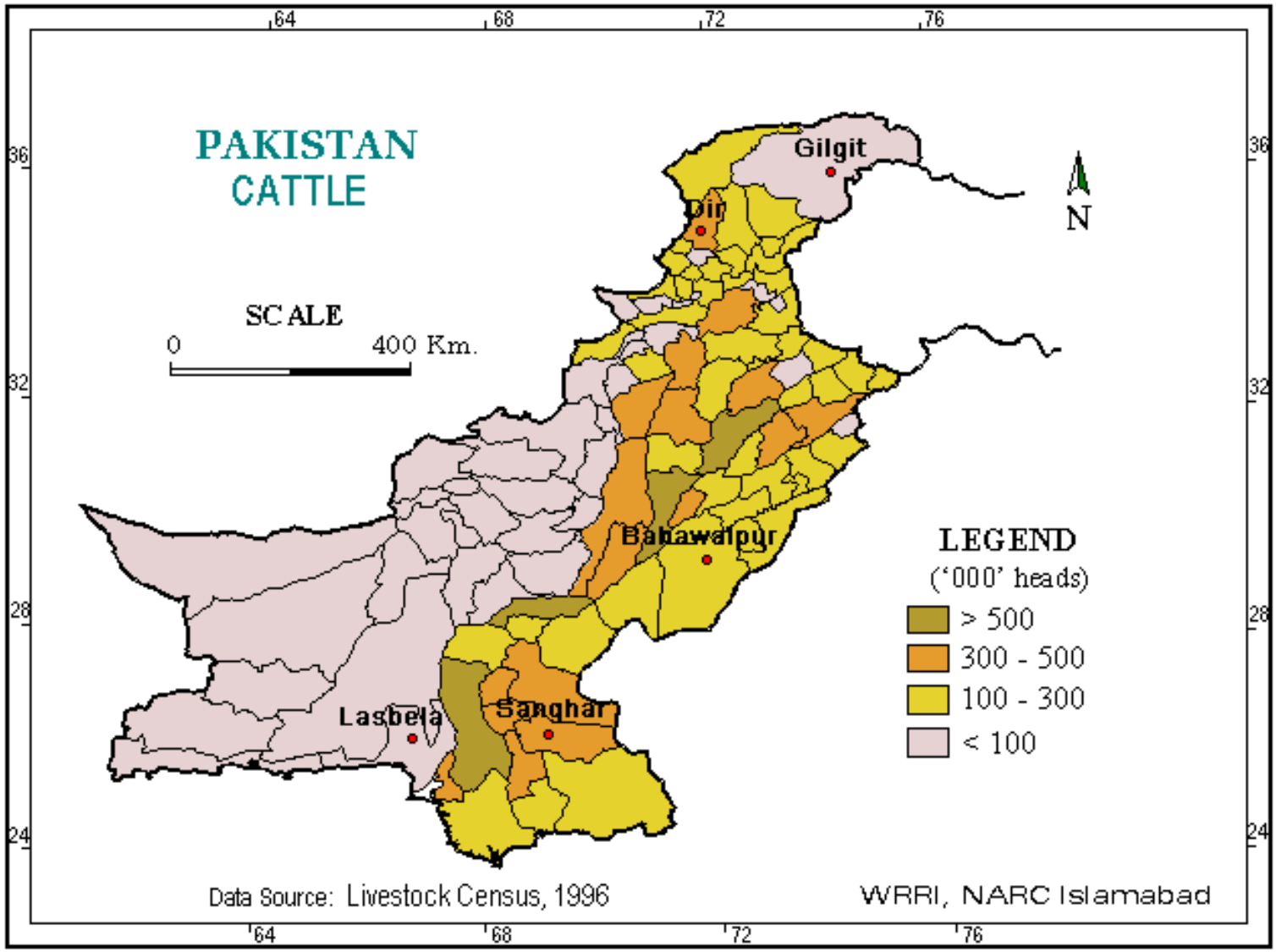
**MAP NO. 5**


PAKISTAN
ANNUAL CROP GROWTH CLASSES
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
Excess (K* , R**)
Excess (K) Adequate (R)
Excess (K), Mod.*** Adequate (R)
Adequate (K), Excess (R)
Adequate (K,R)
Adequate (K), Mod. Adequate (R)
Adequate (K), Deficit (R)
Mod. Adequate (K) , Deficit (R)
Deficit (K,R)
* Kharif ** Rabi *** Moderately
Data Source: Pakistan Meteorological Department & WRRI, NARC, Islamabad,1986. WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

