

B.S/B.Ed./MSC Level

Geography of Pakistan-I

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**Department of Pakistan Studies
Faculty of Social Sciences & Humanities**

**ALLAMA IQBAL OPEN UNIVERSITY
ISLAMABAD**

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FOREWORD

Allama Iqbal Open University has the honour to present various programmes from Metric to PhD. level for those who are deprived from regular education due to their compulsions. It is obviously your own institution that provides you the education facility at your door step.

Allama Iqbal Open University is the unique in Pakistan which provides education to all citizens; without any discrimination of age, gender, ethnicity, region or religion. It is no doubt that our beloved country had been facing numerous issues since its creation. The initial days were very tough for the newly state but with the blessings of Allah Almighty, it made progress day by day. However, due to conspiracy of external powers and some weaknesses of our leaders, the internal situation of East Pakistan rapidly changed and the end was painful as we lost not only the land but also our Bengali brothers. After the war of 1971, the people and leaders of Pakistan were forced to rethink the future of the remaining country. Pakistan Studies was declared as compulsory subject up to degree level by the government of Pakistan after the dismemberment of East Pakistan. AIOU Islamabad proud to offer BS and MSc in Pakistan Studies for the learners from all corners of the country.

Pakistan Studies is the collection of many subjects including history, culture, economy, languages, international relations, politics and geography etc. The recent textbook ‘Geography of Pakistan-I’ is one of the books included in courses of MSc. / B.Ed. and BS. This is the very first version of the said course book and I am hopeful that it would fulfill the requirement of students who enrolled in BS and MSc as well as B.Ed level programmes.

I am pleased that Allama Iqbal Open University has committed the aim to provide the quality education to all at their door step. Now, a new course book Geography of Pakistan-I, for the students of BS/ MSc and B. Ed. is now available. The book in your hands is the latest course of Geography of Pakistan-I developed for you. Its units have been written and reviewed by the experts of the subject and I am hopeful after studying the book, you will acquire the authentic information and facts about the Geography of Pakistan.

**Prof. Dr. Zia Ul-Qayyum
(Vice Chancellor)**

November, 2019

INTRODUCTION

Allama Iqbal Open University Islamabad offers BS, B. Ed MSc Programmes with specialization in Pakistan Studies. The Department of Pakistan Studies has the honour of developing many courses for the university students from metric to M. Phil levels. This course is developed according to the requirements of Higher Education Commission of Pakistan. The course fulfills the needs of the students regarding their queries about Geography of Pakistan.

This course comprises nine units consisting of three credit hours. The units of the course have been written and reviewed by the experts of the subject. Geography of Pakistan-I (Part-I of the course) is designed to introduce you about the area, land, location, dimensions, neighbours, weather, flora, fauna, soil, temperature, air pressure, seasons, cyclones, rainfall and natural contents of their homeland. You will also know about forest types, its distribution, forest products and deforestation problem of Pakistan. This course also evaluates water resources and agricultural system of the country. Following are the brief details of the topics.

Physiography: In Physiography you will study three major features-Mountain, Plateaus and Plains. Mountains lie in the north and west. Pothwar plateau of limited dimension lies at the foot of northern hills. The rest of the country is a vast plain stretching south up to the sea.

Hydrology: Major features of Pakistan's hydrology are rivers, lakes and canals. The country is drained by Himalayan Rivers among them Indus is the major river. Indus river rising in the Tibetan region in the vicinity of Lake Manasarwar. It flows first south-east to north-west and then from north to south and drains its waters into the Arabian Sea. River Kabul, Jhelum, Chenab, Ravi and Stlej are its tributaries.

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 highland climate prevails. Pakistan has three seasons: winter (November to March) is warm and cooled by sea breezes on the coast; summer (April to July) has extreme temperatures and the monsoon season (July to September) has the highest rainfall on the hills.

Vegetation: The vegetation of Pakistan varies with elevation, soil type, and rainfall. Forests are largely confined to the mountain ranges in the north, where coniferous alpine and subalpine trees such as spruce, pine, and deodar cedar grow. The southern ranges of the Himalayas, which are of lower elevation, receive heavy rainfall and have dense forests of deodar, pine, poplar, and willow trees. The more arid Sulaiman and Salt mountain ranges are sparsely forested with a type of mulberry called shisham, abroad-leaved, deciduous tree. Dry-temperate vegetation, such as coarse grasses, scrub plants,

and dwarf palm, predominates in the valleys of the North-West Frontier Province and the Baluchistan Plateau. The arid western hills are dotted with juniper, tamarisk (salt cedar), and pistachio trees. Dry-tropical scrub and thorn trees are the predominant vegetation in the Indus River plain. Known as rakh, this vegetation is native to the region and found in the Indus floodplain, require six weeks of monsoon flooding to sustain them during the dry months. Irrigated tree plantations are found in Punjab and Sindh Mangrove forests in the coastal wetlands are an integral part of the marine food chain.

Soil: Pakistan's soils are classified as (i) Indus basin soils, (ii) mountain soils, and (iii) sandy desert soils. However, the very modes of soil formation give rise to their diversification even within small areas. These soils vary in texture, chemical composition, colour, and organic content from place to place.

- i) The Indus basin soils are mostly thick alluvium deposited by rivers. Soils in the vicinity of river courses are the most recent and vary in texture from sand to silt loam and silty clay loams. They have a low organic content and are collectively known as the khaddar soils. Away from the river, toward the middle of the doabs, older alluvial soils (called bangar) are widely distributed. These soils are medium to fine in texture, have low organic content, and are highly productive under conditions of irrigation and fertilization.
- ii) Mountain soils are both residual (i.e., formed in a stationary position) and transported. Shallow residual soils have developed along the slopes and in the broken hill country. Those soils generally are strongly calcareous and have low organic content, but under sub humid conditions their organic content increases.
- iii) Sandy desert soils cover the Cholistan part of Sindh Sagar Doab and western Baluchistan. They include both shifting sandy soils and clayey floodplain soils. These include moderately calcareous and eolian (wind-borne) soils

Agriculture: Agriculture constitutes the largest sector of our economy. Majority of the population, directly or indirectly dependents on agriculture. It contributes about 24 percent of Gross Domestic Product (GDP) and accounts for half of employed labour force and is the largest source of foreign exchange earnings. It feeds whole rural and urban population.

Pakistan's principal natural resources are arable land and water. About 25% of Pakistan's total land area is under cultivation and is watered by one of the largest irrigation systems in the world. Pakistan irrigates three times more acres than Russia. Pakistan is one of the world's largest producers and suppliers of the Chickpea, Apricot, Cotton, Sugarcane, Milk, Onion, Date Palm, Mango, Tangerines, mandarin orange, Clementine, Rice, wheat and Oranges. Pakistan ranks fifth in the Muslim world and twentieth worldwide in farm output. It is the world's fifth in the Muslim world and twentieth worldwide in farm output. It is the world's fifth largest milk producer. However, in recent years, due to persistent hikes in the prices of essential commodities like pulses, onions, potatoes, chillies and tomatoes these crops have also gained in economic importance.

Mineral Resources: Pakistan is endowed with significant mineral resources and emerging as a very promising area for exploration of mineral deposits. Based on available information, country's more than 6,00,000 sq.kms of outcrop area demonstrates varied geological potential for metallic/non-metallic mineral deposits. Surveys conducted in the recent past have confirmed the great potential of Pakistan in the metallic minerals like copper, gold, silver, platinum, chromites, iron, lead and zinc.

As regards industrial minerals there is a vast potential of multi-coloured granite, marble and other dimensional stones of high quality for export purposes. The major production is of coal, rock salt, and other industrial and construction minerals. The five principal minerals namely limestone, coal, gypsum, sulphur, crude oil and natural gas.

Dear students, I am hopeful that the course will be highly fruitful for those who wish to gain more information about Geography of Pakistan. I have tried my best to provide you authentic knowledge and vast information as you have to learn as non-formal students of Allama Iqbal Open University Islamabad.

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OBJECTIVES

This course is developed for the students of BS / B.Ed. / MSc. Pakistan Studies Programme offered by Allama Iqbal Open University Islamabad. The course comprises 9 units of 3 Credit-Hours as per H.E.C approved criteria. The aim is to provide brief introduction to the students regarding the Geography of Pakistan. The course is designed with the following objectives.

1. To have broad knowledge about the location of Pakistan
2. To have a clear idea of immediate neighbours of Pakistan.
3. To describe the physical features of Pakistan.
4. To explain the strategic importance of Pakistan.
5. To highlight the geographical environment of the country.
6. To analyze different climatic zones of Pakistan.
7. To identify the water resources of Pakistan.
8. To point out the significance of mineral resources of the country.
9. To explain the problems faced by the agricultural of Pakistan.
10. To discuss the processes those are essential for economic development of the country.

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Unit-1

PHYSIOGRAPHY

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Introduction

Pakistan is a God-gifted country for the people of Pakistan which has its unique Physiography. Understanding of relief features of a country is a must for proper understanding of physical and economic environment. In this book, opening chapter is providing this basic information about physical setting of the Pakistan. Pakistan has been divided into three distinct physical regions in accordance with the relief features. These regions include mountains, plateaus and plains. The study of mountains of Pakistan provides information about their location along with a brief introduction of salient rivers, glaciers, lakes, passes and glaciers. There are two Plateaus in Pakistan, their salient relief features and drainage has also been discussed. Plains make up the major part of the relief of Pakistan, their study include topics like flood plains, bars, piedmonts etc. which provide ample information to the students about the plains. So the study of the following unit would help the students to understand the topics related to the climate, vegetation, soil, population, Economic activities in Pakistan.

Objectives

After reading this unit, you will be able:

1. to clear your concepts regarding the physical features of Pakistan (Physiography).
2. to develop your understanding about the mountains and various mountain ranges of Pakistan.
3. to learn about the Plateaus of Pakistan including Potohar and Balochistan.
4. to know the contribution of the Plains in the agriculture sector of Pakistan.

Physiography (Physical Features)

Physical Features of an area refer to the natural surface features of land; such as mountains, plateaus and plains. Mountains are natural elevations of the earth's surface which rise at least 1000 meters above sea level and 50% of their surface consist of steep slopes. Plateaus are table shaped lands which rise at least 300 meters above sea level. They are usually bounded on one or more sides by steep slopes which drop to lower land, or by steep slopes rising to a mountain range. In contrast to mountains and plateaus, plains are flat or gently rolling land surfaces.

On the basis of relief features found in Pakistan, it can be divided into following major physical regions.

1. Mountains
2. Plateaus
3. Plains

1.1 Mountains

Mountains of Pakistan spread over Northern, and Western parts of it. Therefore they can be classified as Northern and Western Mountains.

About 225 to 65 million years ago in place of these mountains existed a sea named as Tethys. Contraction of the Tethys bed began about 65 million years ago and continued up to 54 million years. Northern and western mountain ranges began to appear from the bed of Tethys around 26 to 7 million years ago. Emergence of these mountains completed around 2.5 million years ago, but their uplifting is still evident. These mountains are termed as Fold Mountains because of the presence of the folds in their rock strata. These Folds were formed by the contraction of rock strata of Tethys sea bed due to compressional forces of the surface of the earth.

i) The Northern Mountains

These Northern Mountains of Pakistan comprise of three main mountain ranges such as The Karakoram, The Himalayas and The Hindu Kush. These ranges have been folded and faulted.

The Karakoram Range: It is located to the North of River Indus and is stretched from River Hunza to River Shyok in an east west direction. Their average height is 6000 meters and Godwin –Austen or Chhogori (K2-8611) is the highest peak, it is the 2nd highest peak of the world. These ranges have deep narrow valleys, vertically sharp cliffs form a rugged landscape. Karakoram pass is the highest and Khunjrab pass provide link to china through Karakoram Highway which is also known as Silk route. River Hunza, River Gilgit and River Shimshal provide drainage to this area. Precipitation is in the form

of snow. A number of glaciers exist in upper valleys such as Siachin, Hispar, Baifo, Baltoro and Batura. Important valleys of the area are Skardu, Gilgitand Hunza.

Highest Peaks Of Karakoram	
K2	8611 metres
Gasherbrum-I	8080 metres
Broad Peak	8050 metres
Gasherbrum-II	8035 metres
Gasherbrum-III	7952 metres

Figure 1.1 Highest Peaks of Karakoram

Passes of Karakoram
Kilik Pass
Mintaka Pass
Khunjerab Pass
Shimshal Pass
Mustagh Pass

Figure 1.2 Passes of Karakoram

Glaciers of Karakoram
Siachin
Hispar
Baifo
Baltoro
Batura

Figure 1.3 Glaciers of Karakoram

The Hindu Raj range is located between the Hindu Kush and Karakoram. Its highest peak is Koyo Zom 6,872 m. Other notable peaks include Buni Zom and Ghamubar Zom.

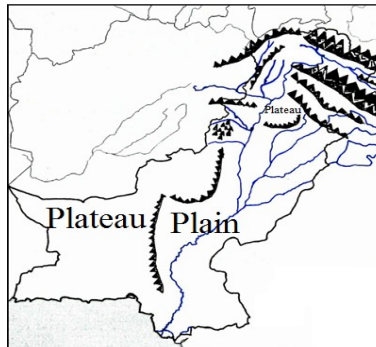


Figure: 1.1 Mountains Plateaus and Plains of Pakistan

The Himalayas

The Himalayas are located to the south of the Karakoram ranges. They run in an east to west direction. Their average height is about 4000m.

Peaks of Himalayas
Nanga Parbat 8126m
Rakhiot Peak 7070m
Ganalo Peak 6606m
Laila Peak 5971m
Sarwali Peak 6096m

Figure 1.5 Peaks of Himalayas

They comprise the following sub-parallel ranges:- Deosai Range, Central Himalayas, Lesser Himalayas and Siwaliks.

i) Deosai Range: stands between the Valley of Kashmir and Gilgit Baltistan. It lies to the south east of the Indus river gorge. There is a vast plain covering an area of 1502 square kilometers, bearing the same name Deosai. The whole area is uninhabited, surrounded by Rocky Mountains, with an elevation of 4114 meters. The road leading to Skardu from Gurez passes through the Deosai Plains. Burzil Pass, situated in this area connects the Valley of Kashmir with Gilgit Baltistan.



Figure 1.2 Deosai Range

ii) Central Himalayas: Central Himalayas are located in south of River Indus which separates it from Karakoram Range. They mostly lie in Kashmir with an average height of more than 4600 meters. Due to great altitude, some glaciers as Rupal (18 kms) are found here. Valley glaciations features are traced at Lake Saif-ul-Maluk in Kaghan.

Nanga Parbat (8126 m) is the highest peak of the area. Some deepest valleys and gorges are also located in these ranges such as Dasu-Patan i.e. 6500 m deep. River Indus is the main source of drainage for this range. Kaghan is the important valley of the area. Lake Saif-ul-Maluk and Satpara are the important lakes of the area. Babusar Pass connects (Kaghan valley to Chilas) and another important pass is Noori Pass which connects Kaghan Valley with Kashmir.

iii) Lesser Himalayas: They are Located to the south of Central Himalayas. Their altitude varies from 1800 to 4500 meters. These ranges spread over Northern Rawalpindi, Abbottabad and Mansehra district. Hill stations like Murree, Nathia and Ghora gallies lie in these ranges.

iv) Siwaliks: These are southern most ranges of Himalayas. Their average height is about 600 to 1200 meters. The ranges cover the hills of Rawalpindi.

The Hindu Kush: They are located to the west of Karakoram and Himalayas mountains in North West of Pakistan. Their average height is about 5000 meters. These ranges guard the north-western borders of Pakistan. Their main part lie in Afghanistan which is a birthplace of many earthquakes. Barren mountains, steep slopes and fast flowing rivers are typical features of the area. Trich Mir (7690 m) and Noshaq (7484 m) are the highest peaks of the area. These ranges occupy the Chitral district. Glaciers such as SakizJarab (30 kms) and Trich Mir (22 kms) are also important features of the area. River Kabul, Ghizar and Mastuj provide the main drainage of the area. Important passes like Barogil Pass (links Pakistsn to Afghanistan through Wakhan strip), Shandur Pass connects (Chitral to Ghizer District of Gilgit- Baltisan), Lawari Pass connects (Dir to Chitral valley) lie in these ranges.

The Kohistan, Swat and Dir Ranges They are located to the south of the Hindu Kush Mountains. They are sub-parallel ranges running from north to south. These mountains are separated by rivers, the Kohistan Mountains lie between the Indus and Swat rivers, the Swat Mountains between the Swat and Panjkora rivers, the Dir Mountains between the Panjkora and Kunar rivers. In north they rise to 5000 to 6000 meters and southward they descent as low as 200 meters in altitude. Peaks are covered by snow.

1.1.2 Western Mountains

These mountains border the western territory of the country. These are lower in altitude than the northern mountains. Western mountains can be divided into Koh-e-safed, Waziristan hills, Suleiman and Kirthar ranges.

Koh-e-Safed: They are located to the south of river Kabul and River Kurram flows in their South. They have an east-west trend. They rise is up to 4700 meters. They are mostly snow covered and therefore called white mountains. Sikaram is the highest peak which is 4760 meters high. Khyber Pass also lies in these ranges and connects Pakistan to Afghanistan. Rugged topography, steep slopes and severe winters are the main

features. Important valleys are Peshawar and Kohat, which are irrigated by canals from Warsak Dam on River Kabul.

Waziristan Hills: These hills are located between the Kurram and Gomal rivers. Their height is up to 3500 meters. Tochi, Gomal and Kurram are the important rivers that join river Indus and are known as western tributaries. Tochi and Gomal are important passes of the area. These hills are rich in minerals. Bannu is the important valley. The Kurram Tangidam on the River Kurram and Gomal Zam dam on Gomal River are the main source of irrigation.

Suleiman Mountains They are located towards the west of river Indus in the South of Waziristan hills. They run for a distance of 480 kms. and merge into Marri-Bugti hills in their south. Their average height is 1500 meters. The highest peak of the area is Takht-e-Suleiman (3383 meters). These ranges are composed of Limestone, Sandstone and Shale rocks. Bolan is the important pass of the area that links Quetta and Sibbi.

Kirthar Ranges They are located to the south of Bolan Pass. Balochistan Plateau is in their west and Sindh province in their east. They merge into low hill ranges of Sindh. Highest peak of this range is Kutto-jo-Qabar which is 2194m a.s.l. Average height of this range is 1219m. Gorakh Hill is a famous hill station and tourist destination in this range perched at an altitude of about 1981m a.s.l.

1.2 Plateaus

Plateaus are table shaped lands which rise at least 300 meters above sea level. They are usually bounded on one or more sides by steep slopes which drop to lower land, or by steep slopes rising to a mountain range. Pakistan has two areas with these distinct features.

- i) Potwar Plateau
- ii) Baluchistan Plateau

1.2.1 Potwar Plateau

It is situated in Northwestern side of the Punjab Province and covers about 18000 sq.kms of area. Its northern boundary is marked by Kala Chitta ranges and Margalla Hills. In the south it is bounded by Salt Range, and on eastern and western sides it is confined by River Jhelum and River Indus successively.

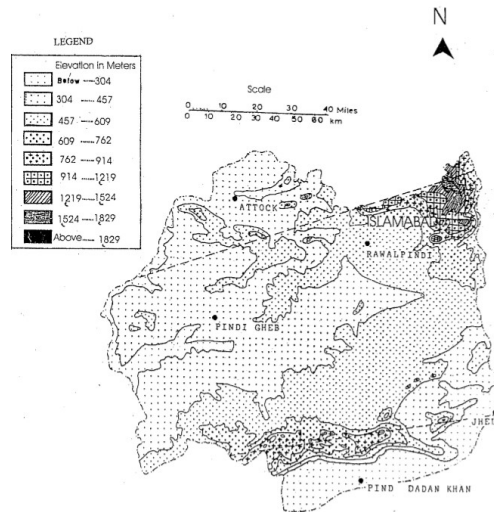


Figure 1.3 Potwar Plateau

The plateau covers the districts of Rawalpindi, Jhelum, Mianwali and Chakwal. Ravines, Ridges, Gullies, Trough and Residual hills are the main features of the area. Ravines and gullies have turned the area into a badland topography. These Gullies and Rivines are called khunders. River Soam, Korang, Harro, Sill and Dharab are the main water bodies of the area. Rock salt, Limestone, Gypsum, oil, Coal and Gas are the main minerals of the plateau. Khairi Murat, Kheri Mar, Bakralla Ridges, Jogi Tilla are significant ranges of the Potwar.

Drainage System

River Soan, River Korang, River Ling, River Harro, River Sill, and River Dharab are prominent Rivers of the area, forming the drainage system of Potwar Plateau.

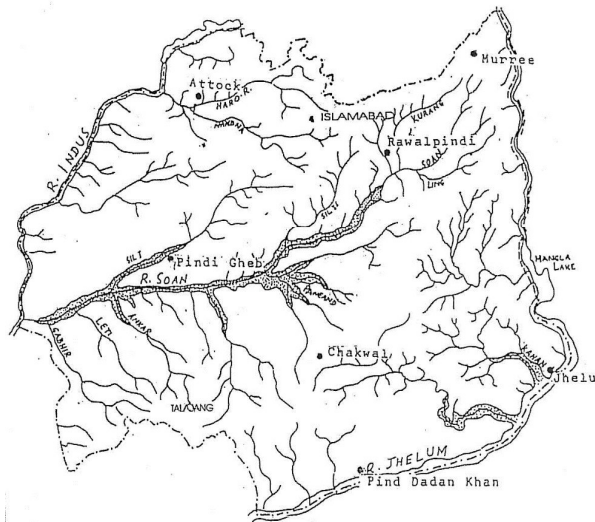


Figure 1.4 Potwar Plateau Drainage

Lakes

There are many saline lakes formed due to the accumulation of seepage water from the adjacent hills lakes like Kaller Kahar, Khabeki and Uchali. These are beautiful lakes in this area which add scenic beauty of the area.

Salt Range

Salt range is located to the south of Potwar Plateau. Its average height is about 750 – 900 meters. Range extends about 300 kilo-meters in east west direction. The Indus River breaks through the Range at Kalabagh. Salt Range covers most of the Jhelum, and parts of Khushab, Chakwal and Mianwali districts. It has become famous because of salt mines of Khewra, Kalabagh, Warcha. The highest peak of the area is Sakesar (1527 m). Khewra, Makrachi, Jaranwala and Jamsukh are small streams found in Salt Ranges. Salt Range is rich in a number of minerals e.g. Rock salt, Limestone and Gypsum.

1.2.2 Baluchistan Plateau

Baluchistan plateau is located on west side of Sulaiman and Kirthar ranges. Its Western boundary is marked by Iran, Northern by Afghanistan and Southern by Arabian sea. Its altitude varies from 600 – 3000 m. Its total area is 347,190 sq. Kms. This plateau is rich in minerals resources such as Natural gas, Oil, Gold, Silver copper & Coal. It is covered by small hill ranges, valleys, plains, water bodies and Kharan desert.

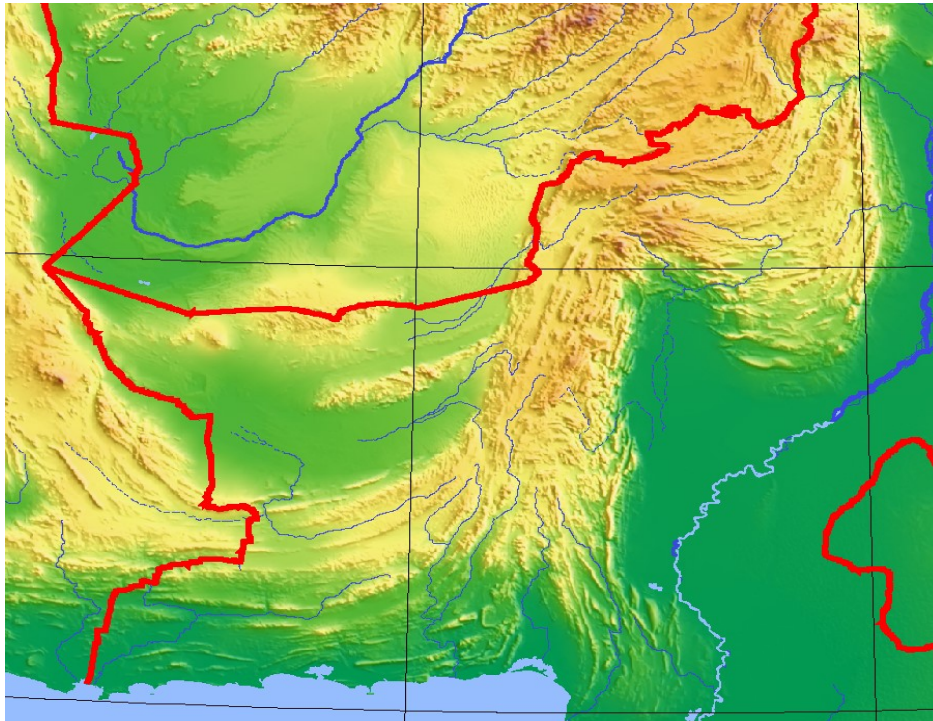


Figure 1.5 Baluchistan Plateau

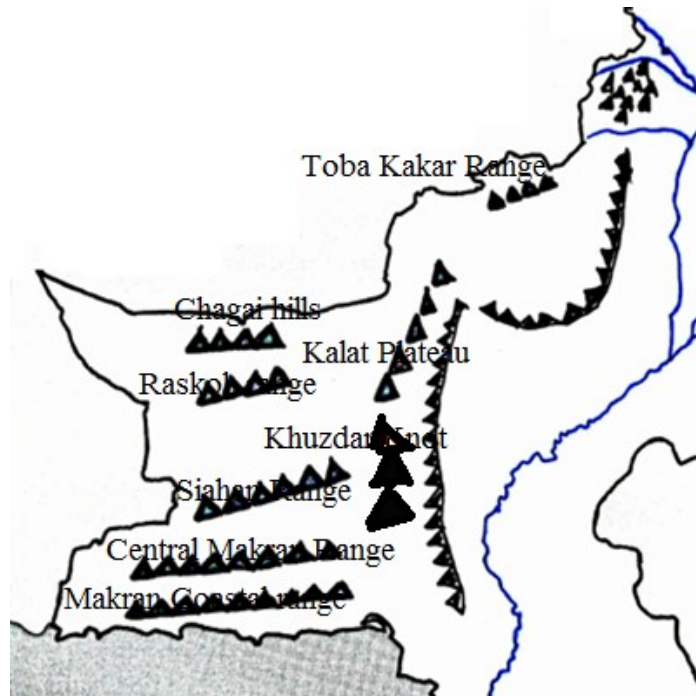


Figure 1.6 Baluchistan Plateau

This plateau is divided into following natural topographical features.

1. Northern Basins
2. Western Basins
3. Mountain Ranges
4. The Coastal Areas

1. **Northern Basins:** Zhob and Loralai basins are drained by Zhob and Loralai Rivers, they are situated between Toba Kakar and Sulaiman ranges. To the south west of the Loralai basin is the Quetta valley surrounded by mountain ranges.
2. **Basins of Western Balochistan:** A number of basins are also located between the mountain ranges of Chagai, Ras Koh, Siahan and Central Makran which contain inland drainage basins of salt lakes like Hamun-e-Mashkhail, Hamun-e-Murgho, Hamun e Lora.
3. **Mountain Ranges:** A number of ranges cover the surface of Baluchistan plateau.

Toba Kakar Ranges: It is located in extreme north of Baluchistan plateau. They are rugged with no vegetation cover. They rise above 3000 meters. They have Khojak pass which link Pakistan with Afghanistan.

Kalat Plateau: Kalat plateau lies in south of Quetta, and is criss crossed by Koh-i-Maran, Harboi, Brahui and Central Brahui ranges. Kalat plateau rises to 1600 to 2000 meters.

Khuzdar Knot: Lies to the south of Kalat Plateau, it's a triangular region. Many active faults are present in this area. Therefore it is subject to frequent earthquakes. Khuzdar Knot rises to 1800 to 2400 meters a.s.l.

Chagai hills: They are located at Pak-Afghan border with altitude of 2000 meters a.s.l.

Raskoh range: Lies to the south of Chagai hills. They also have altitude of 2000 meters a.s.l.

Siahian Range: It's a Curved shaped range in between Central Makran and Raskoh.

Central Makran Range: It lies in South west region of Baluchistan in South of Siahian Range with altitude of 1000 to 1200 meters a.s.l. Most of these rivers are seasonal in nature.

Makran Coastal range: It is Southernmost range along the coastal plain of Baluchistan with an altitude of just 200 to 600 meters a.s.l. Many small rivers from this range flow towards south to Arabian sea.

The Coastal Areas:

The coastal areas of the Balochistan Plateau can be divided into Eastern and Western parts. The eastern part comprises the Lasbela Plain which is marked by gravel and sand dunes. The western part is known as the Makran Coast. The Makran Coast has a narrow beach backed by rock cliffs. Behind the cliffs, there is a coastal plain. The coastal plain is covered with sand dunes and dotted with small hills. The Makran coast is noted for a number of uplifted terraces, including the Clifton hills, Manora, Hawks Bay, Ormara, Gwadar and Jiwani.

Drainage System of Balochistan Plateau.

Following rivers form the drainage system of Balochistan Plateau.

Some of Baluchistan Rivers join the Indus from west, forming the western tributaries such as River Zhob and Gomal. Some rivers fall into Arabian sea such as River Hab, Porali, Hingol and Dasht. Some rivers such as River Mula, Bolan and Chakar absorb into the Kachhi Sibi Plain.

Some rivers drain into inland depressions such as Hamun -e- Mashkel, Hamun Lora and Hamun Murgo forming the inland drainage system in Balochistan Plateau.

1.3 Plains

A large proportion of land of Pakistan consists of flat or gently rolling land surface which is categorized as Plain. Plains of Pakistan are named after the River Indus i.e. Indus Plains.

The Indus Plain was formed by the alluvium laid down by the River Indus and its tributaries about 2 to 0.01 million years ago. The River Indus is a mighty river about 2900 kilometers long. From its source in Manasarovar Lake in Tibet, the Indus flows from east to west between lofty mountains like Karakoram and the Great Himalayas. It then majestically flows into the Arabian Sea passing through Punjab and Sindh Province.

The Tributaries of River Indus

The river Indus is joined by a number of tributaries from the west and from the east which are termed as its tributaries. In general the western tributaries are small and carry a lower volume of water e.g. River Kabul, River Kurram, River Tochi and River Gomal.

On the other hand Eastern tributaries are major rivers which carry large volumes of water and sediments. These rivers are the Jhelum, River Chenab, River Ravi, and River Sutlej.

Indus plain is divided into two parts.

- i) Upper Indus Plain
- ii) Lower Indus Plain

1.3.1 Upper Indus Plain

The area between Jhelum to Mithankot is called Upper Indus Plain. Located in the northern part of the Indus Plain this nearly flat, undulating plain is sloping towards the south-west. It stretches over the whole Punjab Province. River Indus and its major tributaries flow here. River Jhelum meets River Chenab at Atharhazairi, River Ravi meets Chenab near Ahmed pur Sial and Sutlej joins the River Chenab near Uch to form the River Panjnad which joins the Indus near Mithankot. Rivers flowing in upper Indus plain have developed braided river channels. Beside the braided channels Oxbow-lakes, meanders and Levees are also present in upper Indus Plain. In the middle of Doabs, Bars are formed.