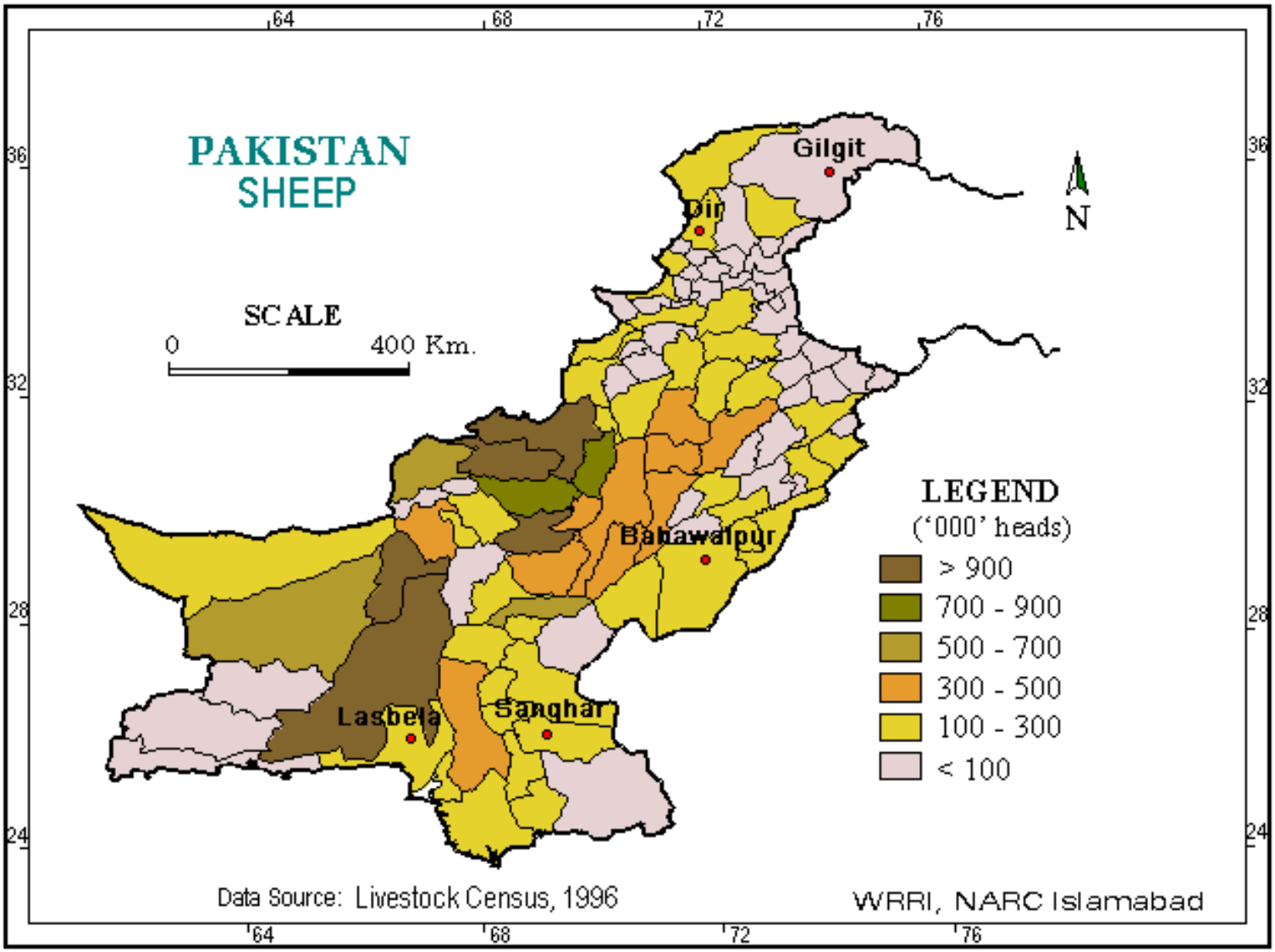
**MAP NO. 6**


PAKISTAN
BUFFALOES
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
('000' heads)
> 700
500 - 700
300 - 500
100 - 300
< 100
64
68
72
76
36
32
28
24
Data Source: Livestock Census, 1996
WRRI, NARC Islamabad

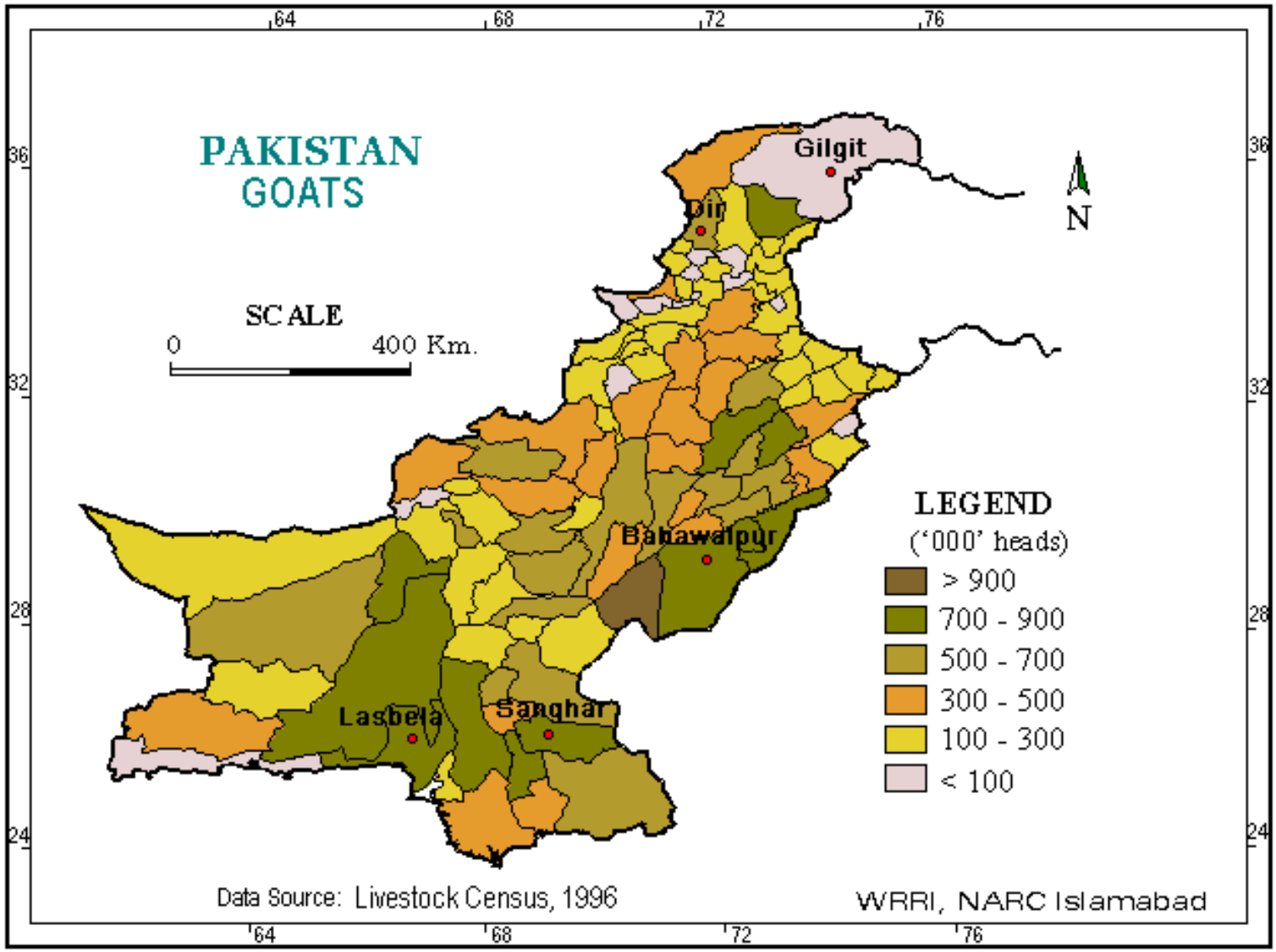
**MAP NO. 7**


PAKISTAN
CATTLE
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
('000' heads)
> 500
300 - 500
100 - 300
< 100
Data Source: Livestock Census, 1996
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