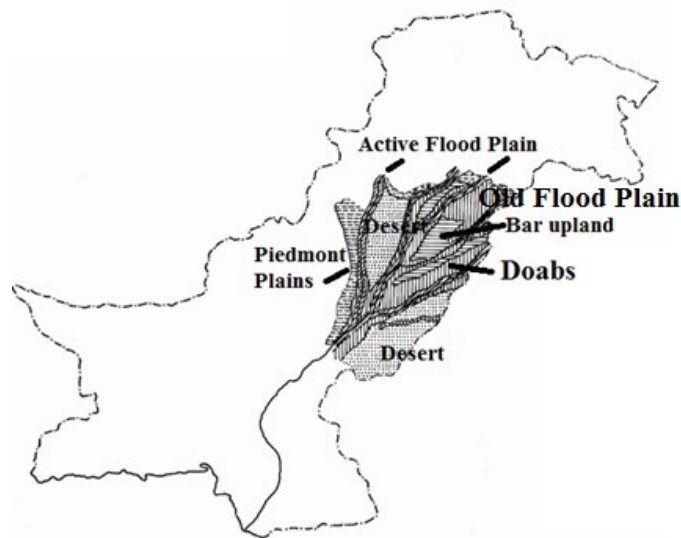


Figure 1.7 Upper Indus Plain

Topographical Features of Upper Indus plain

- i) **Active Flood Plain:** They are the current courses of the rivers. Rivers deposit alluvium in active flood plains. Here river take Meandering course to build Oxbow-lakes. Braided Channel along the river courses and Levees are also formed along the margins of river courses.
- ii) **Old Flood Plain:** They are the plains farther from the Active Flood Plains. They are flooded after every few years due to severe rains in mountainous areas. During these floods alluvium is deposited here which make them more fertile. They are best agriculture areas of Pakistan.
- iii) **Piedmont Plains:** Piedmont plains are located at the foothills of the Sulaiman, Kirthar and Siwalik mountains. The most dominant features of the Piedmont plains are the Alluvial Fans or cones that are developed by the streams flowing from the Sulaiman, Kirthar and Siwalik mountains. The material brought down by the water is dropped within the narrow channels of the streams as soon as the water reach to the less steep area of the Piedmonts. The gravel, sand and alluvium deposited by rivers form alluvial fans. There are extensive areas of alluvial fans on the Southern side of Siwaliks, and on eastern sides of the Sulaiman and Kirthar ranges. The Sulaiman Piedmont plain is also known as Derajat, because of Dera Ismail Khan and Dera Ghazi Khan districts.
The Derajat consist of the trans-Indus territory and are located between River Indus and Sulaiman Mountains covering an area of 2 million hectares.
- iv) **Doabs:** Upper Indus plain is drained by several rivers, areas between these rivers called doabs. Well known doabs are the following.

Bari Doab: It consists of the area that lies between old course of River Beas and River Ravi. Following districts are Included in it. Lahore, Kasur, Okara, Shaiwal, Pakpattan, Vehari, Multan, Khanewal and Lodhran.

Rechna Doab: Area between River Ravi and River Chenab. (Sialkot, Narowal, Gujranwala, Hafizabad, Jhang, Faisalabad and Toba-Tek-Singh).

Chaj Doab: Area between River Chenab and River Jhelum. (Gujrat, Sargodha, Mandi Bahauddin and north western part of Jhang).

Sindh Sagar Doab: Area between River Jhelum and River Indus. (Khushab, Mianwali, Leiah and Muzaffargarh).

v). **Bar upland**

Bars were developed in some parts of the Doabs of the Upper Indus Plain about 2 to 0.01 million years ago. Doabs are also termed as the interfluves and the bars are also called as terraces. Well known Bars are the following.

Kirana Bar in Chaj Doab. Sandal Bar in Rechna Doab. Ganji Bar in Bari Doab. Nili Bar in between the old bed of River Beas and River Sutlej.

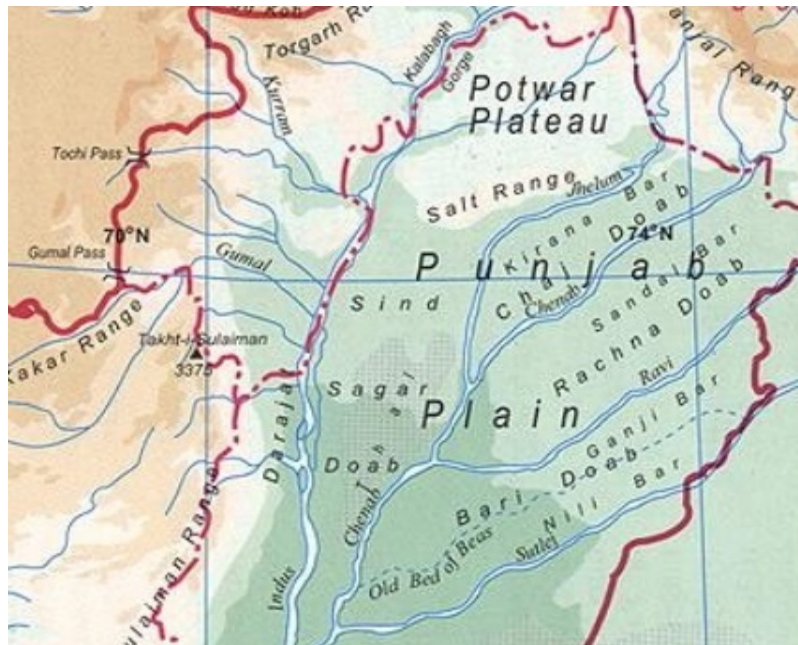


Figure 1.8 Doabs and Bars

- vi) **Desert:** Area of land that has less than 250 mm of rain and is devoid of vegetation is called desert. South Eastern part of Upper Indus plain is known as Cholistan or Rohi desert, it covers the area of Bahawalpur to Rahim Yar Khan in Punjab. It adjoins the Thar desert in Sind. Another desert in Upper Indus plain is located in Sind Sagar Doab Knownas Thal.

1.3.2 Lower Indus Plain

The area between Mithankot to Thatta is called Lower Indus Plain. It is located in the southern part of the Indus Plain. It is nearly flat, undulating plain, sloping towards south. It stretches over the whole Sindh Province. Here River Indus flows alone and enters into the Arabian Sea in south of Thatta. Here width of the River Indus is about 1.6 km. River Indus is in its lower course. Deposition is the main function of River Indus. In lower Indus plain Meanders, Oxbow-lakes, Braided Channels and Levees are also present. Here Doabs and Bars are not present. A ridge of limestone is present in the area is called Cuesta in Rohri and GanjoTakar.

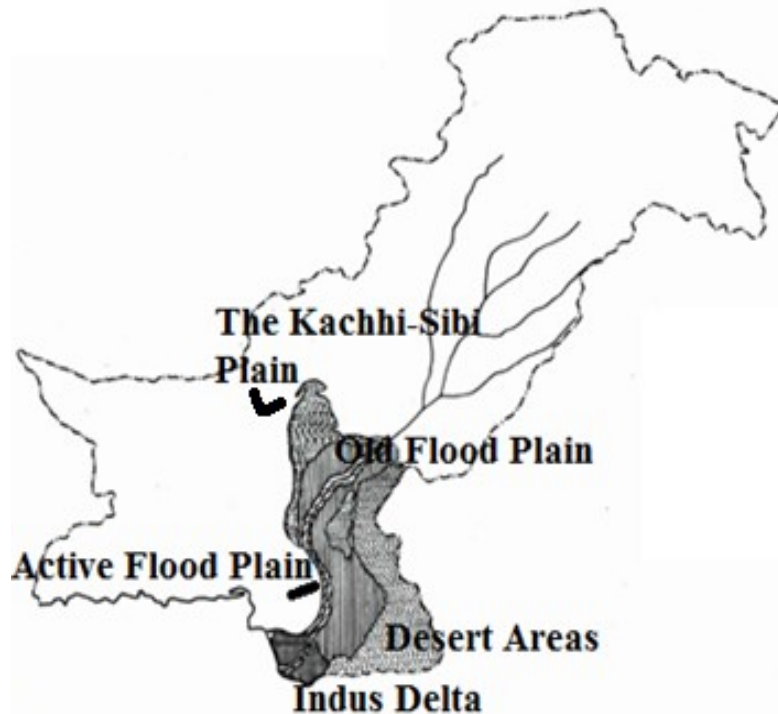


Figure 1.9 Lower Indus Plain

- i) **The Kachhi-Sibi Plain**
It is a barren area which is bounded on the north by the Marri-Bugti Ranges and on the west by the Kalat Range and in south by Indus Plain. Heat and aridity are the common characteristics of this area.
- ii) **Piedmont Plain:**
A piedmont plain with alluvial fans is located to the west of Indus River in Lower Indus plain along the eastern side of Kirthar Range.
- iii) **Active Flood Plain:**
Active flood plain Continues to exist along the course of the river Indus in Lower Indus plain. River Indus spreads alluvium in its course.
- iv) **Old Flood Plain**
It is the plain located farther from the Active Flood Plain. It is flooded after every few years due to severe floods. River spreads alluvium in this area during these floods. This area is also best agricultural area of Pakistan.
- v) **Indus Delta**
It's a triangular area formed by deposition of sediments by river Indus at its mouth. When River Indus reaches near Arabian Sea its speed is reduced due to low gradient. So it divides into many smaller and larger distributaries. The larger distributaries are Ochito and Gungro. Kalri and Panyari are relatively smaller distributaries. There are some depressions in deltaic areas which are filled with water during flood, locally called Dhands.

Indus Delta is the 7th largest delta in the world with an area 780 sq.km. In Pakistan only two rivers form the delta, they are River Indus and River Hub.

vi) Desert Areas

Eastern part of lower Indus plain consists of Nara and Tharparkar desert. Here the Sand dunes are in different shapes like Latitudinal, Longitudinal, Transverse and Crescent.

Self Assessment Questions

1. Describe the Physiography of Pakistan and illustrate its major physical regions.
2. Highlight the highest mountains of Pakistan and elaborate their classification.
3. Discuss the Potohar and Balochistan Plateaus of Pakistan and their importance.
4. Describe the Indus Plain of Pakistan in detail.
5. What do you know about the topographical features of Upper Indus plain? Highlight.

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Unit-2

HYDROLOGY

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Introduction

This unit describes the hydrology of Pakistan. Hydrology and topography of Pakistan are connected to each other as these are closely related with each other in any area of the earth. Hydrological has its specific patterns and these patterns follow the topographic divisions. Like this the hydrology of Pakistan is also related with its topography directly. The topography of Pakistan is a multitude of landscapes which ranging from vast plains to barren deserts, forests, hills and plateaus varying from the coastal areas of the Arabian Sea in the south to the mountains of the Karakoram, Hindu Kush and Himalayas in the north.

Hydrology of Pakistan is affected by the number of factors in which climate has a vital role. The glaciers in Pakistan are of great importance in context of the hydrology. The glaciers of Pakistan are shown in the map which is included in this unit. Hydrology of Pakistan also associated with its rivers. In Pakistan, many hydroelectric plants are built in rivers on Indus and Jhelum for the creation of electricity.

The other source for the hydrology of Pakistan is lakes; Manchar Lake is the biggest lake in Pakistan, while Hamoon-e-Mashkel of Balochistan is the largest lake of the salty water in the world. Keenjhar or Kalri Lake is located in Sindh and its water is supplied to drink in many areas. In Balochistan the socio-agri development has not been developed due to issues regarding hydrology.

Objectives

After reading this unit, you will be able

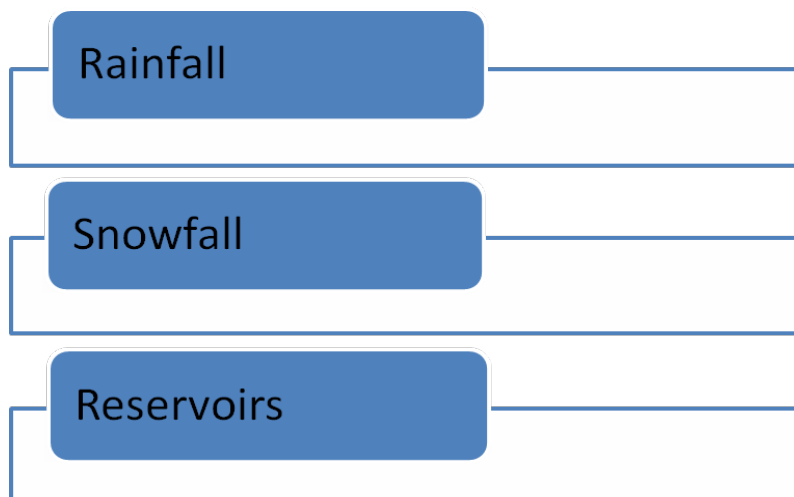
1. to find out the concept of hydrology and the hydrology of Pakistan.
2. to understand the importance of glaciers of Pakistan and their contribution in the hydrology of Pakistan.
3. to learn about the rivers of Pakistan including the importance of rivers in context of hydro-power plants.
4. to understand the importance of lakes of Pakistan which can be seen all corners of the country.

2.1 Hydrology of Pakistan

When we talk about hydrology of an area it includes the movement, distribution and quality of water and also discuss about the water resources in detail. Hydrology is concerned with three different forms of water, such as:

- Above land surface, as atmospheric water and precipitation
- Over land surface, as surface water and runoff
- Below land surface, as subsurface or ground water.

Hydrology and topography of the area are closely related with each other. Hydrological patterns follow the topographic divisions. Hydrology of Pakistan is directly related with its topography. Pakistan's topography is a multitude of landscapes ranging from vast plains to barren deserts, forests, hills, and plateaus varying from the coastal areas of the Arabian Sea in the south to the mountains of the Karakoram, Hindu Kush and Himalayas in the north. Pakistan geologically overlaps both with the Indian and the Eurasian tectonic plates where its Sind and Punjab provinces situated on the north-western corner of the Indian plate while Baluchistan and most of the Khyber Pakhtunkhwa lie within the Eurasian plate which mainly comprises the Iranian Plateau. Gilgit-Baltistan and Azad Kashmir lie along the edge of the Indian plate. General slope of land of Pakistan is from North-East to South-West that is why major river system of Pakistan follows the same pattern. Major hydrological sources of Pakistan are:



Beside topography another major factor that affects the hydrology of Pakistan is its climate. Pakistan lies in the temperate zone, immediately above the tropic of cancer. The climate varies from tropical to temperate. Arid conditions exist in the coastal south, characterized by a monsoon season with adequate rainfall and a dry season with lesser rainfall, while abundant rainfall is experienced by the province of Punjab, and wide variations between extremes of temperature at given locations. Northern parts of Pakistan have a vast glacial system and according to studies there is more glacial ice in Pakistan

than anywhere on Earth outside the Polar Regions. These glaciers feed rivers that account for about 75 percent of the stored-water supply in the country.

We can divide Pakistan into three major generalized hydrological units:

1. Indus basin, covering an area of over 566,000 km² in Pakistan
2. Kharan desert in west Baluchistan with its inland drainage
3. The arid Makran coast along the Arabian Sea in the south.

The total watershed area of the Indus basin, or the region that drains into the river, as well as the river system itself, is 944,000 km², 60% of which lies in Pakistan. Major hydrological contributors in Pakistan are glaciers and their runoff that shares 65% of all available water while 35% water contributor is rainfall and seasonal snowfall. To fully understand the hydrology of Pakistan we should know about the major glaciers, Indus River system, its tributaries, natural lakes and reservoirs.

2.2 Glaciers of Pakistan

Glaciers of northern Pakistan are some of the largest and longest mid-latitude glaciers on Earth. Field-based and space-based glacier studies in this region are important to explain their role in providing melt-water for irrigation, hazard potential, their role in erosion and geo dynamics, and their sensitivity to climate forcing. Repeated field surveys in the 1980s, 1990s, and 2000s of several glaciers in the Hindu Kush and Swat, Kohistan region, the Nanga Parbat Himalaya, and the Karakoram Himalaya, provided reference data and verification for information extracted from satellite imagery. According to some experts there is more glacial ice in Pakistan after Polar Regions than anywhere else in the world. On this basis Northern areas of Pakistan are also designated as third pole of the world.

Pakistan has some of the world's highest and most spectacular mountains. A total of 13 of the world's 30 tallest peaks are located there, including K2 (8,611 m), the second highest peak in the world, Nanga Parbat (8,125 m), the ninth highest peak, and Tirich Mir (7,690 m) in the Hindu Kush. Because of the numerous high mountains, and abundant precipitation characteristic of a monsoon climate, the mountains of northern Pakistan, including the Hindu Kush, Hindu Raj, Kohistan ranges, Nanga Parbat massif, and Karakoram Himalayas, host some of the largest and longest mid-latitude glaciers on Earth. The glaciated area in northern Pakistan is estimated to cover 15,000 km², and as much as 37 percent of the Karakoram region is covered by glacier. According to an estimate there are more than 7259 glaciers in Pakistan. Some important of them are:

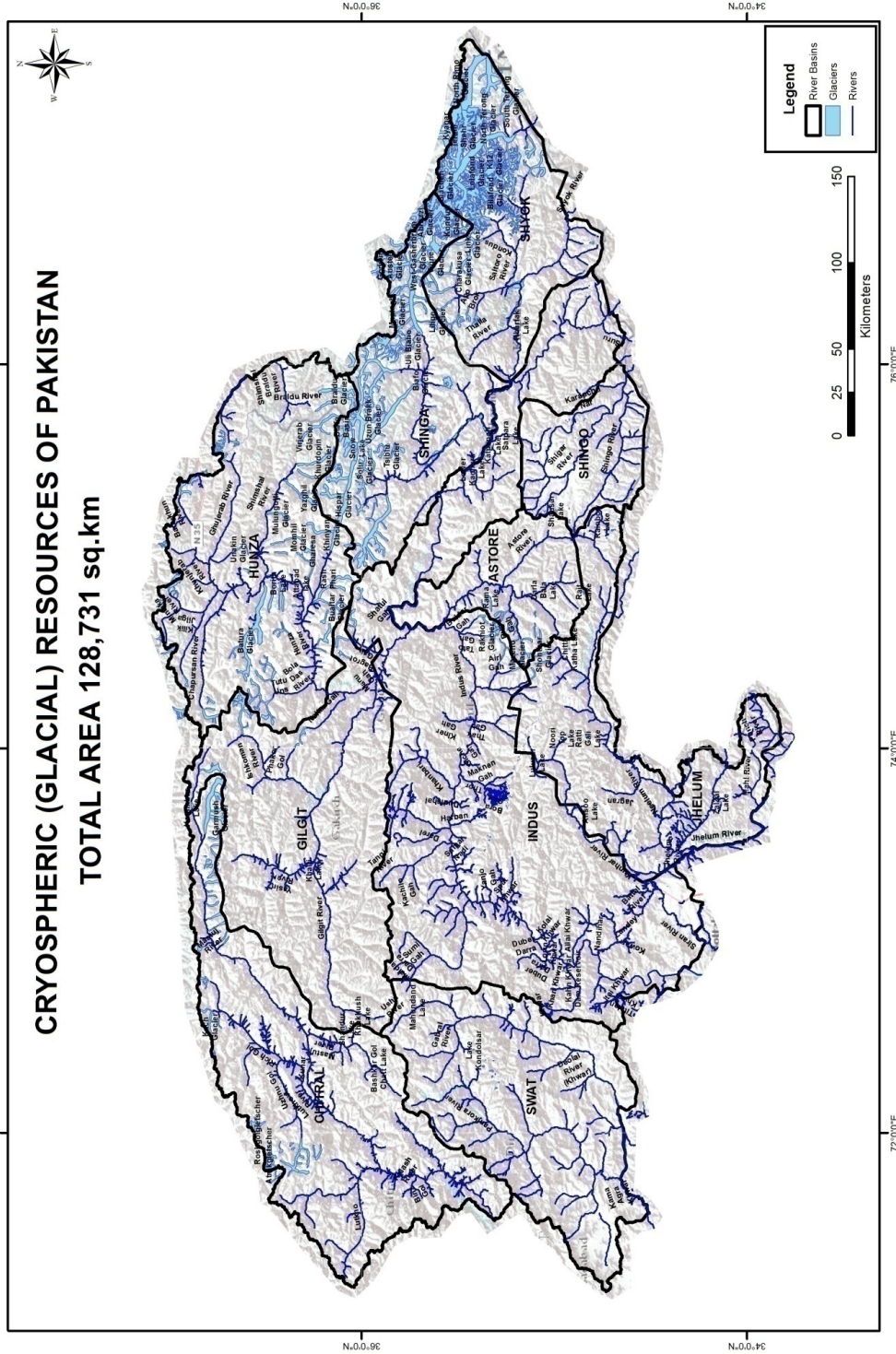
1. Abruzzi Glacier
2. Baltoro Glacier
3. Barpu Glacier
4. Batura Glacier
5. Biafo Glacier
6. Biarchedi Glacier
7. Bilafond Glacier

8. Braldu Glacier
9. Chilingi Glacier
10. Chiantar Glacier
11. Chittiboi Glacier
12. Chogo Lungma Glacier
13. Darkot Glacier Gamo Bahar Glacier
14. Ghulkin Glacier
15. Godwen Austin Glacier
16. Golen Glacier
17. Ghondogoro Glacier
18. Gulmit Glacier
19. Hainablak Glacier
20. Hispar Glacier
21. Hussaini Glacier
22. Hoper Glacier
23. Kachighani Glacier
24. Kero Lungma Glacier
25. Koyo Glacier
26. Kukkijerab Glacier
27. Laatbo Glacier
28. Lupghur Glacier
29. Miar Glacier
30. Malanguti Glacier
31. Momhil Glacier
32. Nobanday Glacier
33. Panmah Glacier
34. Passu Glacier
35. Pechus Glacier
36. Raikot Glacier
37. Rupal Glacier
38. Rimo Glacier
39. Sarpo Laggo Glacier
40. Shaigiri Glacier
41. Shandar Glacier
42. Shani Glacier
43. Shetor Glacier
44. Shishpar Glacier
45. Shuejerab Glacier
46. Siachen Glacier
47. Sim Glacier
48. Siru Glacier
49. Skora La Glacier
50. Sobanday Glacier
51. Sokha La Glacier
52. Sovoia Glacier

53. South Barum Glacier
54. Stokpa Lungma Glacier
55. Tarashing Glacier
56. Thalo Glacier
57. Thui Glacier
58. Toltar Glacier
59. Toshain Glacier
60. Trango Glacier
61. Trivor Glacier
62. Udren Glacier
63. Uli Bahao Glacier
64. Upper Khourdopin Glacier
65. Upper Tirich Glacier
66. Vigne Glacier
67. Virjerab Glacier
68. Yashkuk Glacier
69. Yermandu Glacier
70. Yazgil Glacier
71. Zindakhirim Glacier.

CRYOSPHERIC (GLACIAL) RESOURCES OF PAKISTAN

TOTAL AREA 128,731 sq.km



1. **Siachen Glacier:** The Siachen Glacier is located in the eastern Karakoram Range in the northeast of the point where the Line of Control between India and Pakistan ends. With a length of 76 km (47 mi) long, it is the longest glacier in the Karakoram and second-longest in the world after non-polar areas. It falls from an altitude of 5,753 m (18,875 ft) above sea level at its head at Indira Col on the China border down to 3,620 m (11,875 ft) at its terminus. The entire Siachen Glacier, with all major passes, is currently under the administration of India since 1984. Pakistan controls the region west of Saltoro Ridge, far away from the glacier. The Siachen Glacier lies immediately south of the great drainage divide that separates the Eurasian Plate from the Indian subcontinent in the extensively glaciated portion of the Karakoram sometimes called the "Third Pole". The glacier lies between the Saltoro Ridge immediately to the west and the main Karakoram Range to the east. The glacier's melting waters are the main source of the Nubra River in the Indian region of Ladakh, which drains into the Shyok River. The Shyok in turn joins the 3000 kilometer-long Indus River which flows through Pakistan. Thus, the glacier is a major source of the Indus and feeds the largest irrigation system in the world.
2. **Baltoro Glacier:** At 63 km (39 mi) in length, it is also one of the longest glaciers outside the Polar Regions. It is located in the Shigar valley. It runs through part of the Karakoram mountain range. The Baltoro Muztagh lies to the south and east of the glacier, while the Masherbrum Mountains lie to the south. At 8,611 m (28,251 ft), K2 is the highest mountain in the region, and three other eight thousanders within 20 km. The glacier gives rise to the Braldu River, which is a tributary of the Shigar River. Near the town of Skardu, Shigar River merges with mighty Indus. Several large tributary glaciers feed the main Baltoro Glacier, including the Godwin Austen Glacier, flowing south from K2; the Abruzzi and the various Gasherbrum Glaciers, flowing from the Gasherbrum group of peaks; the Vigne Glacier, flowing from Chogolisa, and the Yermendendu Glacier, flowing from Masherbrum. The confluence of the main Baltoro Glacier with the Godwin Austen Glacier is known as Concordia; this location and K2 base camp are popular trekking destinations.
3. **Biafo Glacier:** The Biafo Glacier is the world's third longest glacier outside the polar regions, second only to the 70 km (43 mi) Siachen Glacier, India-Pakistan and Tajikistan's 77 km (48 mi) long Fedchenko Glacier. Confluence of Biafo glacier with Hispar glacier at an altitude of 5,128 m (16,824 ft) at Hispar La Pass to create the world's third longest glacial system after Siachen glacier outside the polar regions. The snout emerging from Biafo glaciers joins Braldu River near Askoli. Snow Lake, consisting of parts of the upper Biafo Glacier and its tributary glacier Sim Gang, is one of the world's largest basins of snow or ice in the world outside the Polar Regions, up to 1,600 m (0.99 mi) in depth.
4. **Hispar Glacier:** Emerging from the slopes of Hispar pass, this glacier is 49 kilometer in length. Combined with Biafo glacier both form the longest confluence of alpine glaciers after Polar Regions. Hispar and its tributary glaciers feed the Nagar River which is a major tributary of Hunza River.
5. **Batura Glacier:** Batura is 57 kilometer in length and it is also in the list of longest glaciers outside the Polar Regions. It is situated in the Gojaal region of the District Hunza of Gilgit-Baltistan. Ablation from this glacier feeds the Hunza River.

6. **Chogo Lungma Glacier:** This glacier lies in the Karakoram Mountains in Arandu valley Shigar. It is also more than 50 kilometer in length. It feeds Basha River which is the main tributary of Shigar River.
7. **Godwin Austin Glacier:** The Godwin-Austen glacier is a glacier in the Karakoram, close to K2 in Gilgit Baltistan. Its confluence with the Baltoro Glacier is called Concordia and is a popular trekking destination as it provides views of four of the five eight-thousanders in the region. It receives its name from Henry Haversham Godwin-Austen, an early explorer of this region. K2 was originally named Mount Godwin-Austin in his honor.

All the above mentioned glaciers and their tributaries are great blessing for our country. They benefited us in three ways:

- i. They provide drinking water
- ii. They provide water to irrigate our crops
- iii. Ablation from glaciers helps us to generate hydroelectric power.

Glaciers act as reservoirs of water that persist through summer. Continual melt from glaciers contributes water to our country ecosystems throughout dry months, creating perennial stream habitat and a water source for plants and animals. The cold runoff from glaciers also affects downstream water temperatures.

As we know that Pakistan is situated in a region where annual rainfall is not in abundance to meet the needs of irrigation for crops in this scenario our mountain glaciers are wealth for us. Glaciers are a reliable water resource in the dry season. Mountains could be called the “Water Towers”, providing water from glacier melt and orographic rainfall to our lowland regions.

In Pakistan there are many advantages in using glacier melt waters for the production of hydroelectric power. Glaciers are a source of water that is constant and sure during the summer months, unlike the water of rivers and torrents whose capacity is subjected to remarkable variations depending on precipitation. Consequently, in the summer months, when most of the water courses on the surface suffer a lack of water, the water courses fed by the glaciers instead, are rich in this precious resource. The energy obtained from glaciers can therefore be used in the periods in which the other water resources register minimum levels.

Number of glaciers in ten main River Sub-Basins			
Sub Basin	Number of glaciers	Area(Km²)	Ice Reserves (Km³)
Astor	373	242.987	17.1
Chitral	909	1468.6	171.7
Gilgit	967	938.2	71.3
Hunza	1359	2736.9	415.7
Indus	1344	720.4	45.3
Jhelum	368	123.3	5.1
Shigar	437	2372.9	601.9
Shingo	197	45.3	1.4
Shyok	978	3013.2	730.7
Swat	327	127.4	5.3

2.3 Rivers of Pakistan

A river is a natural flowing watercourse, usually freshwater, flowing towards an ocean, sea, lake or another river. In some cases a river flows into the ground and becomes dry at the end of its course without reaching another body of water such as in Baluchistan plateau where many small rivers end up in Hamoon Mashkhail and Hamoon Lora salt flats. Small rivers can be referred to using names such as stream, creek, brook, rivulet, and rill.