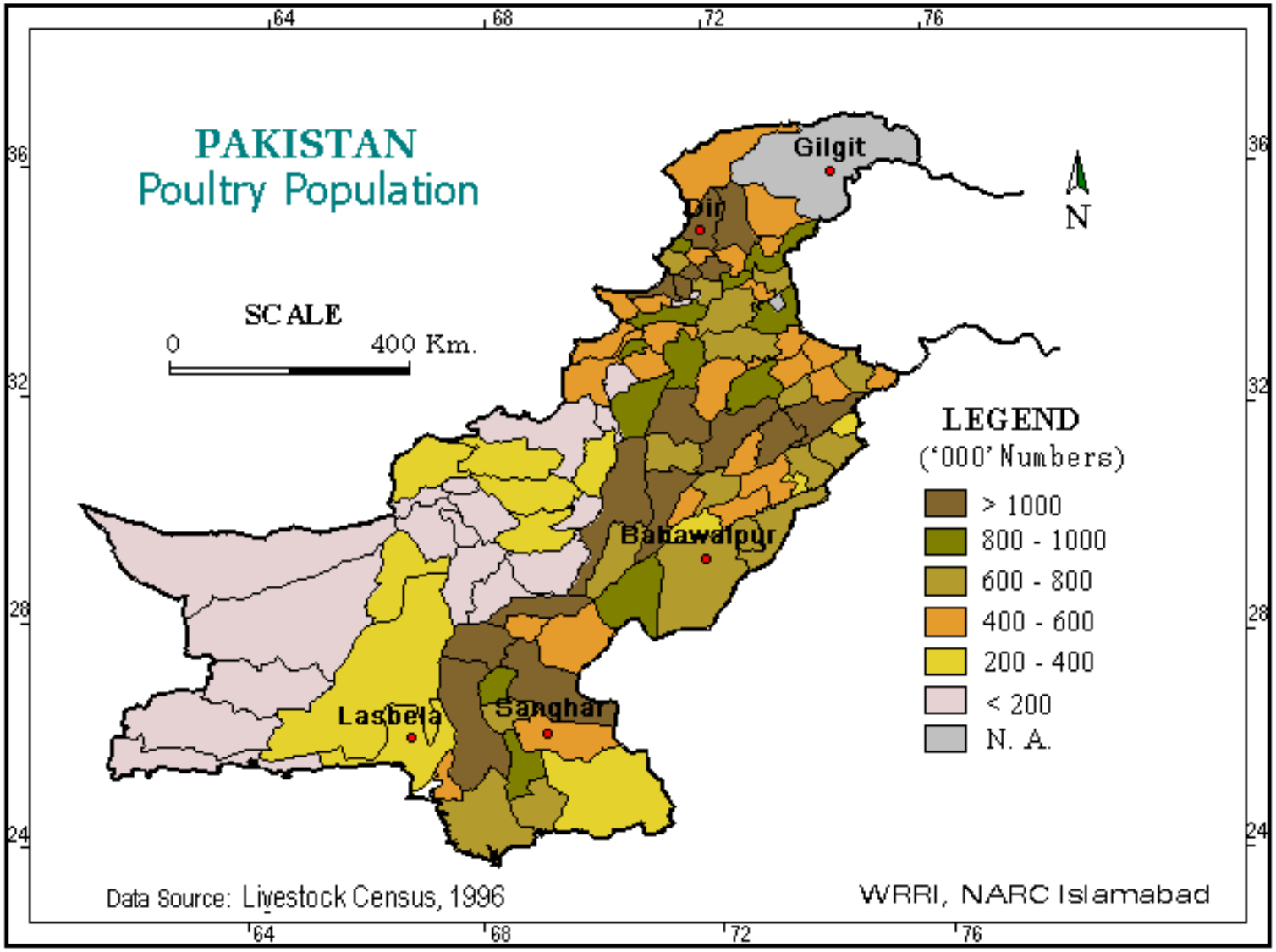
**MAP NO. 8**


PAKISTAN
SHEEP
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
('000' heads)
> 900
700 - 900
500 - 700
300 - 500
100 - 300
< 100
Data Source: Livestock Census, 1996
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

**MAP NO. 9**


PAKISTAN
GOATS
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
('000' heads)
> 900
700 - 900
500 - 700
300 - 500
100 - 300
< 100
Data Source: Livestock Census, 1996
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

**MAP NO. 10**


PAKISTAN
Poultry Population
SCALE
0
400 Km.
N
Gilgit
Dir
Bahawalpur
Lasbela
Sanghar
LEGEND
('000' Numbers)
> 1000
800 - 1000
600 - 800
400 - 600
200 - 400
< 200
N. A.
Data Source: Livestock Census, 1996
WRRI, NARC Islamabad
64
68
72
76
36
32
28
24

**MAP NO. 11**

# 9. POVERTY IN PAKISTAN

## 9.1. POVERTY PROFILE

It is generally accepted that the declining trend in poverty in Pakistan during the 1970s and 1980s was reversed in the 1990s. The incidence of poverty significantly increased from 26.6 percent in FY(Financial Year)1993 to 30.6 percent in FY1999 and the number of poor increased by over 12 million people during this period. Since FY1999, economic growth has slowed further, development spending has continued to decline, and the country has experienced a severe drought. Therefore, the incidence of poverty in Pakistan was significantly increased to 32.1 percent in FY2001. Thereafter, according to government estimate, the poverty has declined by 4.2 percentage points up to second quarter of 2004 (Economic Survey 2003-04).

Pakistan Resident Mission of Asian Development Bank has carried out poverty assessment for Pakistan and published a report on its findings (ADB, 2002). The findings of the report are summarized below:

There was a declining trend in poverty in Pakistan during 1970-90, thereafter; it was linearly increased up to FY2002-03. Poverty in Pakistan has historically been higher in rural than urban areas. Poverty rose more sharply in the rural areas in 1990s, and in FY1999 the incidence of rural poverty (36.3 percent) was significantly higher than urban poverty (22.6 percent). Inequality also increased in Pakistan during the 1990s, in both urban and rural areas, which enhanced the negative impact on poverty of slowdown in growth during this period. In line with the national picture, poverty in the provinces also registered an increase between FY1993 and FY1999. The incidence of poverty in the Punjab increased from 25.2 percent to 33.0 percent; in Sindh from 24.1 percent to 26.6 percent; and in North West Frontier Province (NWFP) from 35.5 percent to 42.6 percent.

There are a number of attributes, which characterize the poor in Pakistan. **First**, education is the most important factor that distinguishes the poor from the non-poor, for example the proportion of literate household heads in poor households was almost half that in non-poor households. **Second**, poor households on average had 75 percent more children that the non-poor households. Most of these children are not receiving any education, and thus the cycle of poverty is perpetuated. **Third**, more than one third of the poor households were headed by aged persons who were dependent on transfer incomes, such as pensions and other forms of social support. **Fourth**, the poor had few physical assets, and according to one study, if a rural household possesses physical assets (land/livestock) the probability of it being poor declines by 55 percent. **Fifth**, the poor rely disproportionately on informal sector employment.

The incidence of poverty is the highest among household heads with occupations such as day labor in agriculture, construction, trade and transport sectors. Incidence of poverty is also high among self-employed, which includes street vendors in urban areas, and share croppers in rural areas.

Gender discrimination is another key attribute that characterizes the poor. Female labor force participation rates in Pakistan are exceptionally low at just 13.7 percent, compared to 70.4 percent for men with low paid employment. Incidence of poverty among women in Pakistan is higher compared with men, and is characterized by low endowment of land and productive assets, unemployment, discrimination in the labor market, and limited access to economic options and political processes. The poor are also characterized by their vulnerability to environmental degradation and deterioration of the natural resource base, given that they tend to be strongly dependent on the exploitation of such resources.

## 9.2. CAUSES OF POVERTY

A number of factors explain the existence of and increase in poverty in the last decade. However, poor governance is the key underlying cause of poverty in Pakistan. Poor governance has not only enhanced vulnerability, but is the prime cause of low business confidence, lower investment levels and growth. Governance problems have also resulted in inefficiency in provision of social services, which has had serious implications for human development in the country.

With regard to economic factors, decline in the Gross Domestic Product (GDP) growth rate is the immediate cause of the increase in poverty over the last decade. In the 1990s, growth declined in all sectors and was slower than average in labor-intensive sectors.

Environmental degradation is also a cause of poverty in Pakistan. The environment-poverty nexus manifests itself most particularly in health effects. For example, waterborne diseases are widespread because 17 percent of the urban and 47 percent of the rural population who does not have access to clean drinking water and pollution free environment. The prevalence of disease exacerbates poverty firstly by compelling the poor to devote ever increasing proportions of their limited income to health costs, and secondly by reducing productivity.

## 9.3. RESPONSES TO POVERTY

A number of initiatives aimed at helping the poor by improving governance and functioning of public sector institutions; creating assets, employment, and income-generation opportunities; revamping social safety net systems; and improving access to basic services are being implemented by the Government, and also by Non Governmental Organizations (NGOs) and the private sector in Pakistan.

Foremost among the Government's governance related reforms is the introduction of the Devolution Plan under which local governments were elected at the district, tehsile, and union levels in all the four provinces in August 2001. Under the Devolution Plan, the delivery of services in the social and other poverty-focused sectors has been decentralized, with the elected local governments given the mandate and responsibility to manage and run these services. It is expected that this would result in significant improvement in the system of delivery of public services by making it more responsive and accountable to the local people. The Government is also in the process of introducing civil service reforms, which in several key areas are also underway to enhance equitable access of the citizens to justice.

The Government has, over the years, undertaken several public works programs to create assets and employment opportunities for poor people, such as Khushhal Pakistan Program (KPP), is an integrated small public works program. Although microfinance in the country has historically been provided by NGOs, the government has, more recently, started playing a direct role in providing microfinance services, through institutions like the Pakistan Poverty Alleviation Fund (PPAF) and the Khushhali Bank, bank established in 2000 with ADB support to provide group loans to poor communities.

Among the social safety net systems run by the Government, Zakat a donation to charity obligatory for Muslims is the main one. The Zakat fund comprising of savings from Zakat proceeds, which is used primarily to disburse grants for rehabilitation, has risen to Rs. 24 billion in 2001.

In addition to the public sector, NGOs and Community Based Organizations (CBOs) are working throughout Pakistan in a wide range of poverty reduction activities. Some NGOs are purely welfare oriented, and were formed primarily as charitable organizations. Many are involved in broader poverty reduction efforts including strategies to improve income-generation opportunities, savings and credit initiatives and social development. Some

NGOs are involved in skill development, while others are more concerned with advocacy and are issues-based. Most NGOs are engaged in direct service delivery as well as facilitating service delivery through linkages with Government line agencies. Amongst the more prominent NGOs are the ones implementing microfinance programs, either as the main activity or as components of integrated rural development programs.

## 9.4. POVERTY REDUCTION STRATEGY OF GOVERNMENT OF PAKISTAN

According to Economic Survey for the FY2003-04 the Government of Pakistan has planned a Poverty Reduction Strategy whose salient features are outlined in the proceeding paragraphs:

### 9.4.1 Community Services

Expenditures on community services include the construction of roads, highways, buildings, water supply and sanitation. Actual expenditure has increased from Rs. 16.6 billion in year 2003 to Rs. 8.6 billion for the current year. Among the community services roads and highways have the largest share. These services will help to create huge employment opportunities and support the economic activity and thus, assist in poverty reduction.