The river system of Pakistan originates from the snow-covered Himalaya, Karakoram and Hindu Kush ranges. The system comprises mainly five rivers that pass mostly through the Punjab province; therefore the name 'Punjab' — 'panj' meaning five and 'aab' meaning water. The main five rivers of Pakistan are Jhelum, Chenab, Ravi, Sutlej and Indus. Beside these there are numerous small and large rivers and streams that flow in Baluchistan plateau, Potohar plateau, Khyber Pakhtunkhwa, Sind and various parts of the country. These rivers and streams are life line to our agriculture and economy. Rivers provide us with fresh drinking water. They are one of the biggest sources of fresh water. Rivers are also a source of energy. It helps in creating electricity. In the hilly areas of Gilgit-Baltistan and other mountainous parts, rivers have a lot of current in it. This energy can be harnessed through various machines and can be converted into electricity. Many hydroelectric plants are built in rivers on Indus and Jhelum for the creation of electricity. List of some important rivers of Pakistan are:

River Shyok and its tributaries mainly flow through Khaplu and Chorbut valleys. Tributaries of River Shyok are:

1. Frano river
2. Chowaar river
3. Piun river
4. Siksa river
5. Hasanabad river
6. Ghangchay river
7. Bara river
8. Thallay river
9. Keris river

B. River Saltoro and its tributaries mainly flow in Saltoro valley Siachen and Hushay valleys. Its tributaries are:

1. Gyang river
2. Ghayari river
3. Chuling river
4. Kondus river
5. Hushay river
6. Machlu river

C. River Shigar and its tributaries mainly flow in Shigar, Braldu and Basha valleys. Its tributaries are:

1. Braldu river
2. Basha river
3. Gulabpur river
4. Sildi river

D. River Indus flow through entire length of Pakistan and all rivers of Pakistan (except rivers of Baluchistan plateau) are directly or indirectly are tributaries of Indus River System. Tributaries of Mighty Indus are:

1. Ganokh river
2. Shingo river
3. Olding river
4. Hamzigond river
5. Kindhrik river
6. Kharmang river
7. Tolti River
8. Pari river
9. Manthoka river
10. Ghasing river
11. Mehdiabad river
12. Sermik river
13. Shyok river
14. Gol river
15. Narh river
16. Hussainabad river
17. Shigar river
18. Sadpara river
19. Katchura river
20. Basho river
21. Tormik river
22. Thowar river
23. Harpo river
24. Stak river
25. Ganji river
26. Sassi river
27. Gilgit river
28. Juglot river
29. Astor river
30. Raikot river
31. Goharabad river
32. Bunar river
33. Thak river
34. Niat river
35. Thalpan river

36. Khinar river
37. Bhutogah river
38. Hudar river
39. Thor river
40. Khanbari river
41. Dudishal river
42. Harban river
43. Sazin river
44. Darail river
45. Tangir river
46. Sumar river
47. Basha river
48. Kandia river
49. Seo river
50. Jalkot river
51. Komaila river
52. Zatkhar river
53. Palas river
54. Kial river
55. Kolai river
56. Pattan river
57. Dubair river
58. Shangla river
59. Allai river
60. Batagram river
61. Torghar river
62. Barando river
63. Siran river
64. Kabul river
65. Soan river
66. Haro river
67. Kurram river
68. Tochi river
69. Gomal river
70. Zhob river
71. Dori river
72. Jhelum river
73. Ravi river
74. Chenab river

E. River Hunza and its tributaries mainly flow in Gojaal, Nagar and Hunza valleys. Its main tributaries are:

1. Khunjerab river
2. Barakhun river
3. Kilik river

4. Mintika river
5. Misgar river
6. Chapursan river
7. Shaujerab river
8. Shimshal river
9. Passu river
10. Karimabad river
11. Nagar river
12. Hassanabad river
13. Ghulkin river
14. Gulmit river
15. Shishkat river
16. Minapin river
17. Chalat river
18. Chaprot river
19. Naltar river
20. Danyor river

F. River Gilgit and its tributaries mainly flow in District Ghizer and Gilgit valley. It's important tributaries are:

1. Khokush(Langar) river
2. Barsat (Chamarkhan) river
3. Teru river
4. Handrap river
5. Galokh river
6. Chashi river
7. Shimrand river
8. Pingal river
9. Sousat river
10. Bathrait river
11. Dhaimal river
12. Darkoot river
13. Hundar river
14. Barkolti river
15. Qorqolti river
16. Asumbar river
17. Thoi river
18. Nazbar river
19. Yasin river
20. Gupis river
21. Hakis river
22. Raushan river
23. Sumal river
24. Darmindar river
25. Imit river

26. Ishkoman river
27. Chatorkhand river
28. Birgal river
29. Gulmuti river
30. Singal river
31. Sherqila river
32. Gulabpur river
33. Kargah river
34. Hunza river
35. Bagrot river
36. Chamugarh river

G. River Astor and its tributaries mainly flow in District Astor. Its important tributaries are:

1. Burzil river
2. Chilam river
3. Das bala river
4. Khirim das river
5. Gudai river
6. Pakora river
7. Kalapani river
8. Tarishing river
9. Rattu river
10. Yashlito river
11. Parishing river
12. Harcho river
13. Shaitan nala river

H. River Swat and its tributaries mainly flow in Swat valley. Its important tributaries are:

1. Kachkhani river
2. Bashkaro river
3. Dadrili river
4. Palogah river
5. Matiltaan river
6. Gabral river
7. Andrap river
8. Utror river
9. Mankyal river
10. Bahrain river
11. Bishigram river
12. Miandam river
13. Matta river
14. Kabal river
15. Panjkora river

- I. River Panjkora and its tributaries mainly flow in Dir and Kumraat valleys. Its important tributaries are:**
1. Kumraat river
 2. Lamutai river
 3. Shetaak river
 4. Shindoor river
 5. Patraak river
 6. Sheringal river
 7. Upper Dir river
 8. Toormang river
 9. Jandool river
 10. Darora river
- J. River Chitral/ Yarkhun / Kunar River and its tributaries mainly flow in Upper and lower Chitral valley and then enter into Afghanistan near Arandu. Near Jalalabad River Kabul drain its water in this river. Its important tributaries are:**
1. Broghal river
 2. Sorlaspur river
 3. Parwak river
 4. Booni river
 5. Barans river
 6. Golain river
 7. Kaghozi river
 8. Garam Chashma river
 9. Bamburait river
 10. Ramboor river
 11. Brir river
 12. Gahirat river
 13. Shishi river
 14. Drosh river
 15. Lowari river
 16. Kabul river
- K. River Kunhar and its tributaries mainly flow in Kaghan valley. Its important tributaries are:**
1. Gittidas river
 2. Chachobut river
 3. Kabalbash river
 4. Satsarmala river
 5. Dudipatsar river
 6. Noorinaar river
 7. Burawai river
 8. Batakundi river
 9. Sooch river
 10. Dumduma river

11. Saifulmalook river
12. Bhimbal river
13. Manoor river
14. Jaraid river
15. Bhoonja river
16. Khairabad river

L. River Neelum and its tributaries mainly flow in Neelum valley. Its important tributaries are:

1. Domail river
2. Kamri river
3. Taobut river
4. Halmat river
5. Hanthi river
6. Sardari river
7. Saonar river
8. Phullawai river
9. Janawai river
10. Doga river
11. Jandarseri river
12. Shountar river
13. Narail river
14. Surgan river
15. Sharda river
16. Kharigam river
17. Khwajaseri river
18. Dudnial river
19. Tejian river
20. Changan river
21. Dowarian river
22. Lawat river
23. Nagadar river
24. Salkhala river
25. Kutton-Jagran river
26. Qazi Naag river
27. Deolian river
28. Patika river
29. Ghorri river

M. River Jhelum and its tributaries mainly flow in Azad Kashmir. Its important tributaries are:

1. Chakothei river
2. Chinari river
3. Gujjar Bandi river
4. Reshian river

5. Hattian Bala river
6. Neelum river
7. Kunhar river
8. Agar Nar river
9. Khad river
10. Mahal river
11. Goin river
12. Beor river
13. Poonch river
14. Kahan river

N. River Chenab is second biggest river of Pakistan. Its course is entirely in Punjab plain area so in Pakistan it has many few tributaries. Its important tributaries are:

1. Tawi river
2. Jhelum river
3. Ravi river
4. Sutluj river

O. River Soan and its tributaries mainly flow in Potohar Plateau. Its important tributaries are:

1. Korang river
2. Lai river
3. Haro river
4. Paniad river
5. Dhurab river
6. Sil river

P. Beside above mentioned important main rivers and their tributaries there are many rivers which are western tributaries of Indus. Name of some of these rivers are:

1. Kurram river
2. Tochi river
3. Gomal river
4. Zhob river
5. Teritoi river
6. Chatru river
7. Vaggi river
8. Jhamra river
9. Gaisoay river

Q. The Rivers of Baluchistan are not tributaries of Indus river system. They have inland drainage and some flow towards Makran Coastal areas. Some important of them are:

1. Basol river

2. Dasht river
3. Hapdrok river
4. Hingol river
5. Hub river
6. Kech river
7. Mula river
8. Nall river
9. Rakshan river
10. Sukleji river

2.3.1 River Indus

Indus River is a great trans-Himalayan river of South Asia. It is one of the longest rivers in the world, with a length of some 2,000 miles (3,200 km). Its total drainage area is about 450,000 square miles (1,165,000 square km), of which 175,000 square miles (453,000 square km) lie in the ranges and foothills of the Himalayas, the Hindu Kush, and the Karakoram Range; the rest is in the semiarid plains of Pakistan. The river's annual flow is about 58 cubic miles (243 cubic km)—twice that of the Nile River and three times that of the Tigris and Euphrates rivers combined. Originating in the Tibetan Plateau in the vicinity of Lake Manasarovar China, the river runs a course through the Ladakh, towards the Gilgit-Baltistan region Hindukush ranges, and then flows in a southerly direction along the entire length of Pakistan to merge into the Arabian Sea near the port city of Karachi. It is the longest river and national river of Pakistan. All rivers of Pakistan are directly or indirectly are tributaries of Indus except Rivers of Baluchistan which mostly have inland drainage. Only Gomal River and its tributary Zhob River meet with Indus near Dera Ismail Khan. The eastern tributaries of Indus include Jhelum, Chenab, Ravi, Sutlej and Soan whereas western tributaries include Kurram, Tochi and Gomal.

The Indus River provides key water resources for Pakistan's economy especially the breadbasket of Punjab province, which accounts for most of the nation's agricultural production, and Sind. The word Punjab means "land of five rivers" and the five rivers are Jhelum, Chenab, Ravi, Beas and Sutlej, all of which finally flow into the Indus. The Indus also supports many heavy industries and provides the main supply of potable water in Pakistan.

2.3.2 River Chenab

Chenab River originates in northwestern India and flow towards northeastern and eastern Pakistan. Its source is near Bara-lacha la pass in Zaskar Range Himachal Pradesh. The Chenab is formed by the confluence of two streams, Chandra and Bhaga, in Himachal Pradesh state. It flows west through Jammu and Kashmir state—the Indian-administered portion of the disputed Kashmir region—between the steep cliffs of the Siwalik Range (south) and the Lesser Himalayas (north). Turning southwest, it continues into Pakistan, descending from the uplands into the broad alluvial lowlands of Punjab province. After receiving the Jhelum River near Trimmu, the Chenab empties into the Sutlej River, a tributary of the Indus River. Its total length is about 605 miles (974 km), and it feeds several irrigation canals of Pakistan. The irrigation system of Pakistan is one of the best

systems because 70% of the cultivated area is under irrigation. This is because of the rivers of Pakistan. From the rivers canals have been dug to irrigate the lands. The upper Chenab and lower Chenab irrigate the area of Rachna Doab. The Haveli system of canal is also located here. Marala Headworks, Khanki and the Qadirabaad play a significant role in the river-canal link system in Punjab.

2.3.3 River Jhelum

Jhelum River originates in Occupied Kashmir and flow towards Azad Kashmir and Pakistan. It constitutes the westernmost of the five rivers of the Punjab region that merge with the Indus River in Pakistan. The Jhelum rises from a deep spring at Verinag, in Occupied Jammu and Kashmir state. The river meanders northwestward from the northern slope of the Pir Panjaal Range through the Vale of Kashmir to Wular Lake at Srinagar, which controls its flow. Emerging from the lake, the Jhelum flows westward and crosses the Pir Panjaal in a gorge some 7,000 feet (2,100 metres) deep with almost perpendicular sides. At Muzaffarabad, the administrative centre of Azad Kashmir in the Pakistani-administered sector of Kashmir, the Jhelum receives the Neelum (Kishanganga) River and then bends southward, forming part of the border between Azad Kashmir to the east and Khyber Pakhtunkhwa province, Pakistan, to the west. The river then flows southward into Punjab province. Near Mangla the Jhelum breaks through the Outer Himalayas into broad alluvial plains. At the city of Jhelum the river turns southwestward along the Salt Range to Khushab, where it again bends south to join the Chenab River near Trimmu. The total length of the Jhelum is about 450 miles (725 km).

The hydrology of the Jhelum River is largely controlled by snowmelt from the Himalaya ranges in the spring and the southwest monsoon on the Indian subcontinent that brings heavy rains from June to September. The highest flood discharges on the Jhelum exceed 1,000,000 cubic feet (28,300 cubic metres) per second. Little rain falls during the winter, so the river level is substantially lower than in the summer months. The lower course of the Jhelum has been developed for irrigation and the production of hydroelectric power. The Mangla Dam and Reservoir irrigates about 3 million acres (1.2 million hectares) and has an installed hydroelectric capacity of some 1,000 megawatts. The Upper Jhelum Canal leaves the river at Mangla and runs eastward to the Chenab River at Khanki, and the Lower Jhelum Canal starts at Rasul. Both canals are used for irrigation.

2.3.4 River Sutlej

The Sutlej River is the longest of the five rivers that flow through the historic crossroads region of Punjab in northern India and Pakistan. The source of the Sutlej is west of Lake Rakshastal in Tibet, as springs in an ephemeral stream channel descending from this lake. Flowing northwestward and then west-southwestward through Himalayan gorges, it enters and crosses the Indian state of Himachal Pradesh before beginning its flow through the Punjab plain near Nangal, Punjab state. Continuing southwestward in a broad channel, it receives the Beas River and forms 65 miles (105 km) of the India-Pakistan border before entering Pakistan and flowing another 220 miles (350 km) to join the Chenab River west of Bahawalpur. The combined rivers then form the Panjnad, the link between the Five Rivers and the Indus. The hydrology of the Sutlej is controlled by spring and summer snowmelt in the Himalayas and by the South Asian monsoon. The

onset of the summer monsoon brings heavy rains that often produce extensive flooding downstream. The maximum recorded flood discharge occurred in 1955, when the river flowed at nearly 600,000 cubic feet (17,000 cubic metres) per second. The winter flow is substantially lower, since there is little precipitation or melts water from the Himalayan glaciers. The 900-mile- (1,400-km-) long Sutlej is used extensively for irrigation. Its water was a source of dispute between India and Pakistan until 1960, when the countries concluded the Indus Waters Treaty, which allocated the water of the Sutlej to India in exchange for exclusive Pakistani rights to the Indus and its western tributaries.

2.3.5 River Ravi

The Ravi River, a trans boundary river of India and Pakistan, is an integral part of the Indus River Basin and forms the headwaters of the Indus basin. The waters of the Ravi River drain into the Arabian Sea (Indian Ocean) through the Indus River in Pakistan. The river rises in the Bara Bhangal, District Kangra in Himachal Pradesh, India. The river drains a total catchment area of 14,442 square kilometers (5,576 sq mi) in India after flowing for a length of 720 kilometers (450 mi). Flowing westward, it is hemmed by the Pir Panjal and Dhauladhar ranges, forming a triangular zone.

The upper reaches of the main Indus River and its tributaries lie in India whereas the lower reaches are in Pakistan. Following the partition of India in August 1947, a dispute arose between India and Pakistan on sharing of the waters of the Indus River Basin. The dispute was resolved with the intervention of the World Bank and a treaty was signed in 1960 on sharing of the Indus waters between India and Pakistan. The Indus System of Rivers comprises the three Western Rivers in the Indus, the Jhelum and Chenab together with three Eastern Rivers; the Sutlej, the Beas and the Ravi. To establish the ownership of these waters, an Indus Water Treaty was signed between India and Pakistan on 1 April 1960, under monitoring of the World Bank. The treaty, under Article 5.1, envisages the sharing of waters of the rivers Ravi, Beas, Sutlej, Jhelum and Chenab which join the Indus River on its left bank (eastern side) in Pakistan. According to this treaty, Ravi, Beas and Sutlej, which constitute the eastern rivers, are allocated for exclusive use by India before they enter Pakistan. However, a transition period of 10 years was permitted in which India was bound to supply water to Pakistan from these rivers until Pakistan was able to build the canal system for utilization of waters of Jhelum, Chenab and the Indus itself, allocated to it under the treaty. Similarly, Pakistan has exclusive use of the Western Rivers Jhelum, Chenab and Indus but with some stipulations for development of projects on these rivers in India.

2.3.6 River Neelum (Kishanganga)

The Neelum River originates from Kishansar Lake in the vicinity of Sonamarg in Indian-administered Jammu and Kashmir, and runs northwards to Badoab village in Tulail Valley where it meets a tributary from the Dras side. Then it runs westwards, parallel to the Kashmir Line of Control. It is fed by many glacial tributary streams on its way. It enters Pakistan-administered Azad Kashmir at Taobut sector of the Line of Control. Then it again runs west, parallel to the Line of Control, passing by Sharda. After Sharda, it bends to a southwesterly direction and runs along the Line of Control near Tithwal. Then it bends northwest again, making a wide arc to join the Jhelum River in Muzaffarabad at

Domail. Famous Neelum-Jhelum hydro power project was recently completed on this river near Nausada. The Neelum River is 245 kilometers long; it covers 50 kilometers in the Indian Occupied Kashmir and the remaining 195 kilometers in Azad Kashmir.

2.3.7 River Kunhar

The Kunhar River is 166 kilometers (103 mi) Long River, located primarily in the Khyber Pakhtunkhwa Kaghan valley. The river originates from Kabalbash Lake near Babusar Pass. Waters of Dudipatsar and Saiful Muluk Lakes feed the river besides glacial waters from Malka Parbat and other high peaks in the valley. The Kunhar River flows through the entire Kaghan valley, Jalkhad, Kaghan, Balakot, Garhi Habibullah and Dalola. The River joins with Jhelum River at confluence just outside Muzaffarabad near the town of Rahra in the Azad Jammu and Kashmir. Patrind hydropower project is under construction on this river near Lohar Gali.

2.3.8 River Shyok

The Shyok River flows through northern Ladakh in India and the Ghangchay District of Gilgit–Baltistan of Pakistan spanning some 550 km (340 mi). It is a tributary of the Indus River, originates from the Rimo Glacier, one of the tongues of Siachen Glacier. The river widens at the confluence with the Nubra River. It enters in Pakistan near the town of Frano some 40 km ahead of khaplu and joins with Indus near Hamayoun Bridge.

2.3.9 River Gilgit

The Gilgit River is a tributary of the Indus River and it joins Indus near town of Juglot where three mighty mountain ranges of Himalaya, Karakoram and Hindukush meet. It flows past the town of Gilgit. The Gilgit River starts from Shandur Lake and Khokush Lake. It is also referred to as the Ghizer River.

2.3.10 River Hunza

Hunza River is the principal river of Hunza in Gilgit–Baltistan. It is formed by the confluence of the Chapursan and Khunjerab Rivers which are fed by glaciers. It is joined by the Gilgit River and the Naltar River, before it flows into the Indus River. The river cuts through the Karakoram Range, flowing from north to south. The Attabad landslide disaster in January 2010 completely blocked the Hunza River. A new lake now called the Attabad Lake was formed which extends 30 kilometers and rose to a depth of 400 feet.

2.3.11 River Astor

Astor River is a tributary of the Indus River and one of the rivers draining the Deosai Plateau, running through Astor Valley. The river originates from western slopes of Burzil Pass. Astor River joins Gilgit River near the town of Thalichi.

2.3.12 River Swat

The Swat River is a perennial river in the northern region of Khyber-Pakhtunkhwa Province. The river commences in the Kalam Valley of Swat Kohistan with the confluence of two main tributaries Ushu and Utror and runs downstream in a narrow

gorge up to Baghdheri. Its source is Kachkhani glacier, from where it is fed by the glacial snout throughout the year and flows through the Kalam Valley in a narrow gorge with a rushing speed up to Madyan and lower plain areas of Swat Valley up to Chakdara for 160 km. In the extreme south of the valley, the river enters to a narrow gorge and joins the Panjkora River, at Qalangi, and finally empties into Kabul River, near Charsadda. It is diverted near Batkhela for irrigation and power generation purposes. The Upper Swat Canal flows under Malakand through Benton Tunnel. Below Dargai, the upper canal is divided into two branches, supplying Charsadda, Swabi and Mardan. The water also used for hydropower generation at Jabban and Dargai Power Stations.

Swat River plays an important role in the economy of the valley. It irrigates large areas of Swat District, Malakand District and lower Peshawar Valley and recharge water wells & springs through seepage. The river serves as a habitat for diverse species of birds & contributes to the fishing industry of the region. The aesthetic scenery of river attracts thousands of tourists from all over Pakistan during the summer season.

2.3.13. River Panjkora

The River's headwaters are high in the glaciers of Hindu Kush Mountains in Kumraat Valley. It flows south through the Upper Dir District and the Lower Dir District. Its confluence with the Swat River is in the Malakand District near Qalangi. The Swat River is a tributary of the Kabul River, part of the Indus River basin.

2.3.14. River Kabul

The Kabul River is a 700-kilometre (430 mi) long river that emerges in Maidan Wardak Province in the Sanglakh Range of the Hindu Kush Mountains in Afghanistan, and is separated from the watershed of the Helmand River by the Unai Pass. The Kabul River empties into the Indus River near Attock, Pakistan. It is the main river in eastern Afghanistan and the Khyber Pakhtunkhwa province of Pakistan. The Kabul River passes through the cities of Kabul, Surobi, and Jalalabad in Afghanistan before flowing into Khyber Pakhtunkhwa in Pakistan some 25 kilometers (16 mi) north of the Durand Line border crossing at Torkham. In Khyber Pakhtunkhwa, the river passes through the cities of Peshawar, Charsadda, and Nowshera.

The Kabul River is little more than a trickle for most of the year, but swells in summer due to melting snows in the Hindu Kush Range. Its largest tributary is the Kunar River, which starts out as the Mastuj River, flowing from the Chiantar glacier in Brughil valley in Chitral, Pakistan and after flowing south into Afghanistan it is met by the Bashgal river flowing from Nurestan. The Kunar meets the Kabul near Jalalabad. In spite of the Kunar carrying more water than the Kabul, the river continues as the Kabul River after this confluence, mainly for the political and historical significance of the name. Third largest dam of Pakistan, Warsak Dam is also built on this river near Peshawar.

2.3.15. River Kunar/Chitral/Yarkhun

The Kunar River or Yarkhun River is about 480 km long, located in northern Khyber Pakhtunkhwa and eastern Afghanistan. It emerges just south of the Broghil Pass, in the

upper part of Chitral District of Khyber Pakhtunkhwa near the Afghan border. The river system is fed by melting glaciers and snow of the Hindu Kush Mountains. The Kunar River is a tributary of the Kabul River, which is in turn a tributary of the Indus River. The river rises in the far north glaciated Hindu Kush Mountains of Chitral, Khyber Pakhtunkhwa, Pakistan. Downstream as far as the town of Mastuj it is known as the “Mastuj River” from there to its confluence with the Lotkoh River just north of the important regional centre of Chitral. It is then called the “Chitral River”, before flowing south into the upper Kunar Valley of Afghanistan. At the confluence in Asadabad, historically Chaga Sarai, it meets with Pech River and finally empties into the Kabul River just to the east of the city of Jalalabad in Afghanistan. The combined rivers then flow eastwards into Pakistan again, roughly following the Grand Trunk Road through the Khyber Pass, and joining the Indus River at the city of Attock.

2.3.16. River Kurram

Kurram River is located in Paktia and Khost provinces of Afghanistan and Kurram Agency, North Waziristan Agency and Khyber Pakhtunkhwa, Pakistan. It drains the southern flanks of the Spin Ghar mountain range and is a right bank or western tributary of the Indus River.

2.3.17. River Tochi/Gambila

The Gambila River also called the Tochi River is emerged in Khost Province Afghanistan and flow from North Waziristan and Bannu District, northwestern Pakistan. The source of the river lies in the hills six miles south of the Spīn Ghar range, the source of the Kurram River, to which it runs parallel and finally joins. It borders North Waziristan while the Gomal River borders South Waziristan.

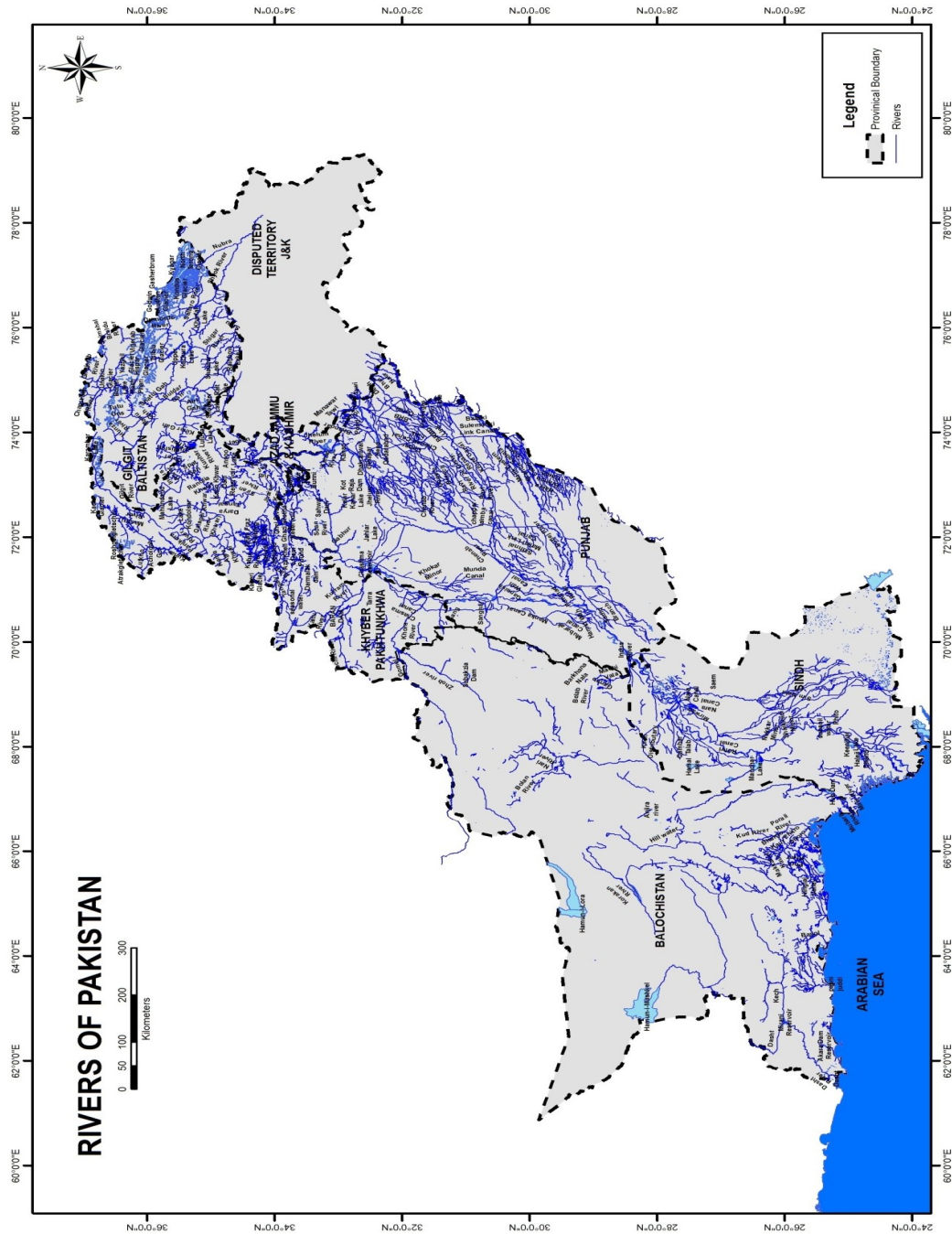
2.3.18. River Gomal

Gomal River's headwaters are located south-east of Ghazni. Within Pakistan, the Gomal River forms the boundary between Baluchistan and the South Waziristan Agency (formerly part of the Federally Administered Tribal Areas, but now part of Khyber Pakhtunkhwa). After approximately 110 miles from its source, it merges with the Zhob River, its major tributary, near Khajuri Kach. It is about 100 miles from the Zhob River to the Indus River. From South Waziristan, the river enters the Gomal Valley in the district of Tank, at a place known as Garwaki. It is mainly here that the water of Gomal is used to cultivate the lands in Gomal Valley through Zam System (Rod Kohi). The river passes then through the Damaan plain in Kulachi Tehsil and later on through Dera Ismail Khan Tehsil, It then joins the Indus River 20 miles south of Dera Ismail Khan. The famous Gomal Zam Dam was built on this river in 2013.

2.3.19. River Soan

The Soan River is an important stream of the Potohar Plateau. It drains much of the water of Potohar. It starts near the small village of Bun in the foothills of Patriata and Murree. It provides water to Simly Dam, which is the water reservoir for Islamabad. Near Pharwala Fort it cuts through a high mountain range, a wonderful natural phenomenon called Soan Cut. No stream can cut such a high mountain, which proves that the Soan was there

before the formation of this range. And as the mountain rose through millions of years, the stream continued its path by cutting the rising mountain. The oldest evidence of life in Pakistan has been found in Soan River valley. It was here that some of the earliest signs of humans have been discovered during the excavations of prehistoric mounds.



2.4 Lakes of Pakistan

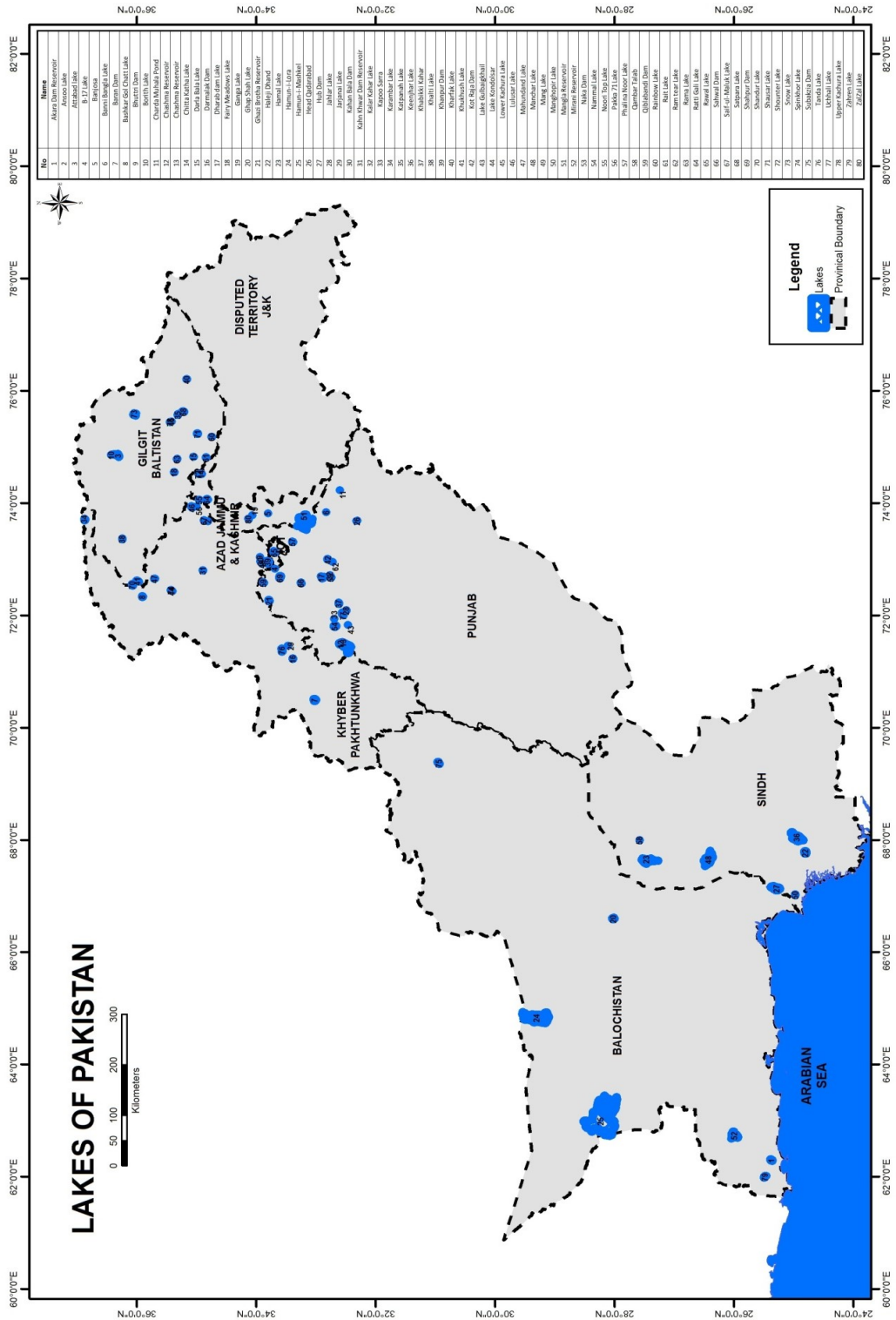
The third main biggest hydrological resource of Pakistan is its lakes. Pakistan is home to many natural and manmade lakes and reservoirs. The glaciated areas of Himalayas, Karakoram and Hindukush are dotted with many alpine lakes which are not only the source of fresh water but also they are attraction for tourists from all over the world. These lakes also serve as habitat for migratory Siberian birds.