### 9.4.2. Human Development

Investment in human development will be as essential as sound microeconomic policies in achieving the objectives of higher economic growths. During the 2002-03, financial year the educational budget was Rs. 88.84 billion, which has been increased to 238.8 billion for FY2003-04. Higher expenditure on education will help effectively in reducing the poverty level in the country. Government has also high priority to various social and

economic programs exclusively for women. Health care is another important area and the government has assigned priority while allocating significantly enhanced financial allocation.

### 9.4.3. Rural Development

About 68 percent of population of Pakistan lives in rural areas. This vast majority cannot be neglected if the poverty level has to be reduced from the country. For this year (2003-04), a budget expenditure of Rs. 34.15 billion has been ear marked for rural development activities, exclusively for; irrigation, land reclamation, rural development and rural electrification.

### 9.4.4. Safety Nets

The government's safety net programs include food subsidies, food support programs, Tawana Pakistan, and low cost housing, etc. These programs are directly related to the poorest section of society. Hence, the government is continuously increasing their budgetary allocations every year. Budget allocation is Rs. 17.67 billion including Rs. 13.26 billion for food subsidies alone for this year.

### 9.4.5. Good Governance

It is generally believed that poor governance is one of the factors causing poverty to rise. It is argued that same economic policies and institutions that have led to high growth and poverty reduction in other countries have failed in Pakistan because of poor governance. Rising poverty enables the value system to decline sharply and allows the elite to exploit and manipulated more easily. Good governance will ensure that the benefits of growth are more equitably distributed. In view of this, the government has been increasing the

allocation to this sector. The budget for good governance is Rs. 41.86 billion in the current fiscal year compared to actual expenditure of Rs. 38.54 billion last year.

## 9.5. LIVESTOCK ROLE IN POVERTY REDUCTION

Agriculture sector in general and livestock sector in particular are operated by low income groups. The large segment of livestock owners are either small land holder or landless. There are more or less poorest of the poor and needs micro-crediting to purchase inputs for their livestock. There should be some special micro-credit initiative for livestock own by the government and non-government organizations. Particularly, rural and peri-urban, dairy production and feedlot fattening on scarifying Eid should be techno-economically backstopped as income generation, which intern will help in poverty reduction.

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## 11. TERM OF REFERNCES (TOR)

- Describing the main agro-ecological contexts and –production systems (i.e., in the terms of biophysical and socio-economic environment, and differentiated by FAnGR species/breeds) are found.
- Describing the main ecological contexts (i.e., in terms of biophysical and socio-economic environment and differentiated by, as relevant wild relatives) in which wild relatives are found.
- In conjunction with the FAnGR status consultancy and the National Coordinator, identifying the target site/regions for further in-depth collection of data. Ensure that these target sites cover the range of agro-ecological/ production system and FAnGR species/breeds richness, such that they are capable of accommodating the complete range of scenarios that will be covered by the various components of the Full Project.
- Collecting/compiling within these target sites/regions secondary data regarding: (i) rainfall (longest possible series); (ii) forest resources (current condition and trends); (iii) water resources and their status during wet and dry seasons (natural water bodies, reservoirs, tanks etc.); (iv) fauna; (v) types of soils; (vi) socio-economic activities (current condition and evolution of production systems); and (vii) equipment and infrastructure.
- Collect GIS (Geographic Information System) land-use and land-degradation maps at the country and/or specific regions as well as maps integrating the biophysical and socio-economic parameters (e.g., poverty maps).
- Analyzing the changes during the past 2030 years, the ecosystems in relation to evolution of production systems (mainly agriculture, livestock farming and forestry) over the country and more particularly at the target sites/regions. It should also include future trends for the forthcoming 20 years.
- Assisting the National Consultant in identifying and to assessing the capacities of governmental and private institutions at the country level as well as within the

country (e.g., provinces) to provide agro-ecological information within the context of FAnGR.

- For further development of DAGRIS (Domestic Animal Genetic Resources Information System), within the scope of the full project, it will be important to know what proportion of information available in the local languages is also present in English.