The biggest lake of Pakistan is Manchar Lake. It is the largest freshwater lake in Pakistan and one of Asia's largest. Keenjhar Lake commonly called Kalri Lake is in Thatta District, Sind. It is 122 km from Karachi and 18 km from the town of Thatta. It is the second-largest fresh water lake in Pakistan and an important source of drinking water for Thatta District and Karachi city. Highest lake of Pakistan is in Ladakh Range in Chorbut Valley which is more than 16,248 feet high. Other highest lakes include Rush Lake and Karombar Lake. Some important lakes of Pakistan are:

1. Attaabad Lake, Upper Hunza
2. Boorit Lake, Passu, Hunza
3. Rush Lake, Hopar, Nagar
4. Shimshal Lake, Shimshal Valley, Hunza
5. Kargah Lakes, Gilgit
6. Khalti Lake, Gupis
7. Phandar Lake, Phandar Valley, Ghizer
8. Handrap Lake, Ghizer
9. Khokush Lake, Langar, Ghizer
10. Dalnati Lakes, District Ghizer
11. Gasho Lake, Juglot, Gilgit
12. Phandar Lake, Ghizer
13. Karombar Lake, Broghal Valley, Chitral
14. Bashkargol Lake, Sorlaspur, Chitral
15. Rama Lake, Astor
16. Sheosar Lake, Deosai Plateau, Astor
17. Sadpara Lake, Skardu
18. Shangrila Lake, Skardu
19. Katchura Lake, Skardu
20. Rainbow Lake, Domail, Minimarg Valley Astor
21. Dhirlay Lake, Kalapani Valley Astor
22. Riat Lake, Kalapani Valley, Astore
23. Saiful Muluk Lake, Naran
24. Dudipatsar Lake, Besal, Kaghan Valley
25. Lulusar Lake, Kaghan Valley
26. Dharamsar Lake, Kaghan Valley
27. Satsar Mala Lakes, Kaghan valley
28. Sambaksar Lake, Kaghan Valley
29. Kabalbash Lakes, Kaghan Valley
30. Shountar Lake, Azad Kashmir

31. Chitta Katha Lake, Kel, Azad Kashmir
32. Ratti Gali Lake, Dowarian, Azad Kashmir
33. Gattian Lake, Surgan Valley, Azad Kashmir
34. Noori top Lake, Azad Kashmir
35. Babusar Top Lake, Kaghan Valley
36. Ghumakhdori Lake, Gumoat Valley, Azad Kashmir
37. Muraat Lake, Thak Valley, Chilas
38. Buthogah Lake, Chilas
39. Saral Lake, Azad Kashmir
40. Duck Lake, Janawai, Azad Kashmir
41. Banjoosa Lake, Rawalakot, Azad Kashmir
42. Patlian Lake Azad Kashmir
43. Gujjar Nar Lakes, Phullawai, Azad Kashmir
44. Bathrait Lake, District Ghizer
45. Gologah Lake, District Ghizer
46. Dabogah Lake, District Ghizer
47. Sadkokhal Lake, Gupis, District Ghizer
48. Koopgah Lake, Gupis, District Ghizer
49. Hakis Lakes, District Ghizer
50. Thapas Lake, Singal Valley, District Ghizer
51. Qorqolti Lake, Yasin Valley, District Ghizer
52. Asumbar Lake, Yasin Valley, District Ghizer
53. Utter Lake, Ishkoman Valley, District Ghizer
54. Birgal Lake, District Ghizer
55. Halibar Lakes, Darail Valley, Diamer
56. Maheen Lakes, Supat Valley, Kohistan
57. Sarogah Lake, Supat Valley, Kohistan
58. Khana Lake, Palas Valley, Kohistan
59. Maro Katha Lake, Palas Valley, Kohistan
60. Barah Lakes, Khaplu
61. Dakholi Lake, khaplu
62. Ghanchay Lake, Khaplu
63. Kharmang Lake, Skardu
64. Kharfaq Lake, Khaplu
65. Shani Lakes, Naltar Valley
66. Kundol Lake, Kalam Swat
67. Mahodand Lake, Kalam Swat
68. Bishigram Dhand, Swat
69. Spin Khwar Lake, Swat
70. Goudar Lake, Kalam, Swat
71. Zomalo Lakes, Kalam, Swat
72. Shindoor Lake, Kumraat Valley, Dir
73. Sheetak Lake, Kumraat Valley, Dir
74. Zharbatso Lake, Shigar
75. Kalar kahar Lake, Chakwal

76. Uchali lake, Soon Valley
77. Khabeki Lake, Soon Valley
78. Namal Lake, Musa Khel, Mianwali
79. Jhalar Lake, Soon Valley
80. Sar Kalan lake, Lillah
81. Manchar Lake, Dadu, Sind
82. Chotiari Lake, Sanghar, Sind
83. Drigh Lake, Qambar, Sind
84. Keenjhar (Kalri) Lake, Thatta, Sind
85. Haleji Lake, Thatta, Sind
86. Hadero Lake, Thatta , Sind
87. Hanna Lake, Quetta



Self Assessment Questions

1. What do you understand by the term hydrology? What is the affect of hydrology on climate of Pakistan?
2. Glaciers of northern Pakistan are some of the largest and longest mid-latitude glaciers on Earth. Discuss.
3. Highlight the important rivers of Pakistan and their contribution in the hydrology of Pakistan.
4. Elaborate the lakes of Pakistan. How the lakes in Pakistan are important in context of hydrology.

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Unit-3

CLIMATE

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Introduction

The land of Pakistan has distinct climate in the region where all the seasons can be found. This unit shows about the difference of weather and climate. Climate is the vast term which is affected by the rainfall, pressure, temperature and humidity. A God-gifted country for the people of Pakistan which has its unique Physiography. In summer, the temperature in Pakistan remains between 21 to 31 Degree centigrade, while in the winters it remains between 10 to 20 Degree centigrade in warm summers and mild winters temperature regions. In hot summer and mild winter regions, the temperature remains 32 Degree Centigrade or more in the hottest month, while in winters the temperature remains between 10 to 20 Degree Centigrade. The unit also elaborates the various aspects of the seasons. In the summer season, the air pressure remains low throughout Pakistan. Moreover, the air pressure begins to decrease in April and continues to fall till July. After the month of July, it tends to increase but continues to relatively low up till the September.

The unit reveals that Pakistan obtains the tail of monsoon winds which enters the country through India. Normally these winds reach in the month of July and ends till the beginning of September. That is why the most of the rain fall take place during July to September in Pakistan. This series of rain fall is called Monsoon. On the other hand, the western disturbance enters Pakistan from the west after passing through Iran and Afghanistan. They carry most of the moisture on the long board journey so only bring little rain to Pakistan. Despite the fact western part receive more rainfall because of western depression from other sources. Sindh is the driest part of the country where the rainfall is very less. The overall rainfall is recorded in this region almost less than 25 mm.

Objectives

After reading this unit, you will be able:

1. to understand the term climate in broader sense.
2. to differentiate between the weather and climate.
3. to learn about the various aspects of the seasons of Pakistan.
4. to know the contribution of the winds in rainfall come from east and west.

Climate

Climate is a composed term which has different features and factors to describe it as an integrated unit. It is accompanied by number of elements like temperature, humidity, air pressure and amount of precipitation over the land. These factors are controlling factors and known as factors of climate.

Definition

According to the early Greek astronomers “The climate is the study of condition of the atmosphere over a definite time and under definite conditions.”

According to F.J. Monkhouse “climate help to determine food, clothing, housing, and general modes of life.”

3.1 Difference between Weather and Climate

Goh says about the difference between weather and climate:

“The term weather should not be confused with climate though they are closely related to each other. In the same country even small or large, the weather phenomenon can change tremendously. It may be sunny in one area and raining dogs and cats in the few kilometers away area”.

When we talk about climate we are referring to the average atmospheric conditions of a certain area over a considerable time. This involves systematic observations, recording of different parameters like pressure, winds, cloud cover, sun shine and humidity.

The importance of weather and climate

The exquisite influence of climate can be seen visually over man’s activities he performs in daily life. Forces of natures has altered the extent of food we eat, the clothes we wear and the things we perform to sustain is all controlled by nature. The elements of Weather and climate Rainfall, pressure winds, temperature are important because of their far-reaching global influences.

Rainfall

Rainfall includes other forms of precipitation like snow hail, mist, dew, ice is always measured by an instrument called rain gauge. The total amount obtained from the daily averages of rain taking place over 35 years will be taken into consideration and develop a map having place with same rain amount called isohyet.

Pressure

Air exert no of gases in it, so it also possesses pressure. The instrument measures this pressure is called Barometer. The barometer is sensitive to gravitational force so at different latitudes its amount of measurement will be different.

Temperature

Temperature is a very important element of climate. The instrument used for measuring temperature is thermometer. Which is a narrow glass tube filled with mercury or alcohol.

To obtain Centigrade temperature = $(F - 32) / 1.8$

To obtain Fahrenheit temperature = $(1.8 \times 20 \text{ c}) + 32$

Humidity

Humidity is the measure of dampness in the air which varies greatly from place to place at variant time of the days, the actual amount of humidity present in the air is called absolute humidity whereas the ratio between total amount of humidity and the actual amount an air passage can hold is called relative humidity.

3.2 Climate of Pakistan

Pakistan is located at the side out of the tropics where the sun slant to much especially summers in Pakistan. Therefore, it records for higher time periods for summer season rather than of winter. Air in Pakistan is mainly heated up by terrestrial radiations.

The oceans have moderate influence on temperature. water has a tendency of holding the temperature for a longer period if time as it holds the energy present in temperature for a longer time span therefore the moderate effect of water is observed in maritime.

Pakistan can be divided into following temperature regions:

- 1) Warm Summers and mild winters
- 2) Hot summers and mild winters
- 3) Warm summers and cool winters
- 4) Warm to cool summer and cold winters

3.2.1 Warm Summers and Mild winters

In Pakistan summer temperature remain between 21 to 31° C and temperatures in winter between 10 to 20° C.

Region:

The following region is present in Narrow coastal belt. Where temperature shows a general tendency of warm summers and mild winters due to maritime effect in the area.

Regions categorization based on temperature

HOT	32° C or more (90° F or more)
WARM	21 ° to 31° C (70- 89 ° F)
MILD	10 ° to 20 ° C (50 – 69 ° F)
COOL	0 ° to 9 ° c (32-49 ° F)
COLD	Below 0 ° C (Below 32 ° F)

3.2.2 Hot Summers and Mild Winters

The temperature of the hottest month is 32°C or more and winters temperature is between 10 to 20°C .

Region:

This area is extended over the extensive areas of Indus plain from north to the southern side and western side of Baluchistan.

3.2.3 Warm Summers and Cool Winters

In this region the temperature of the summer season is about 21 to 31°C . and the coolest month is ranging between 0 to 9°C .

Region:

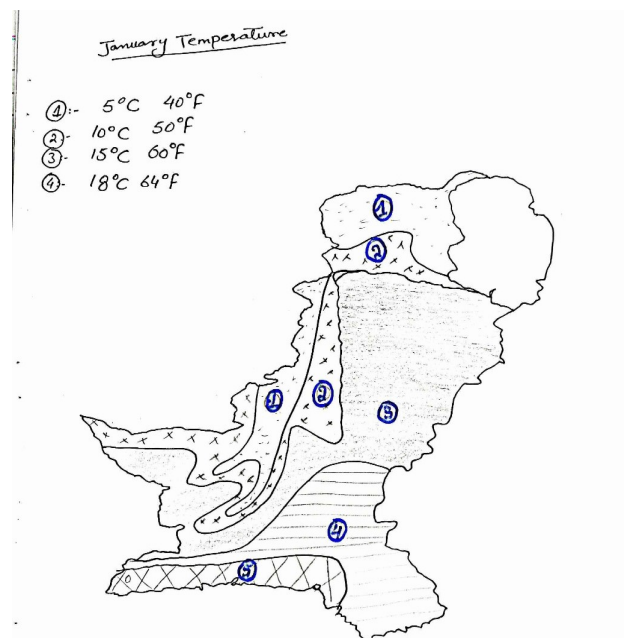
This warm summer and cool winters are mostly experiences in the western highlands of Pakistan.

3.2.4 Warm to Cold Summer and Cool to Cold Winters

Summer temperatures are extremely low ranging between 0 to 2°C and winters temperatures are below freezing that is 0 to 1°C .

Region:

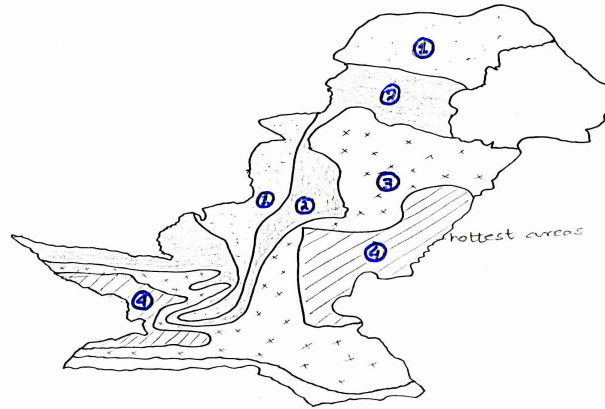
The region accompanied with such extremes of temperature lies in the northern mountainous areas of the region.



Major Temperature Regions of Pakistan (January)

Temperature
June Condition

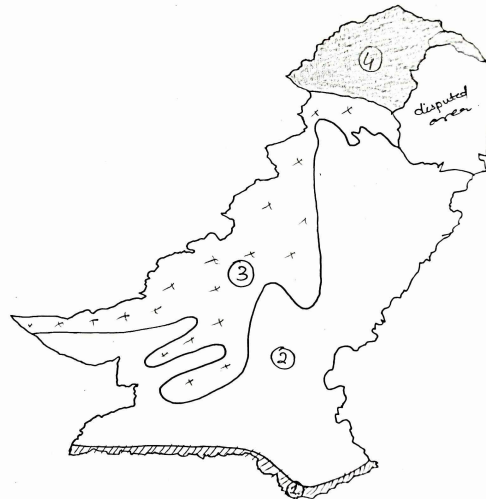
- ① 27°C 80°F
- ② 32°C 90°F
- ③ 35°C 95°F



Major Temperature Regions of Pakistan (June)

"temperature regions"

- 1:- Warm Summer & mild winter
- 2:- Hot Summer & mild winter
- 3:- Warm Summer & Cool winter
- 4:- Warm to Cold Summer & Cool to cold winter



Temperature Regions of Pakistan

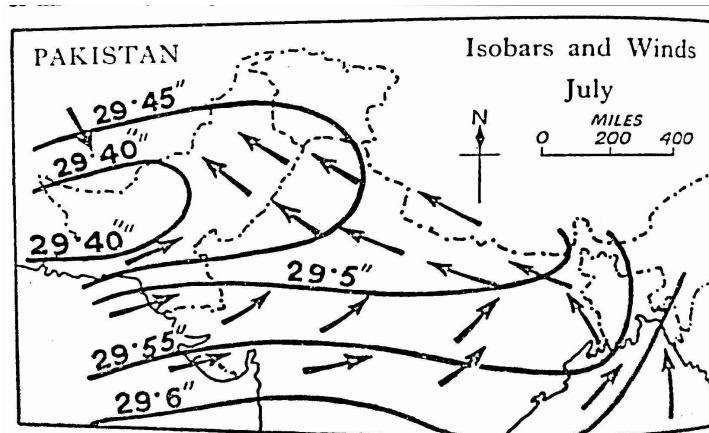
3.3 Air Pressure and Winds in Pakistan

Air pressure distribution in Pakistan exhibits a marked contrast in summers and winters. In summer air pressure remains extremely low while in winters it is high, as a result the pattern of prevailing winds also changes tremendously.

Summers:

In summers air pressure remains low throughout Pakistan. It begins to decrease in April and continues to fall till July. After July, it tends to increase but continues to relatively low up till September.

The NE and SE trade winds roaming from the southern hemisphere to the equator. The area under it is called ITCZ (Inter tropical Convergence Zone).



The Intense low pressure brings no of climatic changes over the area:

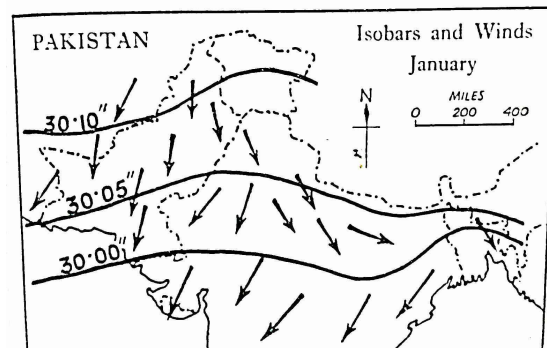
- 1) The Equatorial low-pressure belt becomes very weak.
- 2) The ITCZ moves northward and lies over Northern part of South of Asia.
- 3) The North east trade winds disappear
- 4) The south Eats trade winds of Southern hemisphere no longer stop at the Equator. They cross the Equator and proceed to low pressure belt over Pakistan. Hence deflected on the right side becoming south westerlies in summer. These south westerlies are Monsoon winds which is a low-pressure system over Indian Ocean. Thus, the Monsoon winds can be classified as seasonal winds over the South of Asian region.

Winters:

By the month of September, the low-pressure system during the summer is about to diminish and gets weak, the air pressure begins to rise with the highest pressure being reached in January from 1014 mb to 1016 mb.

In the system of winds circulation, two major events take place

- a) An Intense high-pressure belt developed over central Asia from where cold winds are generated below and in all directions of Himalayas. Some cold wind system also enters to Baluchistan from Afghanistan.
- b) The other Major event is the wind circulation which effects the low-pressure system in Pakistan. And entered by mid latitudes which can cause cyclonic activities often.



3.4 Rainfall

Monsoon:

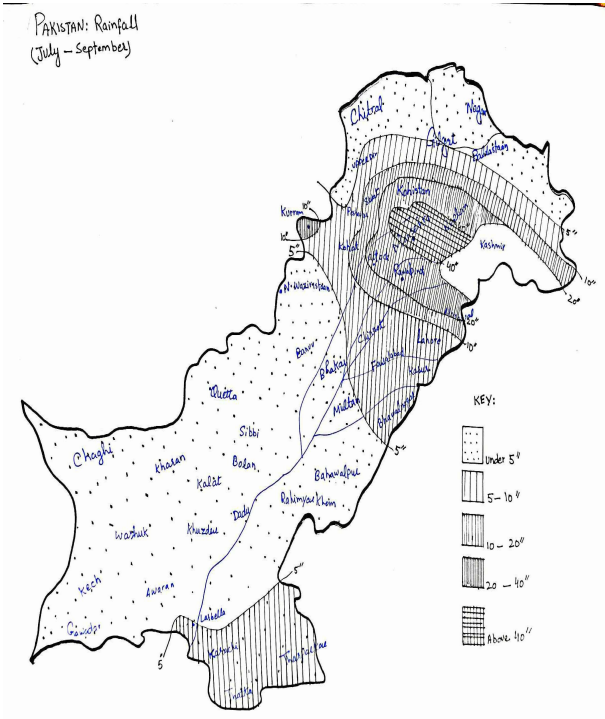
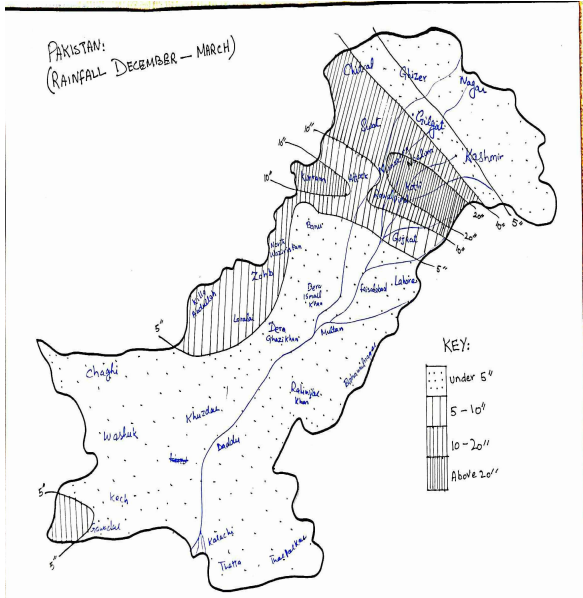
Pakistan receives the tail of monsoon winds which enters the country after India. They usually reach in early July and somewhat end to start of September. Most of the rain fall take place during July to September is the result of Monsoon.

Since it enters from the east, the main winds enter in Punjab, with the secondaries entering from southern Punjab. The hills and mountains record for 500 millimeters of rain.

From Sargodha to south wards the rain are 250 mm or less. The highest rain during monsoon season is recorded at Murree (813mm) and the lowest in Naukandi (2.5mm).

Rainfall by western disturbance

The western disturbance enters Pakistan from the west after Passing through Iran and Afghanistan. They carry most of the moisture on the long board journey so only bring little rain to Pakistan. Despite the fact western part receive more rainfall because of western depression from other sources. Sindh is the driest part of the country. Rainfall recorded in this region is about less than 25 mm.



Self Assessment Questions

1. Define the term climate and differentiate between weather and climate.
2. Discuss the climate of Pakistan in detail. Also elaborate the temperature regions of Pakistan.
3. Highlight the role of air pressure and winds in the climate.

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Unit-4

VEGETATION

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Reviewed by: Dr. Khalid Mahmood

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Introduction

Vegetation of Pakistan has been discussed in this unit. The land of our beloved homeland is full of vegetation including the trees of various types, shrubs, herbs, grasses, epiphytes, lichens, algae and mosses etc. A large number of factors affect the vegetation such as climate, organism, topography and soil as well as the time. The author has described five important types of vegetation found in Pakistan. Vegetation is those natural growth of any part of the land or a locale, which grow naturally without use of chemical fertilizers and irrigated water. In simple words, vegetation are the natural growing plants or trees of a particular area. It also means that the shrubs and herbs, grass and vegetables, fruits and bushes are included in vegetation which has grown naturally without the aid of humans.

Objectives

After reading this unit, you will be able:

1. to define the vegetation and get knowledge about the vegetation of Pakistan
2. to get knowledge about the various forms of vegetation available in Pakistan.
3. to learn about the factors determining vegetation conditions in a specific area.

4.1 Natural Vegetation of Pakistan

When we talked about the natural vegetation of a locale, it means that vegetation which has grown naturally without the aid of humans such as trees, shrubs, herbs, grasses, epiphytes, lichens, algae, mosses etc. It has been left undisturbed by humans for a long time. It is also known as virgin vegetation. Thus cultivated and managed plantations, gardens, orchards, fruits, vegetables and crops do not consider as a part of natural vegetation. In an ecosystem, vegetation is an assemblage of different natural plant species. It is highly a general term which does not include any specific botanical or geographic characteristics. Vegetation is broader in meaning than term flora which refers to specific species composition of an area. Vegetation is the most abundant biotic element of the biosphere. In biosphere, vegetation serves several important and critical functions:

- a. First, vegetation controls, manage and regulates the flow of various biogeochemical cycles, among them most necessary and critically are water, carbon, and nitrogen; it also plays a great role in local and global energy balances. These cycles controls the global patterns of vegetation and climate.
- b. Second, soil characteristics of any region are strongly affected by the vegetation of that locale. These soil characteristics include texture, soil volume and chemistry, which feed back to affect various characteristics of vegetation of that place, including structure and productivity.
- c. Third, vegetation serves as habitat for wildlife and the energy source for the vast array of animal species on the planet such as herbivores (and, ultimately, to those that feed on these such as carnivores).
- d. Fourth, vegetation is also an important source of energy in many parts of the world especially in poor and developing countries where people still use traditional biomass as fuel for cooking and heating their homes.
- e. Fifth, vegetation is the primary source of oxygen in the atmosphere. Plants release oxygen as a byproduct in the process of photosynthesis in the atmosphere. Trees also serves as carbon sinks because they absorb atmospheric carbon dioxide gas and convert it into solid carbon thus eliminating the impacts of green house gases and lessens the impacts of global warming.
- f. Sixth, vegetation is important to humans as they are dependent on vegetation for food, shelter and medicines.

Vegetation integrates the combined influence of a variety of environmental factors. The main factors determining vegetation conditions in a specific area are:

- i. **Climate:** Macroclimate of an area has a primary influence on the overall flora of that area. Flora makes the overall pattern of vegetation of that region.
- ii. **Organisms:** Although plants are the key organisms but animals, fungi, and other microorganisms affects the resulting development of vegetation through various interspecies and habitat relationships.
- iii. **Topography:** It determines the movement of surface and soil water, and therefore the moisture and some nutrient availability. It also influences microclimate of the area, e.g., aspect, cold air drainage etc.

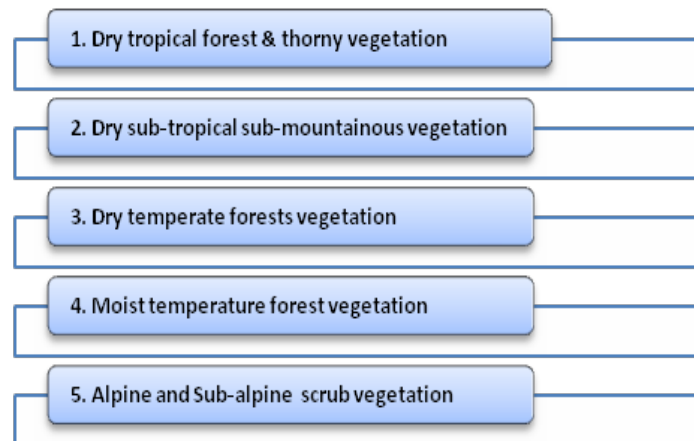
- iv. **Soil parent material:** It has a primary influence on moisture and nutrient conditions in the substrates within which plants grow.
- v. **Time:** Time is an important factor in the development and establishment of vegetation in a region. It also affects the characteristics of present existing vegetation.

Scientists divide the earth into various regions on the basis of types of vegetation in those regions. This classification is mainly based on the climatic characteristics, weather patterns and soil of that area. On this basis world is divided into four major vegetation regions:

- 1) Forests
- 2) Grasslands
- 3) Desert vegetation
- 4) Tundra vegetation

Similarly in Pakistan various phyto-geographical regions are identified and classified on the basis of weather patterns, climatic conditions, altitude, soils and topography of that area. We can divide Pakistan into five major vegetation regions:

4.2 Types of Vegetation of Pakistan



4.2.1 Dry Tropical Forest & Thorny Vegetation

Tropical conditions exist in many parts of Pakistan. But in a true sense it is not exactly tropical because dryness mostly prevails in these parts and rainfall is very scanty. A tropical climate in the Köppen climate classification is a non-arid climate in which all twelve months have mean temperatures of warmer than 18 °C (64 °F). Tropical climates are normally found from the equator to 25 north and south latitude whereas the southern parts of Pakistan start from 24 degree north latitude. As already discussed, dryness prevails in these areas, so mostly dry tropical vegetation is the characteristic feature of this vegetation realm. The Indus Plain, Hills of Baluchistan and Sind and coastal areas are

included in this region. Mostly xerophytic vegetation is present here. Xerophytes are those plant species that have adapted to live in desert or arid conditions. Xerophytes have evolved to bear and survive in extreme, moisture less and harsh environments. These Plants in general dependant on soil for water and nutrients through their long roots. Both of these ingredients are vital for their survival. Various distinguishing features of xerophytes permit them to prevent loss of water, and in some cases, to store water for their survival. The large tract of land in this vegetation region is also used for agriculture. We can broadly divide the vegetation of this region into following categories:

a. Dry tropical thorn forest (Indus plain and hills): This type of thorny bushes and forest is distributed in Indus basin, Plains of Punjab, Sind, and coastal region of Pakistan. There are many ranges of small hills scattered all over the Indus basin in Punjab and Sind. These hills have variety of thorny bushes and tree species. These are low, open and pronouncedly xerophytic forests in which thorny leguminous species predominate. Except the driest parts of Indus Basin, this type of vegetation is present everywhere. Major tree species in this region include: Jand (*Prosopis cineraria*), Karir (*Capparis deciduas*), Beir (*Zizyphus mauritiana*), Frash (*Tamarix aphylla*), Pilu (*Salvadora persica*), Babul or Gum Arabic tree (*Vachellia nilotica*), Kikar (*Acacia nilotica*), Sukh Chen (*Pongamia pinata*), Salt Cedar (*Tamarix aphylla*) etc. Shrubs of all sizes are also present with these tree species. The tree forest climax is very frequently degraded to a very open, low thorny scrub of Euphorbia (Thor), Zizyphus (Beir), etc. owing to the universally heavy incidence of grazing and other biotic factors.

On the basis of climax vegetation, the whole Indus basin plain region with the exception of parts of the districts of Sialkot, Gujrat and Jhelum, consists of tropical thorn forests. Before the development of urbanization, agriculture and irrigation, the area extended from the foothills of the Himalayas and low-hills in the south-west Punjab plains and Balochistan to the Arabian Sea. The climax species of these forests are *Salvadora oleoides*, *Capparis decidua*, *Tamarix aphylla* and *Prosopis cineraria*, which grow on a wide range of soil textures, from flat deep alluvial soils to heavy clays, loams and sandy loams. The climate varies from semi-arid (250 to 750 mm rainfall) to arid (less than 250 mm rainfall). The summer temperature in this tract is as high as 50°C. Earlier, these forests merged with riverain forests along the river banks and with scrub forests in the low hills in the north and north-western regions of Pakistan. Together these forests provided an ideal habitat to the wildlife of the area which seasonally migrated according to their needs; during cold winter from the lower hills towards the plains in search of food and shelter, from the flood plains towards the dry areas during floods and towards the rivers during the summer drought.

b. Vegetation of riverain tracts and Indus delta: The area which is present around the river is called riverain tract. Some of plants found in this area are Munja (*Saccharum munja*), *Tamarix*, Bahan (*Populus euphratica*) etc. *Saccharum munja* is a grass found in arid areas and along river banks of Pakistan. It belongs to the family Gramineae. It grows up to 2 meters (7 feet) in height. Its white flowers are of ornamental value. It is also used as a raw material for thatching roofs. It is used for making baskets. The plant has medicinal value.

The tract where river enters into sea is called delta. The delta of Indus has forests of mangroves. These forests occur at elevation of 0-20 ft. These are more or less gregarious forests of low height which occur in the Arabian Sea around the coast of Karachi and Pasni in Baluchistan and along the coast of Gawadar. The flora of the delta is not diverse as few plants can survive the severe conditions of heat and salinity. In 2003, mangrove forests were estimated to cover 820 square kilometers (320 sq mi) of the delta. 95% of the trees were grey mangroves (*Avicennia marina*), with the remaining 5%, growing on small areas of higher ground, being red mangrove (*Rhizophora mucronata*), Indian mangrove (*Ceriops tagal*) and black mangrove (*Aegiceras corniculatum*). Sea holly (*Acanthus ilicifolius*) and other salt-tolerant plants grow in drier parts. Mangrove forests have a thick canopy and undergrowth consisting mainly of saplings of the mangrove trees.

- c. **Vegetation of deserts and sandy tracts:** Desert areas and sandy tract includes Thal, Cholistan, Nara, Tharparkar and coastal tract of Makran and Sind. The average rain fall in these regions is 6 -12 inches. Some of the plants in these regions are *Salvadora*, *Acacia* and *Euphorbia*. The desert is a harsh, unforgiving environment. It is just as hazardous to plants as it is to animals. Temperatures swing wildly between extremes in desert climates. Water is scarce, and in some deserts as much as a year can elapse between rainfalls. Deserts tend to lack shade, and because there is so little humidity in the air, much more solar radiation is found in deserts than in other climates. This is too much sunlight for most plants to handle. Desert plants have found a variety of ways to cope with these extreme conditions, and survive where other plants cannot.
- d. **Vegetation of irrigated plantations:** Canal system is developed in the Indus basin region of Pakistan. This area was included in tropical rain forests. These forests have been cleared and its land is now used for agriculture.

4.2.2 Dry Sub-tropical Sub-mountainous Vegetation

The vegetation of this region contains bushes, trees and shrubs. Both evergreen and deciduous trees exist here. The evergreens are not as hard as Pines and Spruce. These plants have adapted to the regular climate conditions of this region. This type does not occur extensively in Pakistan but there are limited areas in the Rawalpindi foothills carrying this vegetation type, all much adversely affected by close proximity to habitation or cultivation. It is closely similar both in floristic composition and in structure to that developed freely in the adjoining parts of North West India. The chief tree species are *Lannea* (Kamlai, Kembal) *Bombax ceiba* (Semal), *Sterculia*, *Flacourtia* (Kakoh, Kangu), *Mallotus* (Kamila, Raiuni) and *Acacia catechu* (Kath). Common shrubs are *Adhatoda* (Bankar, Basuti, and Bansha), *Gymnosporia* (Putaki) and *Indigofera* (Kathi, Kainthi). The average rainfall is 12-36 inches and temperature rises to more than 40°C in summer season. Overall humidity is less than 50%. Major area of Baluchistan Plateau and Siwalik Hills falls in this region. Siwalik Hills are the low altitude range of the Outer Himalayas.

This region is further sub divided into two main zones:

- a. **Vegetation of Siwalik Hills:** Siwalik Hills include Potohar Plateau, Salt Range, Kala Chitta Range, Kheri Murat Range, Kahuta Hills, Ghandghar Hills and Hills of

the K.P. These are xerophytic forests of thorny and small-leafed evergreen species. Typical species are; Kau (*Olea cuspidata*) and Phulai (*Acacia modesta*), the two species occurring mixed or pure, and the shrub Sanatta (*Dodonaea viscosa*) which is particularly abundant in the most degraded areas.

- b. Vegetation of Baluchistan Plateau:** The topography of this area is distributed in dry low elevated hills, sand dunes and coastal low lying Hills of Baluchistan. They have mostly xerophytic plants. The plants found in these areas are mostly various species of Junipers including *Juniperus communis*, *Juniperus conferta*, *Juniperus rigida*, *Juniperus macrocarpa*, and other plants include Tamarix and many more.

4.2.3 Dry Temperate Forests

This region have harsh and unfavorable climate thus it has less number of plants. Most of this area has bare soil. Here plants are mostly Xerophytic. This region includes Suleiman Range, Koh Safad Range, Koh Hindu Kush Range, Karakoram Range and lower part of the Neelum valley (Azad Kashmir). This region has long cold winter. Temperature becomes lower than zero. The annual total rain fall is less than 30 inches. Some of these areas are covered by snow. Thus most of this area is a zone of winter rain and snow. These are open evergreen forest with open scrub undergrowth. Both coniferous and broad-leaved species are present. This type occurs on the inner ranges throughout their length and is mainly represented in the north-west. Dry zone deodar, Chalghoza (*Pinus gerardiana*) (and *Quercus ilex* are the main species. Higher up, blue pine communities occur and in the driest inner tracts, forests of blue pine, *Juniperus macropoda* and some *Picea smithiana* (e.g. in Gilgit) are found locally.

4.2.4 Moist Temperate Forests

The evergreen forests of conifers, locally with some admixture of oak and deciduous broad-leaved trees fall in this category. Their undergrowth is rarely dense, and consists of both evergreen and deciduous species. These forests occur between 1500 m and 3000 m elevation in the Western Himalayas except where the rainfall falls below about 1000 mm in the inner ranges, especially in the extreme north-west. They are located in Kashmir, Murree-Hazara Hills tracts, Swat, Dir, Gilgit and Baltistan districts.

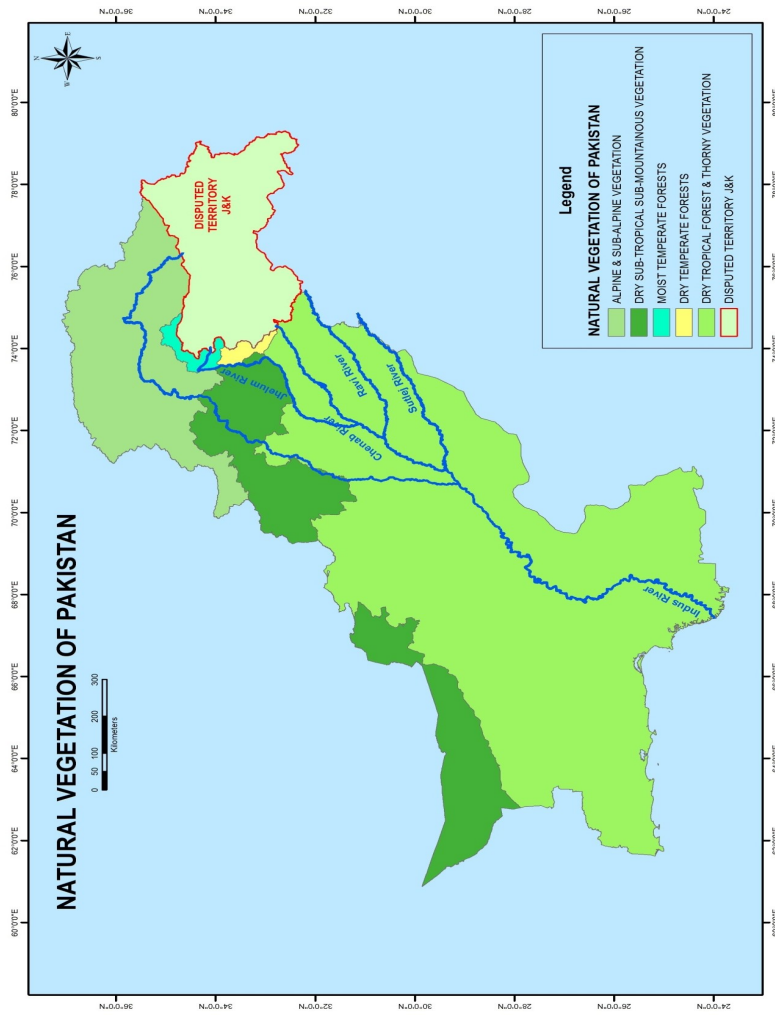
These forests are divided into a lower and an upper zone, in each of which definite species of conifers and/or oaks dominate. In the lower zone, *Cedrus deodara* (Deodar, diar), *Pinus wallichiana*, *Picea smithiana* and *Abies pindrow* (Partal) are the main conifer species in order of increasing altitude, with *Quercus incana* (rin, rinj) at lower altitudes and *Q. dilatata* above 2130 m. In the upper zone *Abies pindrow* and *Q. semecarpifolia* are the dominant tree species. There may be pockets of deciduous broad-leaved trees, mainly edaphically conditioned, in both the zones. Alder (*Alnus* species) colonizes new gravels and sometimes kail does the same. Degradation forms take the shape of scrub growth and in the higher reaches; parklands and pastures are subjected to heavy grazing.

4.2.5 Alpine and Sub-alpine Vegetation

Evergreen conifers and mainly evergreen broad-leaved trees occur in relatively low open canopy, usually with a deciduous shrubby undergrowth of *Viburnum* (Guch), *Salix*

(Willow, Bed), etc. The type occurs throughout the Himalayas from about 3,350 m to the timber limit. *Abies spectabilis* and *Betula utilis* (Birch, Bhuj) are the typical tree species. High level blue pine may occur on landslips and as a secondary sere on burnt areas or abandoned clearings. *Rhododendrons* (Bras, Chahan) occur in the understory but do not form extensive communities as they do in the central and eastern Himalaya. Dwarf junipers are often abundant. It is commonly found in Himalayan Mountains of Kaghan, Swat, Baltistan, Gilgit, Chitral, Dir and Kurram Agency.

Above sub alpine forests alpine scrub is present. The best example is Deosai Plain which is a rolling treeless plain with only sedges, grasses and variety of alpine flowers. The growing season is very short in this zone. Under this type are included shrub formations 1 m to 2 m high extending 150 m or more above the sub-alpine forests. The characteristic genera are *Salix*, *Lonicera* (Phut), *Berberis* (Sumbul), *Cotoneaster* with *Juniperus* and occasionally *Rhododendron* or *Ephedra* (Asmania).



Self Assessment Question

1. What do you know about the natural vegetation of Pakistan?
2. What are the main factors determining vegetation conditions in a specific area?
3. Discuss the various types of vegetation in Pakistan.

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Unit-5

SOILS

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Introduction

The soil of Pakistan is considered very useful for the agriculture. Allah Almighty has gifted us the soil of various types which include minerals, organic matter, liquids, gases and organisms that collectively support life on Earth. Soil minerals, Soil organisms (plants), micro-organisms (fungi or bacteria), burrowing insects, animals and humans are the important components of the soil. The taxonomy of soil has been described by the author through maps and charts in this unit. The Soil taxonomy is based on the properties of soils as they are formed today. Most of the chemical, physical and biological properties of soil are used as criteria for soil taxonomy.

A few examples are moisture and temperature status throughout the year, as well as color, texture, and structure of the soil. Chemical and mineralogical properties, such as the contents of organic matter, clay, iron and aluminum oxides, silicate clays, salts and the soil depth are other important criteria for classification.

On the basis of Pakistan's physiographic and ecological zones the author has divided Pakistan's soils into following twelve categories. But keep one thing in mind that this is not a scientific classification of soil; rather it is based on observed physical feature characteristics and factors of soil formation in these areas which vary from place to place.

Objectives

After reading this unit, you will be able:

1. to know about the soil and its important functions.
2. to get knowledge about the soil profiles and the various layers of soil.
3. to learn about the soil orders and their description.

5.1 Soils of Pakistan

Soil is a mixture of various components which include minerals, organic matter, liquids, gases and organisms that collectively support life on Earth. Total soil present on the surface of the earth is known as Pedosphere and it performs four important functions:

1. It is used as a medium for plant growth
2. The important processes of water storage, supply and purification is performed by soil
3. Modification in the Earth's atmosphere is also done by soil
4. Soil is a habitat for various types of organisms

All of these functions, in their turn, modify the soil.

The Pedosphere interacts with the lithosphere (solid portion of the earth), the hydrosphere (all three states of water on earth), the atmosphere (mixture of various gases that surrounds the earth), and the biosphere (all life types on earth). Soil has evolved through various geomorphic processes of weathering, mass wasting and erosion which in turn are mainly driven by geological, topographical, biological and climatic influences of the area.

Soil is the thin layer of material that primarily formed from the weathering of rocks. All components of soil including mineral particles, organic materials, air, water and living organisms interact slowly yet constantly. Maximum plants get their nutrients from the soil and plants are the main source of food for humans, animals and birds. Therefore, most living things on land are dependent on soil for their existence. Soil is a precious resource that needs to be carefully managed as it is damaged easily, blown or washed away. If we understand soil and manage it properly, we will avoid destroying one of the essential building blocks of our environment and our food security. Five main factors are involved in the formation of soils of Pakistan as well as in the entire world. These are:

5.1.1 Parent Material

The soil minerals are the basis of soil. They are produced basically from rocks (parent material) through the processes of weathering and natural erosion. Water, wind, temperature change, gravity, chemical interaction, living organisms and pressure differences all help break down parent material. Pakistan has diverse relief and topography. If we closely examine the geology of Pakistan we will understand that there are various types of rocks in different areas that serve as parent material for the formation of sundry of soils all over the country. The types of parent materials and the conditions under which they break down will influence the properties of the soil formed. For example, soils in Gilgit-Baltistan and other mountainous parts of our country are formed from granite and other igneous and metamorphic rocks that are often sandy and infertile whereas basalt under moist conditions breaks down to form fertile, clay soils.

5.1.2 Organisms

Soil formation is also influenced by organisms (such as plants), micro-organisms (such as fungi or bacteria), burrowing insects, animals and humans. As soil forms, plants begin to

grow in it. The plants mature, die and new ones take their place. The leaves and roots of these plants are also added to the soil. Animals eat plants and their wastes, excretion and eventually their bodies after death are also added to the soil. This begins to change the soil. Bacteria, fungi, worms and other burrowers break down plant litter and animal wastes and remains, to eventually become organic matter which is commonly known as humus. In Pakistan those areas have rich organic soils where organic content is highly available.

5.1.3 Climate

Rate of weathering and organic decomposition is highly affected by the climate of an area. The areas with colder and drier climate have slower soil formation processes but with heat and moisture these processes accelerates rapidly. Cold mountain areas of Gilgit, Baltistan, and Chitral have very slow soil forming processes but in warm plain areas these processes are very rapid. Rainfall dissolves some of the soil materials and holds others in suspension. The water carries or leaches these materials down through the soil. Over time this process can change the soil, making it less fertile. Due to steep slopes in our mountainous areas fertile soil has been washed away with rain and running water, that creates manifold problems.

5.1.4 Topography

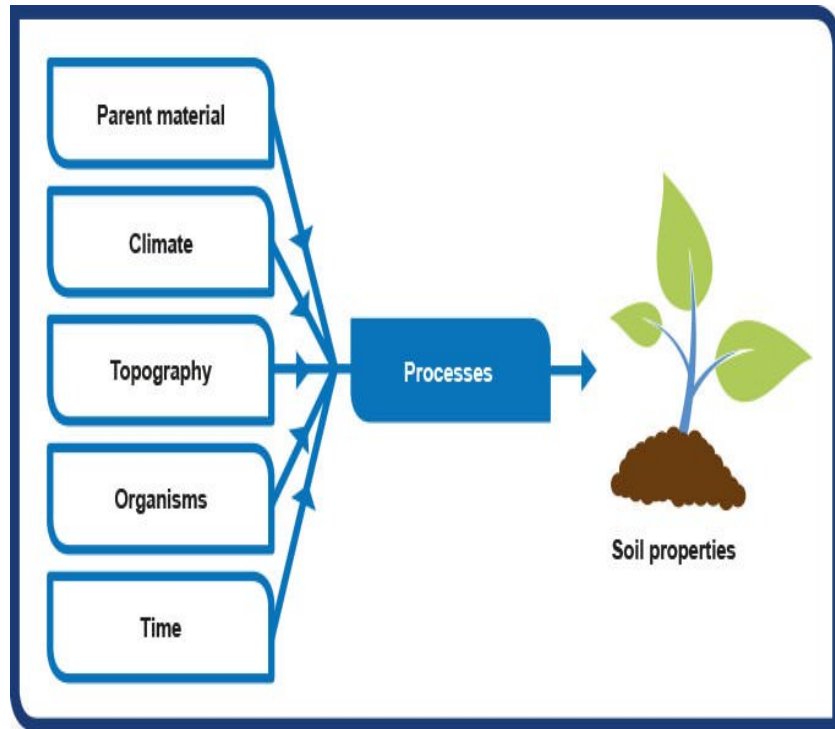
The length, shape and gradient of a slope affect drainage of an area. The aspect of a slope also determines the type of vegetation and indicates the amount of rainfall received. These factors change the way soils form.

Soil materials are progressively slowly moved within the natural landscape by the action of water, gravity and wind (for example, heavy rains erode soils from the hills to lower areas, forming deep soils). The soils left on steep hills are usually shallower. Transported soils include:

- a) ***Alluvial (water transported)***, found in Upper Indus and Lower Indus Plains, in valleys of Swat, Skardu, Bannu etc.
- b) ***Colluvial (gravity transported)***, found on slopes of mountain areas of Pakistan such as Hunza, Gilgit, Gupis etc
- c) ***Aeolian (wind transported) soils***, found in Potohar plateau and some desert areas.

5.1.5 Time

It takes a long time for soil to develop. For example, once rock is exposed in a warm, humid climate, it may take a hundred years for mosses and lichens to take hold. They trap dust and organic matter and break down the rock. Within a few hundred years, grasses and shrubs become established. Roots begin to penetrate the rocks and accelerate physical and chemical weathering. Over thousands of years, climate, organisms and topography influence how parent materials are turned into soils. The soils of Upper Indus and lower Indus plains are quiet young as new soil layers are deposited every year after flooding.



Before discussing about the soils of Pakistan we must probe into basics of soil horizons and classification to better understand about the diverse soils of our country.

The Soil Profile:

Soil profile means layers or horizons present in a soil of an area. These layers of soil develop over time. Most soil profiles cover the earth as 2 main layers—topsoil and subsoil. Most soils exhibit 3 main horizons:

A horizon—it is the topmost layer of the soil which is rich in humus and biological activity is at its peak in this horizon (i.e. most micro-organisms plant roots, insects and earthworms are active). The A horizon is usually dark in color as compared to other horizons because of abundance of organic materials.

B horizon—it is clay-rich subsoil. This horizon is often less in fertility than the topsoil but it holds more moisture than A-horizon. It is generally lighter in color and has less biological activity as compared to the A horizon. Texture of this horizon may be heavier than the A horizon.

C horizon—it is the underneath layer of rocks from which both A and B horizons are made with the passage of time.

Some soils also exhibit an O-horizon that mainly consists of plant litter which has accumulated on the soil surface.

The properties of these above mentioned horizons are used to distinguish and classify soils and they also determine land-use potential.

5.2 Soil Classification

From the time crops were first cultivated; humans noticed differences in soils and classified them according to their suitability for different uses. Farmers use descriptive names such as black cotton soils, or olive soils. Other soil names still in common use today suggest the parent materials from which the soil formed. : Limestone soils, piedmont soils and alluvial soils. Such terms may convey some valuable meaning to local users but they are inadequate for helping us to organize our scientific knowledge of soils or for defining the relationship among soils of the world.

Here we will learn how soils are classified as natural bodies on the basis of their profile characteristics, not merely on the basis of their suitability for a particular use. Soil classification allows us to take advantage of research and experience at one location to predict the behavior of similarly classified soils at other locations. Soil names such as Histosols or Vertisols bring up similar mental images in the minds of soil student everywhere, whether they live in the United States, Europe, Japan, and Pakistan or anywhere in the world. A goal of the classification system is to create a universal language of soils that enhances communication among users of soil around the world.

Soil Taxonomy: The Basis of Soil Classification

Soil taxonomy provides a hierarchical grouping of natural soil bodies. The system is based on soil properties that can be objectively observed or measured, rather than on presumed mechanisms of soil formation. The system uses a unique nomenclature that gives a definite connotation of the major characteristics of the soils in question.

Soil taxonomy is based on the properties of soils as they are formed today. Most of the chemical, physical and biological properties of soil are used as criteria for soil taxonomy. A few examples are moisture and temperature status throughout the year, as well as color, texture, and structure of the soil. Chemical and mineralogical properties, such as the contents of organic matter, clay, iron and aluminum oxides, silicate clays, salts, the PH, and soil depth are other important criteria for classification. While many of the properties used may be observed in the field, other requires precise measurements on samples taken to a sophisticated laboratory

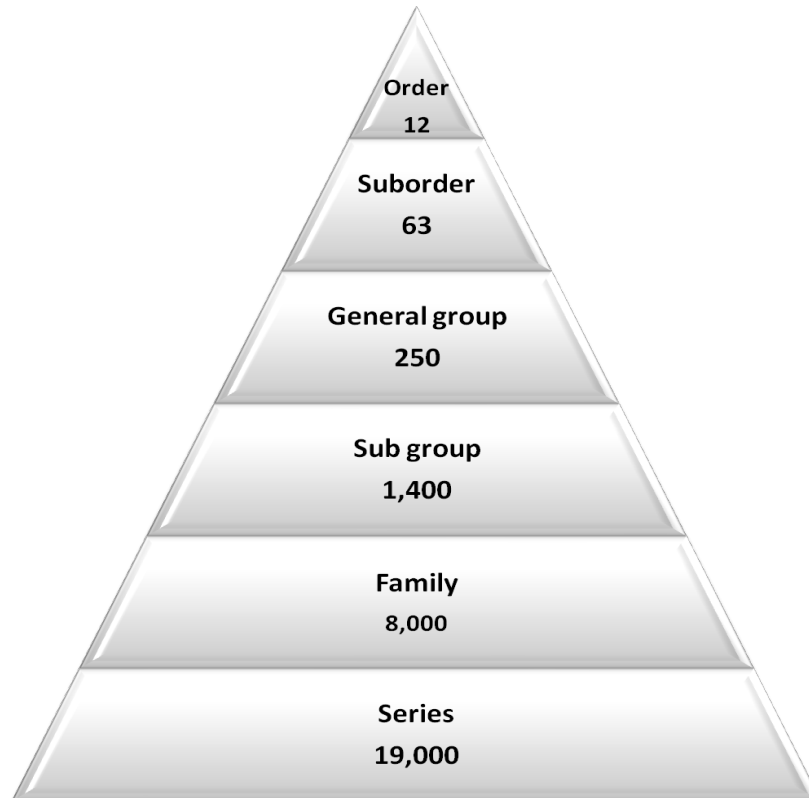
There are six hierarchal categories of classification in soil taxonomy:

- 1) Order, the highest (broadest) category
- 2) Suborder
- 3) Great group
- 4) Sub group

- 5) Family
- 6) Series, the most specific category

Although unfamiliar at first sight, the nomenclature system has a logical construction and conveys a great deal of information about the nature of the soils named.

USDA Soil Taxonomy Hierarchy (World)



Orders: Twelve soil orders are recognized worldwide. Among them only four orders are found in Pakistan. Differences among these orders reflect the dominant soil forming processes and the degree of soil formation. The names of the classification units are combination of syllables, most of which are derived from Latin or Greek. Since each part of a soil name conveys a concept of soil character or genesis, the name automatically describes the general kind of soil being classified.

Suborders: Each order is further divided into suborders primarily on the basis of properties that influence soil genesis.

Great groups: Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of soil horizons.

Sub groups: Great groups are further divided into sub groups to specify exclusive characteristics of individual soils.

Family: Families are established within a subgroup on the basis of properties and characteristics that affect soil management.

Series: The series consists of soils within a family that have horizons similar in color, texture, chemical reaction, consistence, mineral and chemical composition and arrangement in the profile.

The twelve Orders of soils are:

Soil Orders and their Description	
Soil Order	Description
Alfisols	Soils of deciduous forest with subsurface accumulation of clay
Andisols	Soils formed from volcanic material especially in areas of active volcanism
Aridisols (occur in Pakistan)	Soils formed in arid areas. Desert soils with less or no water for plants
Entisols (occur in Pakistan)	Soils with minimum evolution as in eroded or accumulation regions with no subsurface horizons
Gelisols (occur in Pakistan)	Permafrost (frozen soil) within the 100 centimeter from the surface
Histosols	Soils rich in organic matter generally in cold latitudes
Inceptisols (occur in Pakistan)	Soils with weakly developed subsurface horizons
Mollisols	Thick dark surface horizon. Soils of grasslands
Oxisols	Soils of tropical regions with deep and uniform profiles and are highly weathered
Spodosols	Soils of coniferous forest often acidic in nature
Ultisols	Extensively weathered soils with low fertility in sub surface
Vertisols	Shrinking and swelling clayey soils. They exhibit temporal variability in volume

On the basis of United States Department of Agriculture (USDA) classification, there are four major order of soils found in Pakistan. These orders are:

1. Aridisols (Dry Soils): Aridisols occupy a larger area globally than any other soil order except Entisols. Large portion of Pakistan's land is also covered by this soil. Water deficiency is a major characteristic of these soils. The soil moisture level is sufficiently

high to support plant growth for no longer than 90 consecutive days. The natural vegetation consists mainly of scattered desert shrubs and short bunchgrasses. Soil properties, especially in the surface horizons, may differ substantially between interspersed bare and vegetated areas. Aridisols are characterized by generally light colors and low organic matter content. Major sub orders of Aridisols in Pakistan are:

1. **Cryids**
2. **Salids**
3. **Durids**
4. **Gypsids**
5. **Argids**
6. **Calcids**
7. **Cambids**

In stony or gravelly Aridisols, erosion may remove all the fine particles from the surface layers, leaving behind a layer of wind-rounded pebbles that is known as desert pavement. Except where there is ground water or irrigation, the soil layers are only moist for short periods during the year. These short, moist periods may be sufficient for drought-adapted desert shrubs and annual plants, but not for conventional crop production. If ground water is present near the soil surface, soluble salts may accumulate in the upper horizons to levels that most crop plants cannot tolerate.

In Pakistan, Aridisols are widespread and are present in mostly desert and semi desert areas which include Tharparkar desert, Nara desert, Cholistan desert and Thal desert. These areas are mostly sandy with very low average annual rainfall. It has a low content of nitrogen and organic matter with very high calcium carbonate and phosphate, thus making it infertile. The amount of calcium is 10 times higher in the lower layer than in the topsoil. The availability of nitrogen in the form of nitrates, using fertilizer and proper irrigation, in addition to the already-present phosphates makes it useful in growing crops such as barley, rape, cotton, wheat, millets, maize, and pulses. The areas of Thal and Cholistan which are irrigated by canals are very productive in pulses and cotton. These areas include Minchanabad, Bhawalnagar, Fort Abbas, Dunga Bunga, Haveli Lakha, Yazman Mandi, Rahim Yar Khan, Mianwali, Bhakkar, Kalurkot, Mankera, Darya Khan etc. This soil is susceptible to wind erosion and supports a low density of population.

The main features of Aridisols in Pakistan that affect water and nutrient availability include texture, content of organic matter, pH, and orientation within the landscape. These soils show typically little development from parent material and some scientist's even state that typical developed soils do not exist in deserts. Another problem is limited leaching in Aridisols often results in one or more subsurface soil horizons in which suspended or dissolved minerals have been deposited: silicate clays, sodium, calcium carbonate, gypsum or soluble salts. These subsoil horizons can also be cemented by carbonates, gypsum or silica. Accumulation of salts on the surface can result in salinization due to which large parts of our cultivated land is becoming barren.

2. Entisols: These are soils which do not have any profile development other than A-Horizon. Entisols has no distinct horizons and most of these soils are basically unaltered from their parent material which can be unconsolidated rock or sediment. There may be many reasons of the absence of horizon development in Entisols. For example in some areas there may be rocks very resistant to weathering such as quartzite or ironstone. Cold and dry climates are also other causes which slow down the horizon development in Entisols.

Entisols are the second most abundant soil order (after Inceptisols), occupying about 16% of the global ice-free land area and in Pakistan they are the most abundant order found all over the country. The main sub orders of Entisols found in Pakistan are:

1. **Aquents**
2. **Fluvents**
3. **Orthents**
4. **Psamments**
5. **Wassents**

The productivity of Entisols are highly variable, depending upon the environmental conditions in which they exist. This is extremely diverse group of soils with little in common. Entisols are either young in years or their parent materials have not reacted to soil forming factors. Major area of Baluchistan Plateau is covered with Entisols. They are extremely dry areas where scarcity of water and vegetation may slow down soil formation. Some Entisols occur on steep slopes, where the rate of erosion may exceed the rate of soil formation, preventing horizon development as in case of Suleiman Mountains, Kirthar Mountains, Bannu and Waziristan Hills, Koh e Sufaid and Dir Mountains. In these rocky and mountainous regions, shallow medium textured Entisols (Orthents) are common. These support mostly rangeland in dry regions and forests in more humid areas. Sandy Entisols (Psamments) in the humid areas of Punjab plains are successfully used for citrus, vegetable and other crops. Poorly drained and seasonally flooded Entisols (Aquents) occur in major river valleys of Jhelum, Chenab, Sutlej, Ravi and Bias. (Fluvents) Entisols on recent alluvium in Pakistan have produced rice crops for generations.

The agricultural productivity of the Entisols varies greatly depending on their location and properties. Entisols developed on alluvial floodplains are among the world's most productive soils. Such soils with their level topography, proximity to water for irrigation and periodic nutrient replenishment by flood water sediments, have supported the development of many major civilizations in Upper and lower Indus Plains such as Mohenjo-Daro and Harappa.

Indus valley civilization agriculture was highly productive; after all, it was capable of generating surpluses sufficient to support tens of thousands of urban residents who were not primarily engaged in agriculture. Some of them undoubtedly made use of the fertile alluvial Entisols soils left by rivers after the flood season.

3. Inceptisols: In Inceptisols, the beginning or inception of profile development is evident. However the well defined profile characteristics of mature soils have not yet developed. Inceptisols show more significant profile development than Entisols. Inceptisols are widely distributed throughout the world.

In Pakistan they are present in many areas. As with Entisols, Inceptisols are found in most climatic and physiographic conditions. The suborders of Inceptisols in various types of climates are:

- i. Aquepts – with a water table close to the surface
- ii. Gelepts – in very cold climates, especially in glaciated areas of Gilgit-Baltistan and Chitral
- iii. Cryepts – in cold climates in Deosai plateau
- iv. Udepts – in humid climates
- v. Ustepts – in semiarid and sub-humid climates
- vi. Xerepts – in areas with very dry summers and moist winters in some parts of Baluchistan plateau and Potohar plateau.

In Pakistan Inceptisols are mostly common in mountainous areas of Indus Kohistan, Bajur agency, Mohmand agency, Malakand, Swat, Hazara, Dir, Chitral, in some parts of Gilgit-Baltistan, Baluchistan and Potohar Plateau.

The area of Potohar and Baluchistan Plateau is mostly dry in summers whereas in winters they receive rainfall. The suborder Xerepts are present in these areas. Dryland farming and dry farming agricultural techniques for the non-irrigated cultivation of crops are used in these areas. Dryland farming is associated with drylands, areas characterized by a cool wet season followed by a warm dry season. They are also associated with arid conditions, areas prone to drought and those having scarce water-resources. Crops are cultivated during the subsequent dry season, using practices that make use of the stored moisture in the soil.

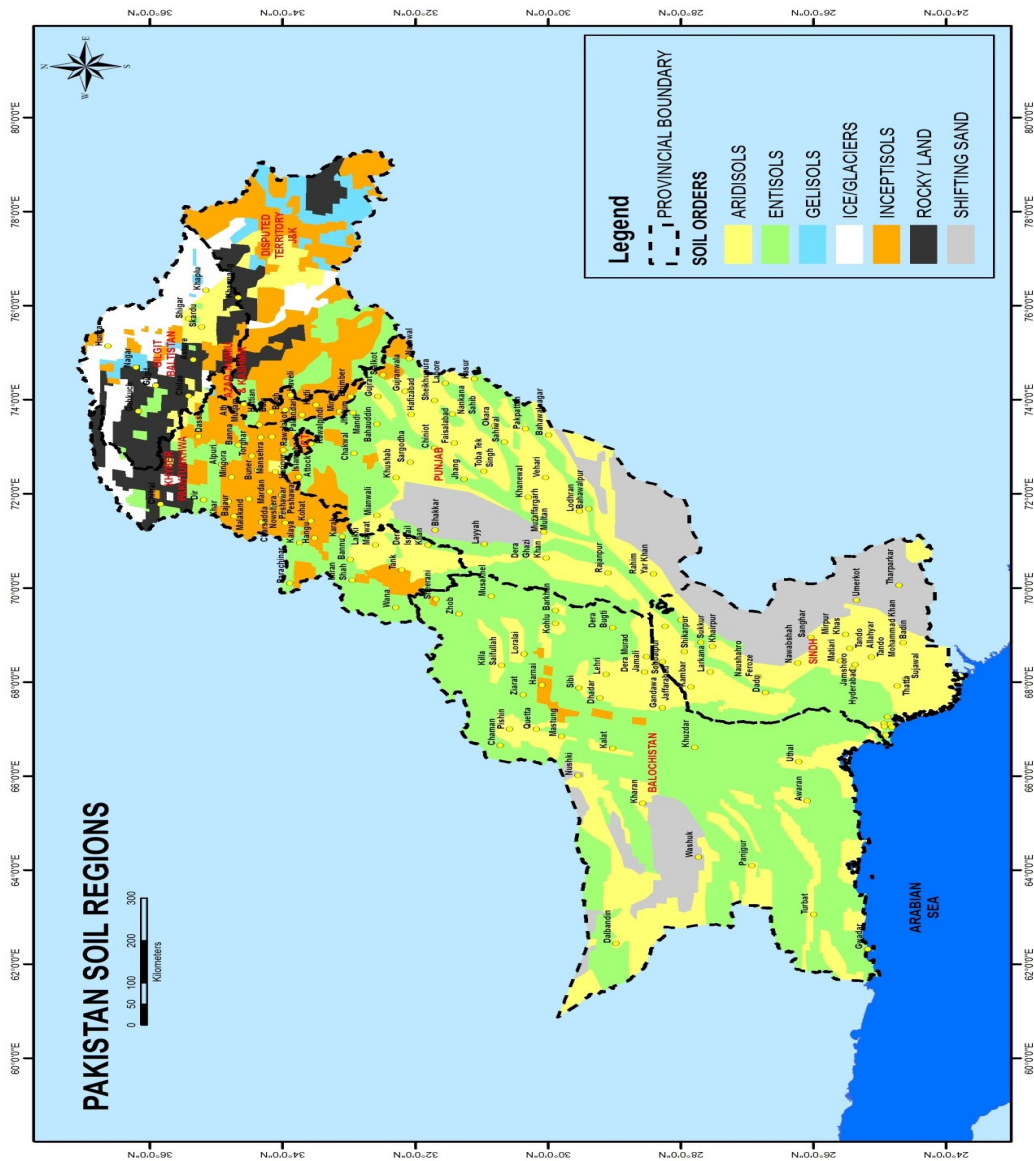
Dry farming depends on making the best use of the "bank" of soil moisture that was created by winter rainfall. Some dry farming practices include:

- Wider than normal spacing, to provide a larger bank of moisture for each plant.
- Minimal tilling of land.
- Strict weed control, to ensure that weeds do not consume soil moisture needed by the cultivated plants.
- Selection of crops and cultivars suited for dry farming practices.

3. Gelisols: Gelisols are the soils of very cold climates. Despite the influence of glaciations in most areas where Gelisols occur, chemically they are not highly fertile because nutrients, especially calcium and potassium, are very easily leached above the permafrost. The permafrost greatly restricts the engineering use of Gelisols, as large structures (e.g. buildings) subside as the frozen earth thaws when they are put in place. In Pakistan their extent is very limited. They only exist in alpine areas or near glaciers. Actually they are soils of permafrost region and have three suborders named as:

1. Histels
2. Turbels
3. Orthels

In Pakistan no true permafrost is present in glaciated regions so only one suborder, Orthels are present in Gilgit-Baltistan and Chitral. Orthels are that suborder of Gelisols that show little or no cryoturbation (less than one-third of the depth of the active layer). Patterned ground (except for polygons) generally is lacking. Orthels occur primarily within the zone of discontinuous permafrost, and in alpine areas. Deosai, Shandur, and other high altitude areas are best examples from Pakistan.

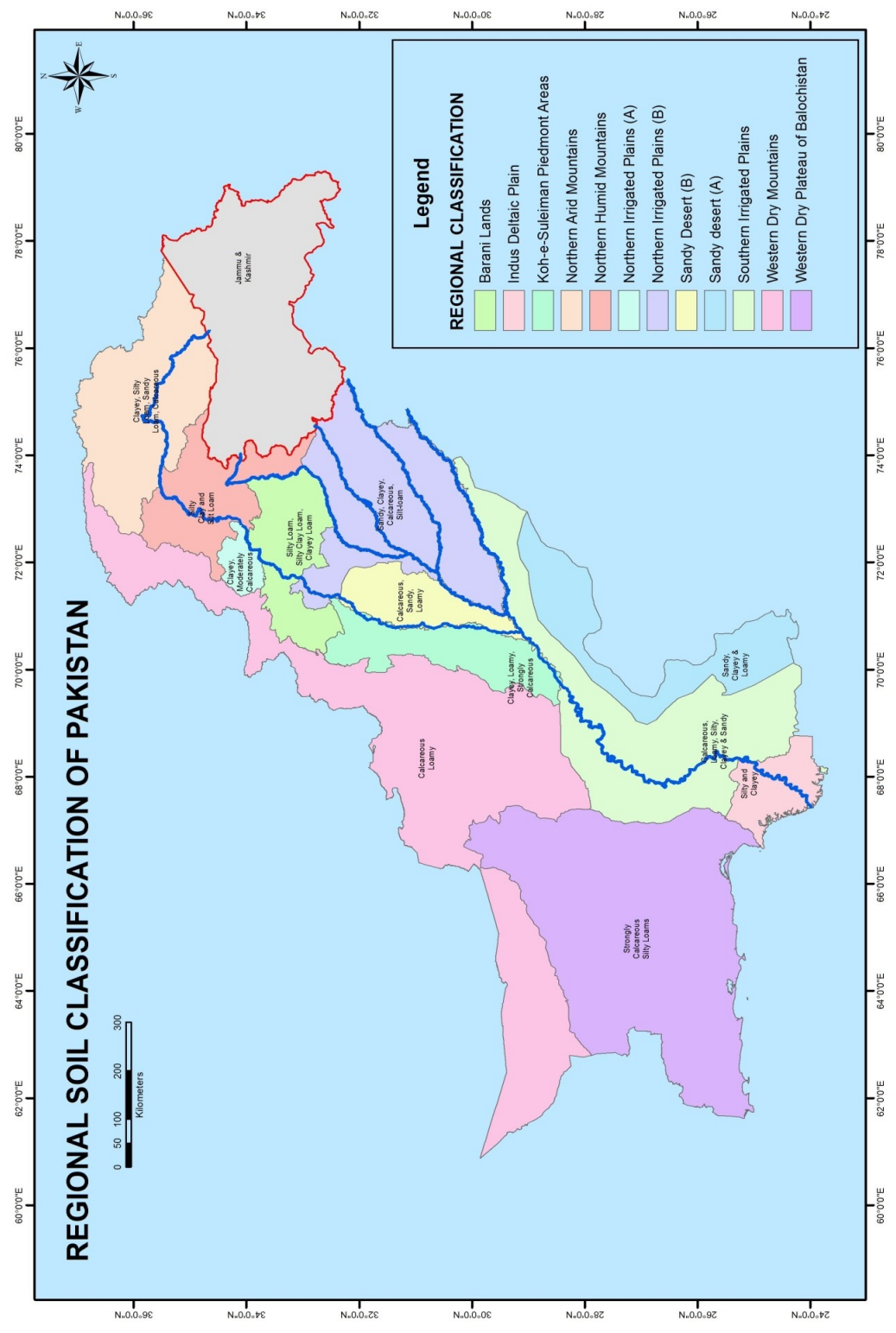


On the basis of Pakistan's physiographic and ecological zones we can divide Pakistan's soils into following twelve categories. But keep one thing in mind that this is not a scientific classification of soil; rather it is based on observed physical feature characteristics and factors of soil formation in these areas which vary from place to place. In this classification mostly textural properties of soil are undertaken.

Serial No.	Name of Region	Geographical Extent	Type of Soil	Major Crops
01.	Northern humid mountains	Haripur, Abbottabad, Mansehra, Shinkhari, Battal, Batagram, Allai, Hazara, Kohistan	Silty clay and Silt loam	Wheat, Rice, Maize, Apples, Citrus, Walnuts
02.	Northern arid mountains	Gilgit, Skardu, Khaplu, Shigar, Kharmang, Hunza, Astore, Yasin, Gupis, Ghakuch, Ishkoman, Nagar, Upper and Lower Dir, Chitral and FATA	Clayey, Silty loam, Sandy loam, Calcareous at low altitude and Non Calcareous and acidic soils above 2100 meters	Wheat, rice, maize, Buck Wheat
03.	Western dry mountains	Tank, Takht e Nasrati, Pezu, Zhob, Kalat, Loralai, Sibi, Pishin, Quetta, Kachhi, Qila AbdULLAH, Bolan, Nasirabad, Kohlu, Jaffarabad, Bolan, Jhalmagsi, Ziarat, Barkhan, Musa Khel, Qila SaifULLAH, Mastung, Dera Bugti	Calcareous Loamy	Grapes, Apricots, Plums, Peaches, Apples, Maize, Wheat
04.	Western dry plateau of Baluchistan	Lasbella, Chaghi, Awaran, Kharan, Turbat, Makran, Khuzdar, Gawadar, Panjgor, Jewani	Strongly Calcareous Silty loams	Sorghum, Millet, Wheat, Melons
05.	Koh-e-Suleiman piedmont areas	Rajanpur, Dera Ismail Khan, Dera Ghazi Khan, Jampur, Dajal, Sakhi Sarwar, Fazilpur, Kulachi, Garwaki, Taunsa	Clayey, loamy, Strongly Calcareous	Rice, Mustard, Gram, Millet, Wheat, Sorghum
06.	Barani lands	Bannu, Miran Shah, Mianwali, Kalabagh, Kundian, Attock, Rawalpindi, Jhelum, Mandi Bahauddin, Lakkhi Marwat, Islamabad, Bhakkar, , Gujjar Khan, Pind Dadan Khan, Sohawa, Chakwal	Silty loam, Silty clay loam, Clayey loam	Wheat, Peanuts, Millet, Maize, Rice, Oilseeds, Pulses, Fodder crops, Olives, Sun Flower

Serial No.	Name of Region	Geographical Extent	Type of Soil	Major Crops
07.	Northern irrigated plains (A)	Peshawar, Mardan, Charsadda, Nowshera, Swabi, Pabbi, Cherat, Rustam, Katlang. Takht Bhai	Clayey, Moderately Calcareous	Berseem, Groundnut, Sugar beet, Pears, Plum, Sugarcane, Maize, Gram, Tobacco, Wheat, Millet

08.	Northern irrigated plains (B)	Okara, Lahore, Kasur, Toba Tek Singh, Faisalabad, Jhang, Sheikhpura, Gujranwala, Hafizabad, Bahawalnagar, Multan, Khanewal,, Lodhran, Vehari, Sahiwal, Pakpattan, Mailsi, Buray Wala, Depalpur, Haveli Lakha	Sandy, Clayey, Calcareous, Silt-loam	Citrus, Mango, Melons, Oilseeds, Millet, Sugarcane, Maize, Wheat, Cotton
09.	Southern irrigated plains	Khanpur, Kashmore, Noshehro Feroz, Hyderabad, Sanghar, Dadu, Khairpur, Larkana, Sukkur, R.Y. Khan, Shikarpur, Jacobabad, Mirpur Khas, Tando ALLAH Yar	Calcareous, Loamy, Silty, Clayey and Sandy	Cotton, Wheat, Rice, Dates, Bananas, Sugarcane, Mustard, Sorghum, Berseem
10.	Indus deltaic plain	Badin, Thatta, Diplo, Dhabeji, Noukot, Mitthi, Tando Bago, Tando Muhammad Khan, Jhuddo, Digri, Kot Ghulam Muhammad	Silty and Clayey	Rice, Pulses, Sugarcane, Berseem, Bananas
11.	Sandy desert (A)	Tharparkar, Nawabshah, Bahawalpur, NoderoFeroz, Mirpur Khas, Cholistan, Yazman	Sandy, Clayey and Loamy	Guar, Millet, Wheat, Castor
12.	Sandy desert (B)	Muzaffargarh, Layyah, Sargodha, Khushab, Kalur Kot, Chowk Azam, Darya Khan, Karor Lal Esan, Kot Addu, Taunsa, Kot Sultan, Mankera, Bhakkar	Calcareous, Sandy, Loamy	Gram, Wheat, Cotton, Guar, Sugarcane, Millet, Pulses



Another very general classification of Pakistani soils are based on regional classification. On regional basis we can divide them as:

A. Indus Basin Soils

The Indus plain is included among the biggest plains of the world. Most part of this plain is made with the deposition of alluvium by the Indus River and its tributaries for thousands of years. These soils are less in organic matter and have more calcium carbonate content in them. These soils are divided into three main categories.

1. **Bongar Soils:** Large part of Indus plain is covered with the thick deposits of Bongar soil. The area includes most of the part of Punjab, Peshawar, Mardan, Charsadda, Bannu and Kachhi plain. A major part of the province of Sindh is also comprised of these soils. These soils are very fertile and rich when properly irrigated and every year gives a huge agricultural production to our economy. As these soils are deposited near the old beds of the rivers so they are very far away from the present rivers beds.
2. **Khaddar Soils:** Khaddar is a new or younger deposit of alluvial soil on the active flood plains of the Indus and its tributaries. So every year new layer of alluvial clay is deposited. These soils have low content of organic matter and salt and are more fertile and productive than Bongar soils.
3. **Indus Delta Soils:** These soils cover the river Indus Delta. Their extent is from Hyderabad to the southern coastal area. Large part of the soil of Indus delta is alluvial clay. Rice is a major crop cultivated in these soils.

B. Mountain Soils

These soils mostly cover the highlands of northern and western areas of Pakistan. The soils of northern mountainous areas which are humid have high content of organic matters. Whereas the soils of western mountainous areas have high content of calcium carbonate and low content of organic matter because the climate of these areas is arid and semi-arid. The soils of Potohar plateau have high lime content. They are productive when plenty of water is available. In Potohar mostly dry farming is practiced.

C. Sandy Desert Soils

These soils cover the western areas of Balochistan, Cholistan and the desert of Thar and Thal in Pakistan. They are formed by layers of sand particles. Desert soil is mostly sandy (90–95%) found in low-rainfall regions. It has a low content of nitrogen and organic matter with very high calcium carbonate and phosphate, thus making it infertile. This soil is susceptible to wind erosion and supports a low density of population.

5.3 Soil Erosion in Pakistan

Soil erosion in Pakistan is becoming an increasingly bigger problem. One of the main causes for this erosion is the overgrazing of land, as well as deforestation and poor water management. This erosion results in a decline of soil fertility making it very hard to grow crops in various areas of Pakistan. Wind and water erosion is affecting over 76% of Pakistan and every year the country losing a billion tons of soil that is being dumped into

the Arabian Sea. This erosion primarily takes place in the summer due to the heavy downpours that exist during Monsoon season. There is particular concern over the soil erosion in the river Chenab basin. This river has eroded over 12,000 acres of agricultural land and is affecting more and more villages in many areas of Punjab.

Part of the reason for the mass erosion of Pakistan's soil is from the deforestation of the country. Pakistan only has a 2.2% forest cover compared to the 25% that is considered acceptable. This is taking moisture from the land held by trees and not allowing organic matter to continue to decompose. These trees are being cut down for families to use them as fire wood and are being done in a way that does not promote sustainable use. Pakistan is considered second in the world for highest forest degradation which could lead to the complete destruction of the agricultural economy.

We can control soil erosion in Pakistan by adopting following techniques:

1. Crop rotation
2. Conservation tillage
3. Contour plowing
4. Cover crops
5. Level spreaders
6. Mulching
7. Perennial crops
8. Reforestation
9. Riparian buffer
10. Riprap
11. Strip farming
12. Sand fence
13. Terracing
14. Wattle construction
15. Wind breaks
16. Hydroseeding
17. Gabions

Self Assessment Questions

1. What do you know about the soils of Pakistan? Discuss.
2. Keeping in view the cultivation of crops, discuss the classification of soils in detail.
3. Elaborate the Soil Orders and their description.
4. Soil erosion in Pakistan has become an increasingly bigger problem. Discuss.

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Unit-6

AGRICULTURE-I (GENERAL)

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Reviewed by: Dr. Khalid Mahmood

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Introduction

Agriculture is the main sector of Pakistan's economy. It actually acts like backbone of Pakistan's economy. It contributes almost around 20.8% of the GDP of Pakistan. Around 63% of our population is living in agriculture sector and they are directly or indirectly relying on the agriculture sector. Almost 47% of the total labour force of Pakistan is engaged in this sector. We are not an economy relying on industries but the industries we have are mainly agro-based industries which are dependent on the production of agriculture sector. So if due to any reason like natural climatic changes for example, if there is reduction in agriculture production then there would be a direct impact on industrial sector and economy will have a dual negative impact.

Although Agriculture is the main sector of Pakistan's economy but due to different reasons many times we were unable to satisfy our own requirements. So, in that case we had to import from different other countries which impact badly our Balance of Payment and our Foreign Exchange Reserves.

Objectives

After reading this unit, you will be able:

1. to clear the importance of agriculture and its role in the economic development of Pakistan.
2. to develop your understanding about the problems and issues regarding the agriculture sector of Pakistan.
3. to learn about the solutions of the agriculture sector of Pakistan.

6.1 Importance of Agriculture Sector

The agriculture sector of Pakistan has great importance in the country due to various reasons. Some of the vital aspects of this sector are discussed below.

6.1.1 Availability of Food

Agriculture sector is very important in making available of the food items to the general public. Pakistan is the 6th biggest country in the world on the bases of population and its population is rising at the rate of around 1.94% annually. According to recent studies of the UN Pakistan's population is 2.81% of the world population. So, its agriculture sector which is serving as the last resort. It provides wheat, rice, vegetables, edible oils etc to the general public. Whenever due to any crises agriculture sector lacks in providing food items then there is an additive burden on the import bill of Pakistan and Balance of Payment become more deficits.

6.1.2 Major Contribution to GDP

Pakistan is an agrarian country so agriculture is the main sector of the Pakistan's economy and economy's growth is directly or indirectly dependent at the growth rate of this sector. Agriculture sector according to the recent statistics of Pakistan Bureau of Statistics contributing almost around 24 % of the GDP of Pakistan.

6.1.3 Provides Raw Material

Pakistan because an agriculture country so, its industries are mainly Agro-based industries which are completely dependent at the production of agriculture sector because it provide raw material to its main industries.

In case there is any climatic change it will negatively affect agriculture production then there would be negative effect at the industrial production also. Because if there is less cotton, wheat, sugarcane production then automatically there would be less production of cotton industry, flour mills, Sugar industry.

6.1.4 Helps in Industrial Development

On the one side agriculture sector is providing raw material to industrial sector and helps in its development and on the other side agriculture sector is having excessive labour force which is not needed actually and marginal productivity of the labour decline with the each additional unit employed. So, agriculture sector provides sufficient amount of labour to the industry that also helps to develop it.

6.1.5 Foreign Exchange Earnings

Agriculture sector is the main source of foreign exchange earnings of Pakistan, which is utilized for the import of machinery, technology products, and all other goods which are not produced in the country. In this way it helps to manage foreign exchange earnings on the one side and on the other side it helps to improve balance of payment of the country.

6.1.6 Helps in Extending Markets

The existence of agriculture sector becomes helpful in the extension of markets. The expanding agriculture sector means income of the farmer is increasing.

That income will be spent to satisfy basic needs, comforts and on luxuries like tv, cars, houses etc. It increases the consumption of industrial goods that will push industrialist to produce more that will increase their income, overall employment, profitability etc. So, automatically markets will be extended.

6.1.7 Helps to Reduce Unemployment

Pakistan is basically an agrarian country which have very limited base of industries so, agriculture sector serves as the big source of employment. Pakistan is predominantly a rural country with almost 63 % of the population living in rural areas and this is the main reason that around 50 % of the total labour force of Pakistan is engaged in this sector. Due to the fact that agriculture sector still running on the basis of primitive production techniques so, to get employment in this sector you don't need to have latest skills. Even an un-educated person can easily adjust in this sector.

6.1.8 Helps to Reduce Rural Urban Gap

Agriculture sector development is also very important in reducing gap between rural and urban areas of the country. Because if there is agricultural development then that will increase the income of agriculturists so, they will spend more on the improvement of living standard. And because of agriculture development more and more agro-based industries would be setup near rural areas which also helps to develop rural areas and that plays a vital role in reducing gap between rural and urban areas.

6.1.9 Plays its Role in the Process of Capital Formation

Agriculture sector development helps to increase the income of agriculturist and that will promote savings in the rural areas of the country. More the savings there will be more investment .So, the process of capital formation in the country increases because of the development in the agriculture sector. And that capital formation process plays a very important part in the overall economic development of any country. So, the funds provided through the savings of agriculturists are given by the institutions to the industrial sector and in that way industrial sector also develop.

Self Assessment Questions

1. On the bases of population what is the ranking of Pakistan in the World.
2. How much is agriculture sector contributing to the GDP?
3. How the production of industries decline because of agriculture sector?
4. Agriculture sector is very important for the management of Foreign exchange reserves. Why?
5. Explain how agriculture sector of Pakistan can help to reduce unemployment problem in Pakistan.

6.2 Problems of Agriculture Sector of Pakistan

Pakistan is included the third world countries and the agriculture sector of Pakistan has been facing a number of issues like other sectors i.e. transport sector, power sector and education sector etc. Some of the chief problems faced by the agriculture sector of Pakistan are briefly discussed below.

6.2.1 Shortage of Capital

This is the first and a very important factor which plays a very negative role in the way of agriculture sector development. Farmers are having low income so, they hardly meet their basic requirements and nothing is left as savings with them. Because there is shortage of capital so, they cannot purchase improved seeds, fertilizer, pesticides and modern machineries for the cultivation of land.

They are unable to improve health of their animals, they cannot install tube-wells for the irrigation. Absence of these factors causes a decline in the agriculture production and it seems that there is no or very less chances of improvement in the near future.

6.2.2 Water Logging and Salinity

Pakistan's agriculture sector is facing another big issue of water logging and salinity due to which large area of land is becoming uncultivable. When the underground water level is up near the surface or appears on the land this is water logging and when there is increase in the salt presence in the ground that is salinity, both are dangerous and a big hurdle in the way of agriculture development. According to an estimate, about 15 lac acres of cultivable land has been destroyed and 1 lac acre of land is decreasing its productive capacity every year due to water logging and salinity.

6.2.3 Uneconomic Land Distribution

Due to inherited system of land distribution in Pakistan, land is divided into small pieces to distribute among the children's of the family. So, they become very un-economic to use for cultivation or for any other agriculture activity. On the one side they are very small on the other they are scattered at different places. So, for a farmer it becomes very difficult to use any modern technique of production. According to a statistics around 35% of farmers are holding only 12 to 25 acres of land and 15% landlords had 50 to 150 acres of land. And those landlords are least interested to use their complete land holdings for agriculture production because they have many other businesses to earn money.

6.2.4 Under-utilization of Land

Total area of Pakistan is comprised of 80 million hectares out of which 21.17 hectares is cultivable which is just 26% of the total area. Therefore, there is huge wastage of cultivable land that is not brought under cultivation due to many reasons like lack of capital, lack of water supply etc.

Efforts are being made to bring more and more area of land under cultivation but they are not enough to increase agriculture production and to meet our increasing food requirements.

6.2.5 Natural Calamities

In Pakistan due to heavy rain, drought and Floods every year millions of acres of crops are destroyed. Floods also destroyed the fertility of land because upper most surface of fertile land is washed away and it takes big time to recover back at the same condition. According to an estimate approximately 2 million acres of fertile land have been destroyed by these floods.

6.2.6 Scarcity of Irrigated Land

In Pakistan almost 2/3 of the area is Barani area which is completely dependent on the rains for irrigation and if there is no timely rain then it effects agriculture production adversely. Scarcity of irrigation water causes a serious limitation in the expansion of crop areas in Pakistan. The availability of water has to be increased by construction of small dams, installation of tube wells etc for raising the level of output in the agriculture sector of Pakistan.

6.2.7 Use of Primitive Methods of Production

According to recent research Agriculture sector of Pakistan is still relying on the primitive methods of cultivation and there is very less use of technology in it. According to a recent research modern techniques like chemical fertilizer, improved seeds, pesticides and mechanical equipment are necessary to improve the productivity of land. But in Pakistan because of weak purchasing power Farmers can't afford such expensive tools and techniques. On the other hand the supply of these inputs is inadequate, irregular and very expensive beyond the reach of a common farmer. This all causes a very negative impact at the agricultural productivity.

6.2.8 Illiteracy

The farmers, labourers and tenants in Pakistan are illiterate. They are not fully aware of their land capabilities and about latest techniques of production used in the world to increase per acre yield of the agriculture sector. They mostly rely on their fate and never try to increase production by different methods. On the other side there is very weak health of farmers due to unhygienic living conditions and substandard food. Therefore their physical capabilities are very low to perform efficiently in the production process.

6.2.9 Non-availability of Agriculture Credit

A large number of farmers in the villages own small units of cultivable land. The farmers having less than 4 acres of land are 25% of the total farmers. Authorities never focused on these farmers, most of the chunk of total agriculture credit is given to big landlord who are least concern about production activities they mostly used them on the non-productive activities having no value for the country.

On the other side access of agriculture credit is not easy for small agriculturists because of heavy documentation and requirements of collateral by the authorities. So, small farmers can't arrange those requirements and not able to receive the credit.

6.2.10 Feudalism

Feudal system in the country is also a very big hurdle in the way of agriculture development in Pakistan. Thousands of acres of land is owned by very a few landlords and they are living far away of the develop areas of the country. They are least concern about bringing more and more area under cultivation and also many of them having very in human behavior with their workers. So, due to that reason neither landlord nor tenant is interested to increase the per acre yield of the land.

6.2.11 Political Instability

Political instability is also a very big problem of Agriculture sector of Pakistan in the way of development. Because of Political instability there is lack of uniformity in the policies of the government to improve agriculture sector of the country. Unfortunately political system of Pakistan instable from many years that causes instability of agriculture development policies and also investor never likes to invest in that condition because of the high risks involved.

6.2.12 Lack of Agro-based Industries Near Rural Areas

Pakistan is basically agrarian country with industries mainly consists of agro-based industries but the real problem is that they are very less in numbers on the one side and on the other that they are not very close to rural areas. Mostly they are near urban areas, so it becomes very difficult for the farmers to reach those industries with their production in time. This situation helps middle man to get reward out of it and no benefit is given to the farmers. That adversely affects the productive capacity of the agriculturist.

6.2.13 Lack of Transportation and Communication

Pakistan also lack very much in its communication network and transportation system to the far areas of the country. So, because of this it becomes difficult for the farmer to reach agriculture markets. Due to this reason they sell their products to the nearest markets which never gave them the due reward so income of the farmer never increases. And that impact negatively at the productive capacity of the farmer. So, Farmer becomes least interested in more and more production.

6.2.14 Lack of Cold-Stores and Warehouses

Farmer is very uncertain about the outcomes of the productive activities he is doing because of uncertainty of weather, availability of water, seeds and fertilizers etc. Because of weak purchasing power they are not able to construct warehouses and cold-stores and they can't afford to use some private facility due to high cost. So, they store with in the houses where there are multiple issues affecting like temperature, rats etc.

6.2.15 Inadequate Public Policy and Agricultural Research

Although we are dependent on the agriculture sector as it is the chief organ to generate our economy; however, public policies mainly focused at the industrial sector only. Governmental policies of giving farm credit, financing for the best seeds and fertilizer, awami tractors scheme etc. never reach poor farmers only big landlords are benefitted by these policies. In spite of a lot of agriculture colleges, universities and institutions, the level of agriculture research has always been very poor. We are unable to solve our problems and not being able to compete the agriculture research centers working internationally.

Self Assessment Questions

1. What is the first and basic problem of the agriculture sector of Pakistan?
2. According to an estimate how much area of the fertile land is destroyed by the Floods?
3. Why 1 lac acre of our cultivable land is decreasing its productivity every year?
4. Why lack of transportation and communication is considered as a big hurdle in agriculture development?
5. Why government is failed to make any beneficial policy for the agriculture sector?

6.3 Solution to the Problems of Agriculture Sector of Pakistan

We have discussed a number of issues regarding the agriculture sector of Pakistan in the above lines. The governments had been launching different agricultural policies time to time. Some recommendations are being discussed in the following paragraphs to solve the problem of the agriculture sector of Pakistan.

6.3.1 Supply of Agriculture Credit

The farmers in Pakistan due to low income cannot afford to buy expensive tools and technology for production, so supply of agriculture credit on easy terms and conditions is very necessary. Because you can't purchase best variety of seeds, pesticides, fertilizer and other agriculture equipment without huge amount of capital so agriculture credit is necessary in this regard.

For this Purpose government established Zarai Traqiati Bank Limited (ZTBL) which is actually a transformation of Agriculture Development Bank established in 1961. Its main purpose is to provide with small, medium and long term loans to the farmers and to support them to increase agriculture production. ZTBL is having Mobile Credit Officers (MCO) who reaches the farmers at their door step.

6.3.2 Measures to Control Water Logging and Salinity

Reclamation of land is necessary to increase the agricultural productivity and to increase the per acre yield of this sector. Millions of acres are destroyed by the water logging and salinity especially of the lands in Punjab and Sindh, steps and measures of reclamation are required. For this purpose installation of tube-wells, repair of canal banks and drainage of water etc. are needed. The SCARP (Salinity control and reclamation project) is run by the WAPDA on the proposal of government of Pakistan to solve this matter.

6.3.3 Flood Control Measures

Floods are caused by heavy rains and that not only destroys the crops but also destroy the fertility of land. In Pakistan floods are not only caused by the heavy rains in the country but they are also caused by the rains in the Indian occupied Kashmir, so our authorities need to keep an eye on both sides of the border. Plantation is very necessary to preserve fertility of land and more number of small dams should be constructed to reduce the impact of floods. We need to develop our meteorological department according to the needs of the time so that we can predict these disasters right before the time.

6.3.4 Land Management

Proper land management system should be use in the country to enhance the agricultural production. A system should be introduce by which small land holders with small parts of the land scattered at different places can consolidate the land at one place. That will help them to work effectively and efficiently, because advance techniques of production work more properly when pieces of land are large in size.

6.3.5 Better Irrigation Facilities

Agriculture production depends mainly on the irrigation facility a country has. In Pakistan 2/3 of the total cultivable land depends on the rains for the irrigation and remaining area is irrigated by canals and tube wells. Large quantity of water is wasted due to these different methods used less efficiently.

Government of Pakistan is focusing on the rehabilitation of canals and *rajbahs (nalas)* to save water from being wasted. The work is in process in Punjab and Sindh. Government is also providing subsidies to the tube well owners and also provides credit for the installation of tube wells.

6.3.6 Provision of Improved Seeds

Mostly in Pakistan farmers use very low quality of seeds which they stored in their homes, because of this reason productivity of land becomes very low. If timely information is provided to the farmer and also improved quality of research seed is provided then it will help to increase the per acre yield in agriculture sector. According to a study 20% of the total yearly productivity can be increased if better quality of seed is provided regularly to the farmers.

6.3.7 Use of Fertilizer

In Pakistan still farmers are using old methods of cultivation, in which no or very low amount of fertilizer is used to enhance the agriculture production. Cow dung was used in rural areas now people use it as fuel. So, supply of more and more chemical fertilizer is necessary to increase the production level for this government must provide subsidy to the poor farmer because he is having low income and he can't afford to buy best quality of chemical fertilizer.

6.3.8 Price Support Policy

Support prices provide healthy working condition for a common small farmer because government is ensuring a specific payment of the efforts he made. Support prices announced well before the season of farming actually ensuring farmers a minimum guaranteed price of his production. The agriculture Price Commission (APC) recommends price policies for the important crops every year. These crops include cotton, wheat, rice, sugarcane, grains, onion, potato etc. If there is increase in cost of production then Support Prices are increased by the commission.

6.3.9 Mechanization in Agriculture Sector

In Pakistan we need to increase the usage of mechanized methods of sowing, cultivation and harvesting to increase the agriculture productivity of the sector. Mechanization helps in managing crops during very short period of time; it also helps to reduce the losses of farmer community due to different reasons. Working capacity of machines is far better than the old methods of production; the uncultivated barren areas can be brought under cultivation by using machines that reduces the cost also.

Mechanized work is carried out mainly with machines like combined harvesters, reapers, threshers, power tillers, tractors etc. Bulldozers can be used for the land development and reclamation of the cultivable waste land. In the recent past government took a number of different measures to promote mechanization in the agriculture sector through governmental and private institutions.

6.3.10 Agriculture Research Centers

Agriculture education and research is necessary to increase the agriculture activities in the country and also to increase agriculture productivity. For this purpose there are different agriculture universities in different parts of the country providing continuous help to the agriculture sector in performing different economic activities efficiently and effectively. In service training is also provided to the staff of agriculture department of all the provinces at various agricultural institutions.

Pakistan Agriculture Research Council (PARC) is the main organization which has carried agriculture research in the fields of crops, vegetables, fruits, tea, animal diseases etc.

6.3.11 Agricultural Marketing

Regulation and organization of agricultural markets is very necessary to protect the interest of growers and consumers. Agriculture marketing and storage limited(AMSL) and Pakistan Agricultural Storage and Service Corporation(PASSCO) have been established to procure the products from the growers at the prices fixed by the government and also to stabilize the prices within the country.

Role of middle man should be eliminated or at least reduced to the maximum extent that will help to improve the income level of real farmer. Means of transportation must be easily provided to the farmer and a valid weight and measure policy should be adopted. An environment should be established which attract the farmer to produce more and more.

Self Assessment Questions

1. What are the steps taken by the government to solve the capital deficiency problem in agriculture sector?
2. What is the primary function of AMSL and PASSCO?
3. How mechanization helps to increase the production of agriculture sector.
4. Why governments fix support prices?
5. How to control floods, water-logging and salinity for agriculture sector development.

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Unit-7

**AGRICULTURE-II
(PRODUCTION)**

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Introduction

Agriculture is an important sector of Pakistan's economy as it is considered as the backbone of its economic structure. Our country relies heavily on its production i.e. crops. Country's population is directly supported by this sector. It contributes 26% to its GDP. Pakistan holds one of the largest irrigation systems which heavily support production in Pakistan. In order to improve production in Pakistan, the resources must be fully utilized mainly land and water, but this alteration mainly depends upon big land holders because 40% of the arable land has been owned by them hence they control most of the irrigation system thus stopping any rapid and frequent agricultural reforms.

One must conclude that this sector plays a central role and out of the total population, 42.3% people has been absorbed by the sector. Agriculture is a key source of foreign exchange earnings. With passage of time, population is increasing day by day thus demanding government to take suitable measures for better annual production in the country. The performance during 2017- 2018 showed a remarkable growth of 3.8%. This was done with the help of supportive government policies, availability of better certified seeds, pesticides etc. The crop sector recorded a growth rate of 3.83% as compared 0.91% in the last year. Agricultural development also raises the contribution for industrial development.

Objectives

After studying this Unit, you would be able to know about:

1. the importance of agriculture sector of Pakistan;
2. the division of crops according to season;
3. the standard physical conditions for the growth of these crops;
4. the regions producing these crops
5. the difference between cash crops (non-food crops) and food crops; and
6. the benefits of different fruits and vegetables in our daily life.

7.1 Crops in Pakistan

Pakistan has variety of landforms and climate therefore we experience two seasons for cropping i.e. summer and winter. They are also known as Rabi and Kharif crops. Rabi crops are usually called as winter crops whereas Kharif as summer crops.

7.2 Rabi / Winter Crops

These crops are sown in October and November (after monsoon rainy seasons and start of winter) and are usually harvested in spring (March to May). Common examples of Rabi crops are wheat, barley, grains, oilseeds etc.

7.3 Kharif/ Summer Crops

“Kharif” is a Arabic word for autumn since the season coincides with the beginning of autumn or winter. These crops are also known as monsoon crops.

Kharif crops are sown in Spring Season i.e. from February to May and harvested in the Winter. Harvesting has done in the beginning or during the Winter season hence further classified into Zaid Rabi and Zaid Kharif crops. This is mostly done in the region of Punjab and Sindh. Common examples of Kharif crops are cotton, maize, millets (jawar and bajra), sugarcane, rice etc.

Zaid Crops

There is also a short season between season of Kharif and Rabi in the months between March to July. The crops that cultivated in this season are Zaid crops. These crops are grown on irrigated land. The characteristic of these crops is they don't have to wait for monsoons. They require warm and dry weather for growth and longer day length for flowering,

Some examples of Zaid types of crops are pumpkin, cucumber, bitter gourd and Brassica Compestris. Brassica Compestris is usually called as Indian Rape or Mustard plant.

Rabi crops are further divided into Zaid- Rabi and Zaid-Kharif crop. Zaid- Rabi are the crops that are harvested a little after the end of Rabi season and Zaid-Kharif crops are harvested a little after the end of Kharif season.

7.4 Division of Crops

The principal crops of Pakistan are usually divided into three categories:

- a. Food Crops (Wheat, Maize, Rice, Millets and Pulses etc.)
- b. Cash Crops (Sugarcane, Tobacco, Cotton, Jute and Oilseeds etc.)
- c. Plantation Crops (Coffee, Coconut, Tea, and Rubber etc.)

7.5 Food Crops

These are plants which are intentionally grown with the primary purpose of being eaten by humans or animals. Important food crops of Pakistan are wheat, rice and maize whereas barley and millet are considered as minor food crops.

7.6 Non-Food/Cash Crops

These are the crops that are grown to earn profit by selling them in market place or with individual's agro-based industries. Important Cash crops in Pakistan are sugarcane, cotton, jute, sugar beet, groundnut and tobacco etc.

Self Assessment Questions

1. Keeping in view the importance of agriculture sector in Pakistan, discuss the division of crops according to different seasons.
2. What do you know about the cash crops of Pakistan? Discuss in detail.
3. What are Zaid crops and do you understand the difference between Zaid-Kharif and Zaid Rabi crops?

7.7 Food Crops

Some important food crops of Pakistan are being discussed in the following lines.

Wheat (Rabi Crop)

Wheat is the staple food/diet of the country. Pakistan holds fourth position in Asia whereas ranks tenth in the world in the production of wheat. It contributes 2.9% to the GDP. It has cold tolerance therefore grown as a long duration Winter crop. Wheat is a tall plant having average height of 1.2m (4 feet). Wheat is used in the manufacture of flour, production of breakfast foods and a feed for livestock. It has mainly three parts i.e. Bran, Endosperm and Germ. The outer shell that is hard is called as Bran which contains minerals, fibres and antioxidants. Endosperm is its middle layer which is made up of carbs. The inner layer is known as Germ which contains vitamins, proteins and minerals. The wheat is a good source to lower the risk of heart disease, if taken in its fine form. It also reduces the risk of strokes, obesity and type 2 diabetes. It also supports healthy digestion, reduces chronic inflammation and risk of cancer. But it must be kept in mind that whole grains are not healthy for everyone in all forms do, nutritionists must be consulted in that case.

Physical Conditions for the Growth of Wheat

a) Climate:

Climate is a major contributor for the growth of wheat as specific temperature and rainfall is required for the growth of wheat.

b) Temperature:

Wheat is a Rabi crop hence sown in Winter and harvested in hot dry weather. Best areas for the wheat growth are the areas where temperature remains between 50-60-degree Fahrenheit.

c) Rainfall:

Wheat is usually grown in the areas where rainwater is not sufficient so, in Pakistan 83% of wheat grown areas are irrigated. Remaining areas where wheat is grown are usually rainfed.

d) Soil:

Along with climate and temperature, it is also important to verify that which type of soil is best to produce wheat. It gives highest production in a soil which is mixture of sand and clay along with animal and vegetable matter known as silt and loam soil (the soil of Indus Plain). It is also proved through research that Chestnut Brown soil is also best for its growth. In acreage and production, it dominates all crops because it is the staple food. Therefore, sown in rainfed as well as irrigated area of Pakistan according to the high demand rate but as we discussed earlier that its production depends and varies from area to area, region to region depending upon the tendency of the soil of that specific areas.

Poor soil, less rain results in the low production i.e. area of Baluchistan Plateau and Thal Desert. The areas where there are favourable conditions, production is good i.e. Trans-Indus and Indus Plain (Punjab and Sindh).

Wheat Growing Regions:

Wheat growing areas are Indus Plain, Lower Indus Plain (Khairpur, Nawab shah, Ghotki, Hyderabad etc.). K.P.K (Mardan, D. I. Khan), along with many other districts of Pakistan.

Jawar (Sorghum) and Bajra (Millet)

Jawar and Bajra are sown in both areas whether irrigated or unirrigated and are included in Kharif crops. Hectares wise, Bajra is sown less as compared to Jawar. Irrigated areas of Punjab and Sindh are famous for its production whereas unirrigated areas include Pothwar Plateau, Baluchistan and K.P.K. In past, it was used on equal proportion as rice and wheat but with the passage of time, it has been observed that their importance is not as same as was in past because of the change tastes of people however, it is still used as a grain as well as a fodder crop. Bajra (Millet) is rich in essential compounds like proteins, magnesium, iron, fibre and phosphorus. Moderation is required during its intake in summers because it may cause serious discomfort and digestive problems. Jawar (sorghum) is Gluten-free and rich in fibre and proteins. It controls blood sugar level. It is full of Iron which is good for healthy bones.it is packed with vitamins, minerals and micronutrients. It improves heart health and energy levels in the body.

Jawar Growing Regions:

Irrigated areas include Gujrat, Khushab, Rajanpur etc. whereas unirrigated land includes area of Mandi Bahauddin, Lodhran, D.G. Khan, Gujrat, Jhang etc. Areas include in Sindh are Jaccobabad, Dadu, Khairpur. Baluchistan includes Nasirabad, Bolan, Kohlu, Jafarabad.

In K.P.K, it is very least in production hence only planted in D.I.Khan and Karak.

Bajra Growing Regions:

Punjab: Attock, Rawalpindi, Mianwali, D.I. Khan
Sindh: Tharparkar, Nawabshah, Hyderabad and Sanghar
K.P.K: D.I. Khan and Karak
Baluchistan: Bajra crop is not much popular crop in Baluchistan hence the area is a non-producer of Bajra.

Barley

It is a Rabi crop and is considered as minor food crop of Pakistan. It is produced mainly for feeding livestock however small proportion is also milled for human that is called **Pearl** or **Pot Barley**. Barley is a Rabi crop so according to its characteristics, it needs cold areas with less rainfalls. In warm lands, it is grown with a need of 20 inches rainfall whereas in cool area like Northern regions, only 10 inches rainfall is required. However, it required sunny weather when the crop is ready to harvest. Soil required for its plantation is Volcanic, Loess, Chestnut Brown with good drainage. Barley reduces hunger and may help you in weight loss. Its soluble and insoluble fibre content improves digestion. It may prevent gallstones and reduce risk of gallbladder surgery. it contains beta-glucans which helps in lowering cholesterol. Cultivated area in Pakistan is very small. K.P dominates whereas Punjab is at second, Sindh at third and Baluchistan is at fourth in its production.

Barley Growing Regions:

Punjab: Attock, Chakwal, Layyah, Kasur, Jhang, Sargodha
Sindh: Thatta, Badin, Dadu, Larkana, Sukkur
K.P.K: Peshawar, Newshehra, Mardan, Swabi
Baluchistan: Pishin, Loralai, Nasirabad, Kalat, mustang
FATA: Bajor Agency is the highest yield production area.

Rice (Kharif Crop)

Rice is an important food as well as cash crop in Pakistan. It accounts for 3.0 percent of the value added in agriculture and 0.6 percent of GDP. It contains high percent of starch i.e. 90% however, it contains less proteins and vitamins when comes in comparison with other cereals. As we discussed earlier, it is the second largest staple food so, is a major export item contributing 2.1% in GDP.

During 2018-19, rice crop area decreased by 3.1 percent (to 2,810 thousand hectares compared to 2,901 thousand hectares of last year). The production declined due to decrease in area cultivated, dry weather and shortage of water. Rice improves bowel movements, regulates and stabilizes blood sugar level, it is a great source of providing Vitamin B1 to the body. It gives a strong boost to metabolic system and immune system. It also provides protection against dysentery and chronic disease.

Physical Conditions for the Growth of Rice

a) Climate:

Like other crops, climate is the major physical factor therefore specific rainfall quantity and temperature is required.

b) Irrigation:

During growing season of about 18 weeks, specific amount of rainfall i.e. 45 inches is required. In Pakistan, where the rice is usually grown in the area where rain fall is deficit hence the production depends upon the irrigation.

c) Soil:

Along with temperature and irrigation, soil is also an important factor in its growth. Soil selected for its production must be sloppy so that water may be added or drained as and when required. This is much important as it is a watery plant so amount of water provided to it must be checked properly.

Soil of river plains, deltas, clay and loamy soil with fine texture are the most preferred ones to produce rice. Basmati and Super Basmati is a high value export variety and is majorly grown in Punjab and in some areas of Sindh. As it is grown highly in the two provinces i.e. Sindh and Punjab but production is also possible in Baluchistan which is third in rank and K.P which is fourth.

Rice Growing Regions:

Punjab: Gujrat, Sialkot, Gujranwala, Lahore, Qasur, Okara etc.
Sindh: Thatta, Badin, Dadu, Larkana, Sukkur, Jaccobabad etc
K.P.K: Peshawar, Newshehra, Mardan, Swabi, Kohat, Swat, D.I. Khan, Bannu etc.

Baluchistan: Nasirabad, Jafarabad

Maize (Kharif Crop)

In Pakistan, after wheat and rice, Maize is the third most important cereal crop. It contributes 2.6 percent to value addition in agriculture and 0.5 percent to GDP. During 2018-19, maize cultivated on 1,318 thousand hectares and witnessed an increase of 5.4 percent over last year's 1,251 thousand hectares. Its production increased by 5.1 percent during year 2018-19 as per survey of Pakistan.

Among cereals, maize is the largest plant in its height (2-15 ft). In Maize plant, there is possession of male and female flowers. Its size may vary from 2ft(minimum) and maximum 15ft but some researchers have proved that in tropical areas it may vary and grow more than 15 ft. It is the world's third most used cereals. It is used as well as animal feed. Maize is a Kharif crop but according to its usage, it is also sown as Spring crop. Intake of maize is beneficial for good eye vision. It prevents diverticular diseases and anaemia. It contains bio-active plant compounds and is a gluten free source of energy. Use of maize also prevents hyper tension

Physical Conditions for the Growth of Maize

a) Temperature:

It usually requires high temperature and humid climate. It is considered as warm weather crop. Warm moist climate is required for its growth.

b) Irrigation:

It requires large amount of water till it fertilizes the whole soil, according to its nature, it is heavenly sown in the areas of Punjab and Sindh as the demand or consumption is high as human food and as a fodder; hence it is also sown in the areas where rain water is not sufficient (irrigated lands).

c) Soil:

Soil required for its best production is loamy soil. Soil near rivers or water bodies are best for its production where there is a large water storage capacity.

Maize Growing Areas in Pakistan:

Maize grown areas in Pakistan are primarily the areas where there are heavy rainfall specifically Northern regions of Pakistan. The main corn producing areas in K.P and Punjab includes districts of Mansehra, Abbotabad, Haripur, Swat, Dir, Kohat, Mardan, Sargodha, Faisalabad, Jhang, Sahiwal, Okara etc. Sindh and Baluchistan are less in its production however in Punjab, there is no specific time for its plantation. It is sown in Spring season (Feb-March) and in July-August i.e. twice in a same season whereas for animal feed, it is grown from Feb-October.

Self Assessment Questions

1. What is the difference between cultivation of Rice and wheat?
2. What do you know about the Cash crops of Pakistan? Discuss any two in detail.
3. Can you specify the areas where Maize and Barley is produced?

7.8 Cash Crops/Non-Food Crops

In this section major cash crops of Pakistan are being discussed.

Sugar Cane (Plant Cane and Ratoon Crop)

It is also an important non-food crop/cash crop of Pakistan and occupies a good status even in its raw form. Raw form of sugar cane is being utilised in the production of Gur, white sugar etc. It is a Kharif crop. Good amount of sugar which is two third; goes to sugar factories whereas remaining is used in making Gur and Khandsari. After one or two crops, its plantation is done on fresh basis which is termed as “Plant Cane” and “Ratoon Crop”. The initial and first crop of sugar cane is called Plant Cane. The crop grown after first crop i.e. succeeding crop is called as Ratoon Crop.

The plant has been attributed as a natural remedy for so many problems. It boosts the immunity level and body’s protein level; and makes body capable of fighting against many infections. It is rich in calcium, magnesium, iron and electrolytes and is helpful in dehydration. It helps in treating urinary tract infections and kidney stones. It strengthens the best working of liver as it builds up plasma. It reduces the causes of tooth decay and bad breath.

Physical Conditions for the Growth of Maize

a) Climate:

Dry weather conditions are good enough for its best productivity as it increases its sucrose content. Sucrose content also depends upon the quantity of water supplied to it because if the amount of water provided exceeds than the demand; sucrose content decreases.

b) Temperature:

As it requires dry ripening period so hot weather is important during its cultivation. However, slightly moderate sunny weather is also important during its further growth and fruit time.

c) Irrigation:

It requires moisture during its cultivation, the regions where there is less rainfall then irrigation is done to overcome the deficiency.

d) Soil:

Well drained fertile soil which is rich in phosphorus, potash, lime and good amount of humus is most important for its production. Along with this, alluvial, loamy and silty loamy soil are also suitable for its plantation.

Sugar Cane Growing Areas in Pakistan

It is cultivated in Punjab, Sindh and K.P with the help of canal irrigation system because these areas are deficient in rainfall quantity.

Punjab: Sargodha, Bhakkar, Faisalabad, Toba-Tek Singh, Jhang, Kasur, Okara etc are famous.

Sindh: Khairpur, Nawabshah, Sanghar, Baddin, Thatta
K.P.K: Peshawar, Charsadha, Mardan, Malakand, D. I. Khan etc

Tobacco (Nicotiana)

It is also a cash crop of Pakistan and is included in Kharif crop. When tobacco plant is mature, its height is usually up to 1-3 meters. It is conical in shape with oval leaves which are broader in size. These leaves are plucked, dried and then used in the production of cigarettes. Tobacco, in modern times is related much with smoking hence earned quite a bad reputation. However, the plant has many uses and medical cures. It is used as a pest poison for example snails, caterpillars and centipedes that destroys the crops. If a soil is well mixed with minced garlic, water and tobacco leaves then the combine force drives the pests away from the crops. It is also used in relieving skin allergies and inflammations by controlling the itching and mild pains. Boiled leaves of tobacco (in a water) keeps the mosquitoes and bedbugs away.

Physical Conditions for the Growth of Tobacco:

a) Temperature:

Moderate temperature is required for its growth (50-80-degree F). Spring season (warm days and cool nights) are most favourable for its production.

b) Rainfall:

As it is crop grown with moderate temperature, so rainfall required for its production is from moderate to heavy. However, where there is less rainfall, it is planted through irrigation system.

c) Soil:

Well drained loamy soil and sandy soil with less organic material is best for its production.

Tobacco Growing Areas in Pakistan:

Major producers of Tobacco are Punjab and K.P. Baluchistan is third in production rank while very less quantity is cultivated in Sindh.

K.P.K: Charsada, Mardan, Sawabi, Malakand, Nowshehra etc.

Punjab: Vehari, Sahiwal, Toba-Tek Singh, Faisalabad, Okara etc.

Baluchistan: Pishin and Qilla Saifullah

Cotton

Cotton is considered as life line of economy of Pakistan. It has a 0.8 percent share in GDP and contributes 4.5 percent in agriculture value addition. Cotton crop faces significant challenges vis-à-vis competing crops especially sugarcane. Most important being unfavourable international prices. During 2018-19, cotton production remained moderate at 9.861 million bales, a decrease of 17.5 percent over the last year's production of 11.946 million bales, and 31.5 percent against the target of 14.4 million bales as per Survey of Pakistan. This below expectation performance of the cotton crop was largely due to contraction in the cultivated area on account of less economic incentive to the farmers

It is a Kharif crop and is an irrigated crop. It is the Pakistan's most important cash crop which contributed a lot in its GDP and has largest shares in export revenues. It is sown at second largest area after wheat in the country. Depending upon the climatic condition and physical feature of the region, plant grows up to height of 3-6 ft (depending on its variety also). It is pyramid in its shape. Its usage is vast in making different fibres i.e. for human clothing, textile products, in making lintens used in cars, furniture etc.

Other than this, it is also used as a source of oil because cotton seed is most commonly used as a vegetable oil. Further usage includes making of many lubricants, paints, soaps etc. Therefore, cotton occupies a special and good status in Pakistan as a Kharif/Summer crop.

Physical Conditions for the Growth of Cotton:

Climate is major contributor in growth of any crop. During its vegetation, sunny days, water and a long period is required but it is harvested in dry weather.

a) Temperature:

Direct and excessive heat is not good and is too harmful. Limited sunshine is well enough with average temperature of 25 degree Centigrade.

b) Water:

Minimum rainfall required for its growth is 20cm to 50cm but for best production, 30-48 inches is required. Dry air conditions are very best for its quality.

c) Soil:

The soil good for its growth is deep friable having humus and lime in it. Alluvial soil of upper and lower Indus plain is regarded as best for its production. The soil which is rich in Phosphate and Potash mainly decomposed lava soil are most suitable for cotton cultivation.

Cotton Growing Areas in Pakistan:

Like other crops, Punjab and Sindh are the areas where it is produced more. Bahawalpur, Rajanpur, D.G Khan, Multan, Jhang etc. in Punjab whereas in Sindh, Sukkur, Mirpurkhas, Umar kot and Hyderabad are famous for its production.

Self Assessment Questions

1. What is the difference between cultivation of Sugar Cane and Cotton?
2. Discuss the conditions that are good for the cultivation of Sugar Cane.
3. Can you specify the areas to where Cotton and Tobacco is produced?

7.9 Condiments and Vegetables

First, we need to define the term “Condiments” so that it would be easy to pick and understand the main concept. Condiment is a substance used to add flavour to food e.g. onion, garlic, chillies etc. These are used in food making as spices and condiments e.g. onion is used as a condiment in almost all the food just to add the flavour or a taste. It is not a vegetable which can be cooked separately. It contains sulphur compound in it which protects against cancer. Use of onion in a daily life reduces the risk of prostate and stomach cancer. Similarly, garlic and chillies are used as a condiment in Pakistan. Garlic is a condiment which is used in cooking and as a medicine due to its unique speciality. It is a natural antibiotic which helps in fighting against harmful bacteria in the body. Vegetables grown in Pakistan are almost cultivated in both seasons i.e. Rabi and Kharif. Largely produced vegetables in Pakistan are potato and tomato. Vegetables are very important due to high nutritional value. It provides protein, mineral and vitamins also which is required by a healthy human body. Many kinds of vegetables are grown in Pakistan. Tomato, chillies, brinjal, potato, gourds and okra are sown in summers whereas peas, coriander, turnip, radish, carrot, cabbage etc. are winter crops. According to updated data, Punjab produces more vegetables, Sindh is at second, Baluchistan ranks third and K.P fourth. One of the easiest ways for people to improve their health is to eat plenty of vegetables. Spinach is a leafy vegetable which contains antioxidants, iron, vitamins and calcium in it. Its intake fulfils the daily requirement of Vitamin K and high amounts of Vitamin A and C. it is full of magnesium and folate. Eating spinach leaves reduces blood pressure and is good for a healthy heart. Broccoli is among healthful vegetable. Its family is as same as cabbage and cauliflower. Consumption of Broccoli reduces the risk of cancer and block the tumor growth. Carrot is vegetable which contains 52% calories with beta-carotene. It also provides Vitamin A which is good for healthy eyesight. Nutrients in carrots helps in fighting against cancer. Tomatoes are technically a fruit but, most people treat them as a vegetable.

7.10 Oil Seeds

Animals fat and oil seeds are used as an essential need of human body. In past, many ways were used to extract oil after harvesting for example threshing, shelling and drying and in the end the obtained product was stored in the form of grains. Oil seed crops can be divide into two groups.

a) Traditional Oil Seed Crops:

Traditional oil seed crops include castor seed, cotton seed, linseed, sesame, mustard and groundnut.

b) Non-Traditional Oil Seed Crops:

It includes soybean, safflower and sunflower etc.

Cropping Season

Winter oilseeds include rapeseed, sunflower, linseed and mustard. Summer oil seeds include sesame, soybean and groundnuts. Sunflower seed is grown both in spring and autumn season. The largest oilseed of Pakistan are palm oil and soybean oil.

Edible and Industrial Oil Seeds:

There are some oil seeds in Pakistan which are edible means they are used as food grade oil usually known as odourless frying oil for example mustard, sesame, sunflower, soybean and rapeseed. Other oil seeds like groundnut is mostly used in snack food items. Some edible types are also used in industries for example; Castor and linseed are used for industrial purposes by extraction of oil.

7.11 Fruits

Due to wide range of agro-climatic condition in Pakistan, country is producing variety of fruits which occupies prominent status in agricultural sector of Pakistan. Fruits are important source of many nutrients like fibre, Potassium, Vitamin C and Folic acid etc. some important fruits grown in Pakistan are Mango, Apple, Banana, Guava, Peach, Pear, Grapes, Pomegranate, Dates, Watermelon, Falsas, Apricots, Plums, Jamun, Lychee, Ber etc.

Ber

It is a fruit which is not well known to many parts of the world. Production and cultivation is only done in Africa, in some parts of Pakistan, India, China and Australia. It is usually green to red in colour with lot of benefits. It contains a high nutritional value along with Vitamin A, C and Calcium, a human body needs 18 to 24 essential amino acids and naturally, Ber is a fruit which contains the whole of it.

Benefits:

- a) It helps in digestion.
- b) Due to its sedative properties, it soothes the nervous system.
- c) It is used as a skin tonic because it keeps skin young and healthy.
- d) It is also beneficial in keeping the muscles, bones and teeth healthy.
- e) It strengthens the immune system.
- f) It helps in weight reduction.
- g) Ber has a special quality that is used as an anti-cancer supplement.

Jamun

Jamun is a fruit which is mildly sour but sweet as well i.e. combination of both. It has a strong tendency that it turns tongue purple while eating. This fruit is very useful in dealing with many issues such as it acts like a healing agent to control diabetes. It lowers the blood glucose level, blood sugar and glucosuria. It is also used to control blood pressure. It contains a high source of Vitamin A and Vitamin C in it.

Apricots

Apricot is a fruit which is very beautiful in its colour. It is full of Beta-Carotene and lot of fibre. Its skin is velvety in nature. In Gilgit-Baltistan, it is used and cultivated as a cash crop for many households. Apricots are usually sweet and very tasty. Baluchistan almost produce 90% of the total crop. Apricot producing areas in Baluchistan are Killa Saifullah, Zhob, Loralai, Pishin and Quetta.

Peach

Apricots and peaches are often considered as cousins. It is grown in Northern areas where this is a traditional crop. But, other provinces also contribute a lot in its production e.g. Kasur, Khushab, Islamabad etc (from Punjab), Hazara, Mardan, Peshawar and tribal areas from (K.P), Quetta, Pishin, Sibbi, Kalat, Mastung (from Baluchistan).

Falsay (Grewia)

People in Pakistan used Falsa as a cool summer drink normally used with black salt. It is a small tree which is 8m tall. The leaves are broad and round. It has beautiful purple to black shade when ripe properly.

Orange

Favourable climatic conditions and best soil in Pakistan has given a unique flavour to orange. It requires rich nitrogen content in the soil and cool weather to grow. Faisalbad, Kasur, Okara, Sahiwal, Khairpur, Haripur, Swat, Dir, Malakand etc are the areas where it is grown on a large scale.

Water Melon

Water melon is known for its sweet and refreshing quality. It is the favourite fruit in Pakistan used to combat the deadly heat. It is used in summers just to get relief from the hot weather. Among all fruits, water melon is the most hydrating made up of 92% water so they have strong ability to reduce cholesterol and bold pressure.

Mango

Over 150 varieties of mango are being produced in Pakistan. Pakistan is considered as an important mango growing country in the world. Because of favourable climatic condition and best soil, cultivation of mango is highly suitable in Pakistan. It is best in quality and known for its good taste.

Mango Growing Areas in Pakistan:

Punjab: Multan, Bhakkar, Bahawalpur, Khanewal, Vehari, Okara, Faisalabad, Jhang etc.

Sindh: Khairpur, Mirpur Khas, Badin, Nawabshah, Sanghar etc.

Self Assessment Questions

1. Write down four benefits of Ber.
2. Why vegetables and condiments are necessary for a healthy life.
3. Specify the names of some important oil seeds in Pakistan and discuss their importance.

7.12 Pulses

Pulses are main source of protein but with growing population rate in Pakistan, the country is deficient in producing the required amount of pulses. Important pulses grown in Pakistan are Matter, Masoor (lentil), Mash, Mung and gram etc.

Masoor

Masoor is a Rabi crop. Its production in Pakistan is more than Mung and Mash. The main production of Masoor is in Punjab which has high yield of Masoor in acreage as well as in production. Masoor is also known as “Red Lentils”. Since past, it is used and taken as an essential part of our cuisines. It helps in stabilising the blood sugar level, lowers the cholesterol and keeps the heart healthy. It is an effective remedy against weight loss with anti-ageing property. It can be used as a skin tonic and can directly applied on to the skin. It nourishes out teeth and bones.

Areas Producing Masoor:

Baluchistan: Jafarabad, Bajor agency and Nasirabad.

Sindh: Thatta, Baddin, Hyderabad, Larkana, Shikarpur etc.

Punjab: Sialkot, Hafizabad, Chakwal, Jehlum, Rawalpindi, Sargodha, Mianwali, Jhang, Gujrat etc.

Gram

It is among the most important pulses in Pakistan, it is cultivated mostly in rainfed areas. It is also known as “channa” and called as “chickpeas”. It contains high nutrient content such as iron, phosphorus, vitamins, zinc and manganese. It is helpful in getting instant energy therefore, it is also used as a food to feed the horses too. It helps in proper generation of the cells. It helps in treating issues such as anaemia. It tends to regulate hormonal actions in women.

Areas Producing Masoor:

Baluchistan: Jafarabad and Nasirabad.

Sindh: Sukkur, Jaccobabad, Shikarpur etc.

Punjab: Sialkot, Hafizabad, Chakwal, Jehlum, Rawalpindi, Sargodha, Mianwali, Jhang, Gujrat etc.

K.P: Laki Marwat, D.I.Khan and Karak.

Mung

It is Kharif crop but due to special nature it is possible to cultivate the crop in both area whether rainfed or irrigated. Mung is best source of proteins, vitamins, minerals. It is rich in amino acids.

Areas Producing Mung:

Baluchistan: Kharan, Kohlu and Kurrang agency.

Sindh: Sanghar and Tharparkar.

Punjab: Sialkot, Hafizabad, Chakwal, Jehlum, Rawalpindi, Sargodha, Mianwali, Jhang, Gujrat etc.
K.P.K: Laki Marwat, D. I. Khan and Karak.

Matter

It is a winter crop as well as irrigated. It is multi-nature in its production therefore sown as a vegetable as well as pulse crop. The major producer of Matter/Peas is Sindh. It is a sweet and starchy vegetable. green peas are rich source of protein, fibers which ensures the presence of good and beneficial bacteria which helps a lot in the bowel movements and healthy digestive system.

Areas Producing Matter:

Jafarabad, Swat, Multan, Jhang, Shiekhupura, Muzaffargarh, Hyderabad, Dadu, Larkana, Shikarpur and Jacobabad etc.

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Unit-8

**AGRICULTURE-III
LIVESTOCK AND DAIRY
DEVELOPMENT IN PAKISTAN**

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Introduction

Pakistan is an agricultural country and livestock is a vital component of agriculture sector. Fortunately, Pakistan is blessed with a large livestock population. Specifically in rural areas almost all farmers rear animals for the domestic need as well as for the commercial purpose. This Unit is focusing on livestock and dairy development in Pakistan. The Unit enlightens the students of Pakistan studies about the livestock potential of Pakistan. In terms of species and breeds, Pakistan has seven types i.e. Buffaloes, sheep, cattle, goat, camel, equine (horses, donkeys, mules) and poultry. These animals also provide raw materials like skin, wools and hides. Other than that they are the main sources of agro-based industries e.g., Milk, eggs, butter, meat and oils which provide nourishment that are extremely significant to the good health. This Unit also discusses the classification of livestock farming i.e. subsistence and commercial farming. Government of Pakistan has established Livestock and dairy development department which are responsible for the sustainable development of livestock, dairy and poultry farms. We also discussed the aims, policies and functions of the department. Fishing industry plays a significant role in national economy of Pakistan. Pakistan exports a substantial amount of Shrimp and fish to the foreign countries. This unit also discussed the issues affecting livestock and poultry sector of Pakistan. The author is optimistic about the future of our country to be prosperous and bright by the participation of the government in introducing new development programs and policies. Serious efforts on government level should be made to enhancing productivity, improving availability of feed and fodder, provision of animal health care, provision of extension services, improvement of promotion or commercializing and integration of public and private sector. The government should implement dynamic reforms in livestock sector for its up-gradation and expansion of production.

Objectives

After reading this unit, you will be able to understand:

1. the background of livestock and dairy development in Pakistan;
2. the classification of livestock farming;
3. the aims, functions and policies of livestock and dairy development department of Pakistan;
4. major livestock resources of Pakistan and their important breeds;
5. poultry farming in Pakistan and issues affecting the poultry sector.
6. fish farming and its resources in Pakistan
7. problems facing by the livestock sector in Pakistan

8.1 Background

Livestock plays a significant role in human life. Domestication of livestock has been one of the most former and common occupation in Pakistan specifically in rural areas. It is as old as the Indus civilization. Being a country whose large population is living in rural areas, animal keeping provides a major source of livelihood to many farmers.

Primarily, Pakistan is an agricultural country and livestock is a vital component of agriculture sector. Moreover, approximately 35 million people are engaged in this sector which contributes nearly 11% to the GDP. Specifically, majority of women are deeply engaged in the management of animal keeping. They earn reasonable amount of cash through sale of milk and excess stock. Mechanization has also been introduced in agriculture sector but still large numbers of farmers are deprived of the latest machinery as bullocks and other animals are being utilized as draught animals. They are also used for irrigation purposes like drawing plough, lifting water and carts. In specific areas of Pakistan, livestock is considered a symbol of prestige and these are also used in sports and entertainment.

In Pakistan, animal keeping is predominantly a subsistence activity and is characterized by small size herds with widespread ownership. Generally, large numbers of farmers in Pakistan are smallholders in addition one million of which are landless. It is a supplemental source of farm income for most farmers. Other sources are crops, horticulture, on farm non agriculture and off-farm employment. In terms of species and breeds, Pakistan has seven types i.e. Buffaloes, sheep, cattle, goat, camel, equine (horses, donkeys, mules) and poultry. These animals also provide raw materials like skin, wools and hides. Other than that they are the main sources of agro-based industries e.g., Milk, eggs, butter, meat and oils which provide nourishment that are extremely significant to the good health.

As animal rearing is quite prevalent throughout the country, fertile provinces of Punjab and Sindh are the main hub of agriculture and farming activity. While the arid regions of Pakistan like Thal, Balochistan, K.P and Thar, are best suited for rearing sheep and goats. Good breeds of sheep are mostly found in the cold areas of northwestern mountainous region.

After China, USA and India, Pakistan is rated fourth position in milk production. It is also one of the fastest growing sectors as its share to the national economy is increasing rapidly. Growing population and urbanization is one of the reason behind this as well as the demand for dairy products is also increasing and it will further rise in the future; thus over the next few years it can be a challenge for the country to meet this demand. Regrettably, Pakistan is underutilizing its livestock potential which is not fully exploited. This may be because of conventional facilities we are using. Majority of these animals are raised by rural communities who lack the appropriate knowledge of animal husbandry and do not possess the enough capital to invest in treatment, prevention and control of animal diseases.

Poultry sector of Pakistan came forth as a best alternative of beef and mutton. It plays a vital role as it provides employment and generates income to 1.5 million people. Poultry includes broilers, layers, and turkeys usually raised indoors in the accumulation of manure and considerable interaction with the bedding. In 1960s, Commercial production of poultry was started and till now it has been providing a significant share of daily proteins to the Pakistani population.

Pakistan is also blessed with abundance of fishery potential. This potential can be found in the northern part of the Arabian Sea and has a coastline of about 1,120 km with a broad continental shelf. There are approximately 16,000 fishing boats in coastal area of Pakistan which function in shallow coastal waters along with offshore areas. It is also a major source of export earnings.

8.2 Classification of Livestock Farming

Pakistan is blessed with a large livestock population. Specifically in rural areas almost all farmers rear animals for the domestic need as well as for the commercial purpose such as for milk, farm operation or meat. Even those people who are landless also keep some goats/sheep, a donkey, one or two cows and a few chickens.

In Pakistan livestock sector is on the developing stage, people in rural areas used them for various agricultural operations. Yaks are usually found in the northern mountain areas with high altitude where people usually domesticated them for subsistence. In the arid areas, deserts and mountainous areas, camels are used for various purposes. Goats and sheep are mostly confined to irrigated areas of upper and lower Indus plains.

Livestock farming can be classified into two groups:

- a. Subsistence Livestock Farming**
- b. Commercial Livestock Farming**

a. Subsistence Livestock Farming

Animal keeping is one of the most former occupations of the country and predominantly a subsistence activity in rural areas. Subsistence farming is done to meet their basic needs and sometimes to earn small amount of income by selling in local market to fulfill other family needs. They usually keep animals for the production of meat with wool, hair and milk as a by-product. However, the way of domestication of animal is quite different in different areas. We can further classify subsistence livestock farming into two categories:

- i. Subsistence Livestock Farming by Nomadic Pastoralism
- ii. Subsistence Livestock Farming by Sedentary Pastoralism

i. Subsistence Livestock Farming by Nomadic Pastoralism

Nomadic pastoralism is a form of pastoralism in which animals are herded from one place to another in order to find out fresh pastures on which to graze. Nomadic pastoralist does not follow a regular pattern of movement in contrast with sedentary pastoralist. In underdeveloped regions of Pakistan, people keep animals for subsistence and they also

depend on nomadic farming. This type of pastoralism is common in vast areas of Thar, Cholistan, Balochistan and Thal Desert, Mountainous and sub-mountainous areas of K.P and Triba areas, because of their extremely cold or hot dry climate. The animals they herd may vary from few to hundred. Cattle, sheep and goats are usually found in Thar, Thal and Cholistan while most of the goats and sheep are commonly reared in Tribal areas and Gilgit Baltistan.

ii. Subsistence Livestock Farming by Sedentary Pastoralism

Sedentary Pastoralism is the rearing of animals on a fixed land. Sedentary farming is practiced at/on one place by a settled farmer not moving around like nomadic pastoralist. Villages of Canal irrigated zones of Sindh, Punjab and K.P is quite suitable for this farming. They form unique culture and civilization as they stay on one place. In these areas, animals are used for different purposes like transport of agriculture goods, ploughing of the field, meat, milk and skins. They also use animal's waste material to fertilize the field and cow dung for cooking and fuel purpose.

b. Commercial Livestock Farming

Commercial livestock farming happens when livestock and its by-products like wool, milk, skins, and meat are used for commercial purposes. They provide raw material for the agro-based industries e.g., Milk, eggs, butter, meat and oils which not only provide nourishment to human but also generate income and new markets.

Commercial livestock farming is exercised at both small scale and large scale level. Small scale includes private owners who sell the livestock products like meat, skins, milk, ghee, wool to the local market. For instance in urban areas, people keep cows and buffaloes to supply milk to the urban population. While on the other hand large scale includes public sector, government owned livestock and dairy farms or military farms. They are established to increase livestock production, research and development, prevention of animal ailments, scientific breeding methods and training for livestock production.

8.3 Livestock and Dairy Development Department

Livestock boosts the national economy of the country as it plays a vital role in exports of the country. The annual foreign exchange we earn from livestock and its products were almost 53 billion rupees in 2001-2002, that is approximately 12.3% of all the export earnings of the country [Government of Pakistan, 2002]. Pakistan needs a great deal of effort to improve and strengthen its livestock sector. There is an estimation that Pakistan has three times the animals that Germany has, but production or output is one fifth of Germany's and one third of New Zealand's.

Overall in Pakistan, Punjab Province is leading in livestock sector; numbers of women are engaged directly or indirectly with this sector as a rural woman spends 59% of her everyday life in livestock related activities. According to 2006 Census, the Punjab province dominates in the livestock sector. Punjab Province has 49% of Pakistan's cattle,

65% of the buffaloes, 37% of the goats, and 24% of the sheep. In Livestock product, it is generating 62% of milk, 32% of mutton, 43% of beef and 75 % of poultry of the country.

The Livestock and dairy development department is categorized in various directorates and every directorate has its own aims, functions and policies, and these are given below:

a) Aims

1. Sustainable development of the Livestock ,Dairy and poultry farms
2. The Market led growth
3. Bring paradigm shift from curative to Preventive
4. Research and Development in various areas of livestock.
5. Eradication of Animal and Poultry viruses
6. Providing Vaccination to the livestock
7. Prevention of mistreatment to animals
8. Provide relevant and up to date information to public and farmers
9. Proper forecasting and surveillance of diseases
10. Animal husbandry training for farmers and professionals

b) Functions

1. Development and Preservation of Livestock genetic resources
2. Health of Livestock
3. Providing training and research to increase the livestock production
4. Management of dairy, Livestock and poultry

c) Policies

1. Reduction of poverty in rural areas
2. Disaster management protocols
3. Conservation of Animal Biodiversity
4. Effective marketing policies to increase the supply and demand of livestock products to urban areas.
5. Effective quality control of livestock products for human consumption.

The livestock population for the last five years is given below:

Table 2: Livestock Population (Million Numbers)

Year	Cattle	Buffaloes	Sheep	Goat	Camels	Asses	Horses	Mules
2004-05	24.2	26.3	24.9	56.7	0.7	4.2	0.3	0.3
2005-06	29.6	27.3	26.5	53.8	0.9	4.3	0.3	0.2
2006-07	30.7	28.2	26.8	55.2	0.9	4.3	0.3	0.2
2007-08	31.8	29.0	27.1	56.7	1.0	4.4	0.3	0.2
2008-09	33.0	29.9	27.4	58.3	1.0	4.5	0.4	0.2

Source: Economic Survey of Pakistan (2008-09)

Table 3: Annual Growth Rate of Livestock Population (Million Numbers)

Species	1996 Census	2006 Census	Increase 1996-2006	Annual Growth Rate (1996 to 2006)
Cattle	20.42	29.56	45%	4.50%
Buffalo	20.27	27.34	35%	3.50%
Sheep	23.54	26.48	13%	1.30%
Goat	41.17	53.79	31%	3.10%
Camels	0.82	0.92	13%	1.30%
Asses	3.56	4.27	20%	2.00%
Horses	0.33	0.34	3%	0.30%
Mules	0.1	0.16	18%	1.80%

Source: Economic Survey of Pakistan (2008-09)

If we look at the importance of livestock in human life as well as for the economy, the Government is trying the best to fix priorities to enhance the production of meat, milk and poultry to not only meet the increasing demand of domestic population but also produce export surplus. The key products of livestock are meat and milk, their production of last three years is given below:

Table 4: Livestock Production (Million tons)

Sr. No.	Milk Type	2006-07	2007-08	2008-09
1.	Milk (Gross Prod.)	40.87	42.19	43.56
	i) Cows	13.91	14.44	14.98
	ii) Buffalo	25.47	26.33	27.03
	iii) Sheep	0.04	0.04	0.04
	iv) Goat	0.68	0.70	0.72
2.	Milk (Available for Human Consumption)	33.00	34.06	35.16
	i) Cows	11.13	11.55	11.99
	ii) Buffalo	20.37	20.99	21.62
	iii) Sheep	0.04	0.04	0.04
	iv) Goat	0.68	0.70	0.72
3.	Meat	2.62	2.73	2.52
	i) Beef	1.50	1.55	1.60
	ii) Mutton	0.57	0.57	0.59
	iii) Poultry Meat	0.55	0.60	0.65

(Source: Economic Survey of Pakistan 2008-09)

8.4 Major Livestock Resources of Pakistan

The major livestock resources are given below:

- a) Buffaloes
- b) Cattle (Bullock and Cow)
- c) Horses
- d) Sheep and Goats
- e) Camel
- f) Poultry

A. Buffaloes

Domestic buffaloes play an important role in agriculture sector of Pakistan. People keep buffalo for their milk, meat and draught purposes. Fortunately, Pakistan is blessed with the two best tropical and sub-tropical breed i.e., Nili Ravi and Kundi breed. Nili-Ravi produces more milk than the other breeds of the world that's why she is considered the best performing animal of this group. These two breeds are found in the canal irrigated areas of Sindh and Punjab such as Lahore, Sheikhpura, Faisalabad, Okara, Sahiwal, Multan, Bahawalpur and Bahwalnagar, where ample of fodder supply and crops are readily available.

“Kundi” is another significant buffalo breed. She is mostly located in the Hyderabad and Karachi district, irrigated regions of Larkana, Khairpur and Sukkur district. In comparison with Nili Ravi, Kundi are usually smaller and jet black in color. The demand of buffalo's milk is continuously increasing as their milk is preferred more than the cow's milk.

According to Pakistan Livestock census 1996, the percentage distribution of buffaloes among the provinces is given; Punjab 64% Sindh 28%, K.P 7% and Balochistan 1%. As per Pakistan Livestock census 2006, the total population of buffaloes increased from 20.3 million in 1996 to 27.34 million.

Table 5: Adjusted Population of Buffaloes by Provinces in Pakistan (000Heads)

Area/Year	1955	1960	1980	1996	2006
Punjab	1981	6129	8679	13101	17747
Sindh	776	1353	1668	5615	7340
K.P	423	651	940	1395	1928
Baluchistan	11	26	23	161	320
Gilgit-Baltistan	1	2	3	----	----
Pakistan	5,192	8,161	11,313	20,272	27,335

Source: Pakistan Livestock Census 2006

B. Cattle (Bullock and Cow)

Cattle consider one of the biggest resources of Pakistan. They are the key farm animal of the country. Cattle serves human being in various ways like providing raw materials for industries, dung cakes for the fuel, maintain soil fertility through their manure. Originally, people keep cattle for draught purpose but with passage of time as mechanization gained popularity, they also kept cattle for milk and meat purposes. Many farmers also raise cattle to sell on the occasion of Eid-ul-Azha for sacrificial purpose. Cows play an important role in milk production. Different breeds are found for draught and milch, draught includes Dhani, Dajjal, Rojhan, Lohani, Thari, Bhagnari, Hisseri well reputed for work while milch includes sahiwal, Red Sindhi and cholistani. Sahiwal is rated as the best milking cattle breed, which produces almost 8-10kgs per day plus an average lactation period of 10 months. The production of milk can be increased by taking certain measures such as sufficient nutrition and worm control through regular drenching etc.

According to Pakistan livestock census, the estimated cattle population was 24.2 million for the year 2005 but as per 2015-16 estimates they have reached about 42.8 million heads. Cows produce more milk as compared to the Buffaloes, therefore can't meet the increasing demand as a result they are less profitable than cows. Cows become mature at the age of 15-18 months while on the other hand buffaloes fully matured at the age of 24 – 30 months. Consequently, cows become productive milkers much earlier in their lives than buffaloes. The main characteristics of cattle breeds of Pakistan are given below:

Table 6: Main Characteristics of Cattle-Breeds of Pakistan

Breed	Type	Areas of Concentration	Adult Weight (Kg)		Age at Maturity (days)	Milk Yield/305 days	Lactation length (Days)
			Male	Female			
Red Sindhi	Milch	Western Sindh and Lasbela in Balochistan	530	325	852	1675	270
Sahiwal	Milch	Sahiwal, Okara, Multan and Faisalabad	544	408	861	1852	283
Dhagnari (Kachhi)	Draught	Bhag Territory in Kalat and Northern Sindh	650	480	966	950	262
Dhanni	Draught	Attock, Rawalpindi, Chakwal and Jhelum	412	285	910	800	204
Lohani	Draught	Loralai and D.I. Khan	315	253	900	613	163
Rojhan	Draught	Suleman Range of Mountains, D.G. Khan, D.I. Khan, Kohat and Bannu	370	267	–	735	192
Tharparkar	Dual	Tharparkar and surrounding areas	470	285	891	1584	277
Cholistani	Milch	Cholistan area	470	341	609	1471	285
Kankreg	Dual	South West part of Tharparkar	591	432	–	1200	–
Dajjal	Draught	Dajal area of D.G. Khan	587	400	–	900	257

C. Goats and Sheep

Goat and sheep farming is very popular in Pakistan. It is a good source of income for poor landless people as goats have good capacity of milk production and meat that's why they are called "poor man's cow". Specifically, Goat farming plays a significant role in the economy of this country by producing about 275 thousand tons mutton, 25 million skins, 21.4 thousand tons hair, and nearly 851 thousand tons milk per annum. Moreover, this production contributes about 2.5% of total national income of Pakistan.

Sheep and goats are usually found in hilly and plain areas of Pakistan. Raising sheep and goats is one of the main occupations of people living in canal irrigated areas of Punjab, K.P and Sindh. People keep sheep mainly for wool, skins and meat which also provides raw material to our carpet, leather and woolen industry. Thus, the by-products of goats and sheep are of high quality and standard and have a great demand in the international market. The details of goats and sheep breeds are given below:

Table 7: Goat breeds in Pakistan = 34

Area	Number of Breed	Goat Breed
Punjab	4	Beetal, Dera Din Panah, Nachi, Teddy
Sindh	14	Barbari, Kamori, Chappar, Bari, Dugi Toori, Sindh Desi, bujri, Jattan, Kacchan, Kurri, Lohri, Pateri, Tapri, Tharki
KPK	3	Kaghani, Damani, Gaddi
Baluchistan	3	Lehri, Khursani, Kajli
Northern Area and AJK	10	Baltistani, Beiri, Buchi, Jararkheil, Jattal, Kohai-Ghizer, Kooti, Labri, Pamiri, Shurri

Table 8: Sheep breeds in Pakistan = 28

Area	Number of Breed	Goat Breed
Punjab	7	Buchi, Lohi, Thalli, Kajli, Cholistani, Salt Range, Sipli
Sindh	3	Dumbi, Kachhi, Kooka
KPK	7	Balkhi, Damani, Kaghani, Hashtnagri, Michni, Tirahi, Waziri
Baluchistan	4	Balochi, Bibrik, Harnai, Rakhshani
Northern Area and AJK	7	Baltistani, Gojal, Kail, Kali, Koh-i-Ghizer, Pahari, Poonchi

An overview of comparison of buffalo milk production with other species is given below:

Table 9: Share of various species in total milk production (Million tons) in Pakistan

Fiscal year	Buffalo	Cattle	Goat	Sheep	Total	% increase
1991-92	9.50	3.03	0.566	0.042	13.2	
1992-93	10.0	3.14	0.602	0.044	13.9	4.91
1993-94	10.6	3.25	0.64	0.047	14.6	5.18
1994-95	11.2	3.37	0.68	0.049	15.3	5.17
1995-96	14.9	7.46	0.509	0.03	22.9	50.2
1996-97	15.4	7.6	0.527	0.03	23.6	2.65
1997-98	15.9	7.74	0.546	0.03	24.2	2.69
1998-99	16.4	7.89	0.565	0.03	24.9	2.73
1999-2000	16.9	8.03	0.586	0.031	25.6	2.76
2000-01	17.5	8.19	0.607	0.031	26.3	2.8
2001-02	18.0	8.35	0.652	0.031	27.0	2.93
2002-03	18.6	8.51	0.652	0.031	27.8	2.79
2003-04	19.2	8.75	0.669	0.031	28.6	2.92
2004-05	19.7	9.00	0.729	0.031	29.5	2.96

Source: Economic Survey of Pakistan 2004-05

D. Horses

Almost 5000 years ago, horses were first domesticated as they were considered a part of wealth and service to mankind. Still Pakistan is a country of horse lovers in spite of the modern means of transportation; they are still use as a means of transport like drawing Tongas and carts in different cities of the country. Specifically in rural areas where road system has not been completely developed horses are frequently used by the villagers. Horses are usually found in some areas of Punjab, Sindh and Balochistan. Nomads use horses as a means of transport in northern mountains of the country.

Important Breeds of Horses

Among the various breeds of horses, Baluchi and Thoroughbred are widely reared in the country.

- **Baluchi Breed:** Baluchi horse is a tremendous breed of horses. They are smart, compact body and medium sized with different colours. They are indigenous to the Punjab (Dera Ghazi Khan, Muzaffargarh, Multan) and in some areas of Baluchistan and Sindh provinces in Pakistan.
- **Thoroughbred:** This breed is quite powerful and best known for horse racing because they have solid musculature body. They are commonly used for riding, races and tent pegging. They are also raised for military purposes and police guards.

Table 10: Adjusted Populations of Horses

Area	Number of Horses (1996)	Number of Horses (2006)
Punjab	1,181,101	1,63,000
Sindh	63,300	45,000
K.P	47,025	76,000
Baluchistan	42,518	60,000

D. Camel

Camels are most useful animals generally raised for draught purpose with milk, meat and hair as a by-product. They are an important source of income and food for the poor rural people. It is usually used for pulling luggage, running races, riding, ploughing field and dancing on the different festivals and occasions. Nomads with families travel long distances with camel as they can easily travel in desert areas without any food and water. They are mostly found in desert areas and known as “Aeroplane of the Desert”. Because of the geographical location, Arabs travel on camel frequently and also consider it the most prestigious animal. Social scientists also say that camel milk is very imperative for survival in arid countries. They have the significant potential for milk, meat in the profitable markets of Libya, Egypt, Saudi Arabia and other UAE states.

The camel population can be found all over the country, primarily in Sandy deserts (Thal and Cholistan in the Punjab and Thar in Sindh), Coastal mangroves (Thatta, Badin and Karachi districts of Sindh), Mountainous tracts of all Baluchistan, D.G. Khan and D.I. Khan, districts of Punjab and K.P and also Irrigated plains of Punjab and Sindh.

Important Breeds of Camels

- **Marecha, Bikanari or Mahra Camels:** These types of camels are widely raised in riverine tract of the Punjab province and usually found in desert areas.
- **Mountain, Pahari Camel:** The Pahari camel is extensively reared in Salt Range and Potwar Plateau (Attock, Chakwal, Rawalpindi, Jehlum districts) and some parts of Balochistan. They are basically raised for riding and transport purpose.
- **Bagri or Booja Camel:** These type of camels possesses slim body as they are raised in desert areas of Cholistan and Thar while those who are raised in riverine tract areas of

districts Bhakkar, Mianwali, Bawalnagar, Bahawalpur, Jhangand Rahim Yar Kahn district of Punjab province are heavier due to sufficient amount of feed.

- **Brela Camel:** These camels are milch breed, heavier sized domesticated in riverine tract of Punjab. Milk production of Brela is 10-14 litre per day. They are also used to carry luggage or weight from one place to another.

Apart from above mentioned animals, people also keep donkeys for the transportation purpose while mules are raised in specific areas. According to 2008-09 statistics, the population of donkeys and mules is 4.5 million and 0.2 million respectively.

8.5 Poultry

Background

Centuries ago in the sub-continent rural people domesticated poultry for subsistence level as well as they were used for fighting and considered as a symbol of fertility. There was no concept of keeping poultry for commercial purpose. Though, with the passage of time poultry came forth as a good substitute of mutton and beef and then it emerged as a profitable business. Eggs and meat industry heavily depends on the production of chickens.

In Pakistan, poultry sector is a strong and vibrant component of agriculture sector as its contribution to the GDP is 1.4% during 2015-16 and livestock value added reached at 11.7%. Commercial poultry started in 1962 in Pakistan and government played a significant role in the development of poultry sector. In the middle of 1960's, Pakistan's first commercial hatchery in Karachi was established by Pakistan International Airlines (PIA) in collaboration with Shaver Poultry Breeding Farms of Canada. Besides that, Lever Brothers Pvt. Ltd. established the first commercial poultry feed mill in the district of Punjab in Rahim Yar Khan. From that time till now, Poultry sector has been rendering a major portion of daily proteins to the ever increasing population.

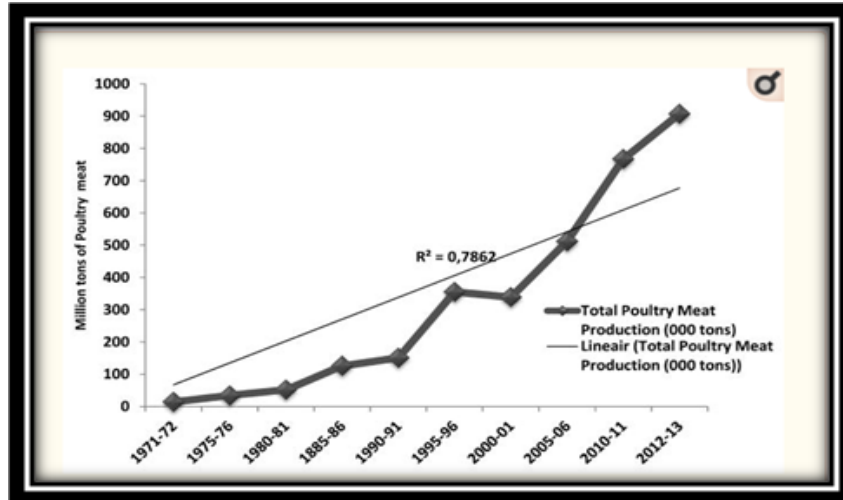
Poultry includes broilers, layers, and turkeys usually raised indoors in the accumulation of manure and considerable interaction with the bedding. This sector plays a vital role as it provides employment and generates income to 1.5 million people. In the initial years of the poultry sector, we have seen a steady growth in the poultry industry that was because of the promotional policies and special incentives from the government. Consequently, in the early 1970s, the sector experienced 20–30% annual growth, and continues growth at a rate of 10–15% till the end of 1980s. The most vital factor of this increasing growth rate was a vibrant domestic market which increased poultry meat consumption more than 4% annually.

Poultry Farming in Recent Times (2001 until now)

Before 2001, we have seen ups and downs in the poultry industry because of the eruption of severe diseases and then re-emergence of the industry. In the end of 1990s, poultry industry began to stabilize and by adopting modern technologies like environmentally controlled housing this sector gained good revenue from the poultry products. New investors invested huge amount in the poultry sector consequently poultry farms equipped with start of the art facilities.

The University of Veterinary and Animal Science was established in Lahore in 2002 to support the fastest growing industry in Pakistan by providing help to solve disease issues and trained personnel. In addition the graduated students obtaining the degree of veterinary medicine and poultry science turned out to be an asset for the industry.

The poultry industry earned good profit incentives and excellent growth upto 2004. Though, the outgrowth of avian influenza in South East Asia badly affected the production of the industry. Instead of these ups and downs, according to government of Pakistan 2013 statistics, the industry still achieved 127% growth in the production of total number of birds, 126% growth in the total meat production and 71% growth in the production of eggs from 2000 to 2010. Currently eggs and meat of chicken are the cheapest available sources of animal protein in Pakistan. The overall increase in production of poultry in terms of total number (million no.) is as follows:



Source: Federal Bureau of Statistics, Government of Pakistan.

Issues Affecting Poultry Sector of Pakistan

A lot of issues are linked with the poultry sector that needs to be addressed so government should devise some proper strategies to solve these issues in order to demonstrate an active presence in international markets.

1. Power shortage is the main issue. Particularly, in the extreme hot weathers long hours of load shedding cause real damage to the growth of poultry industry.
2. Deteriorating law and order condition in Pakistan has always been a contributing factor to slower growth of the local poultry industry. Investors always feel reluctant to invest because of the threat issue.
3. Lack of consultants or consultancy firms is another problem because Local farmer is not well trained and educated and they need consultancy about the selection of

appropriate sites for constructing poultry farms as previous poultry farms confront with occurrence of high diseases.

4. Highly fluctuating prices affects the industry in various ways this is because of the lack of monitoring by government sector.
5. Lack of research and training programmes for the poultry farmers so they get up to date information about the poultry related issues.
6. Lack of implementation of bio-security plans as well as poor control upon temperature, humidity and ventilation further worsened the condition of poultry farms.

8.6 Fishing

Background

Fishing is one of the oldest well-known occupations of the world. People also do fishing for different purposes like for recreational purpose, a competitive sport, and a cultural, spiritual experience. Moreover, Fish has always been a vital source of food for human being which is full of proteins and fat along with Iodine, Iron, Phosphorus, Calcium and Vitamin D & A.

Pakistan is also blessed with abundance of fishery potential. This potential can be found in the northern part of the Arabian Sea and has a coastline of about 1,120 km with a broad continental shelf. There are approximately 16,000 fishing boats in coastal area of Pakistan which function in shallow coastal waters along with offshore areas. Inhabitants living in coastal areas of Sindh and Baluchistan strongly depend on fishing as it is their main source of bread and butter. Pakistan's resources of marine and inland fisheries (rivers, ponds, lakes, dams etc), played an important role in increasing the growth of fish industry. Still there are various marine resources that need to be explored.

Fishing industry plays a significant role in national economy of Pakistan. Although, it has a meagre share in GDP however, a major source of foreign exchange through export earnings. Pakistan exports a substantial amount of Shrimp and fish to the foreign countries. Pakistan's main fish exporters are USA, Japan, UK, Germany, Thailand, Malaysia, Korea, UAE, China and other countries. According to government statistics, during 2014-15, 137.4 thousand metric tonnes fish and fishery products were exported whose value was approximately 35,429.4 million rupees. Fishing sector is also an employment generating sector, during 2014 to 2015 approximately 400,000 people are attached with this sector.

Fisheries Development Commissioner (FDC) is the sole responsible authority for the management of the fishing industry in Pakistan that is controlled by Ministry of Food, Agriculture and Livestock. FDC also interacts with national and international agencies for instance Asia Pacific Fishery Commission and devise a plan and policy for the betterment and development of the fishery industry.

There are also different organizations those are involved in different projects and doing research for fisheries industry and aquaculture. These are:

- Aquaculture Technologies Pakistan

- The Pakistan Agricultural Research Council (PARC) is conducting the research on different projects related to fisheries.
- Food and Agriculture Organization (FAO) Fisheries Department
- Different universities are also involved in research of the fishery and trying to solve the issues related to the industry on a government level.

Table 11: Exports of Fish and Fishery Products to European Union (EU) 2018-19(P)

Commodity /Country	Fish		Cuttlefish		Shrimp		Total	
	Quantity (MT)	Value US\$ (000)	Quantity (MT)	Value US\$ (000)	Quantity (MT)	Value US\$ (000)	Quantity (MT)	Value US\$ (000)
Belgium	74	210	28	102	32	142	134	454
Cyprus	24	61	74	274	-	-	98	335
Spain	21	74	215	1,123	-	-	236	1,197
Italy	38	71	-	-	-	-	38	71
UK	148	901	-	-	29	159	177	1,060
Total	305	1,317	317	1,499	61	301	683	3,117

P: July – March

Source: Marine Fisheries Department

Pakistan's Fishery Resources

Pakistan has ample fishery resources; it includes marine and inland fishing. Over the years, we have seen an increasing trend in the production of fish.

Marine Fishing

Marine fishing determines the fishing that is carried out in all the oceans and seas of the world; it includes estuaries and bays. As compared to the inland fishing, marine fishing is considered more significant because Pakistan earns a handsome amount of foreign exchange through the export of fish and shrimp. It contributes more than 66.7% of the total fish of the country. There are two main marine fishing areas of Pakistan

- 1) Coastal line covering Makran (Balochistan)
- 2) Coastal area of Karachi (Sindh).

Sindh and Balochistan coasts are quite dispersed over a wide area and they have small landing areas which is utilized by small craft furnished with sails as well as with outboard engines. The marine fish are being commercializing as freezing, fresh and canning for domestic consumption. As the increasing importance of fishing around the world, Government of Pakistan established Karachi and Mekran being the most important fishing ports as a fishing centre. Sindh coastal area is famous for Shark, Prawn and Sardine fish. Middle East, Japan and European countries import a large quantity of Prawns from Pakistan. Types of fish caught from Baluchistan coastal area includes sharks, herring, sardines, droakers, drums, catfish, rays and skates.

Inland Fishing

Inland fisheries are becoming more popular in Pakistan as its growing development potential is recognized globally. Inland resources comprised of dams (Tarbela, Mangla and Chashma), small rivers, lakes (Haleji, Keenjhar and Manchhar), reservoirs, barrages, canals and ponds.

Inland fishing contributes 33% of the total fish of the country. Province wise in Pakistan, Sindh practiced 56.6% of inland fishing while Punjab 38%, K.P 5.2% although no inland fishing is going on in Baluchistan. Inland fishing is not completely developed; almost all fish production consumed by the local industry. To provide surplus, it requires a lot of attention by the government so that it could become beneficial for the economy.

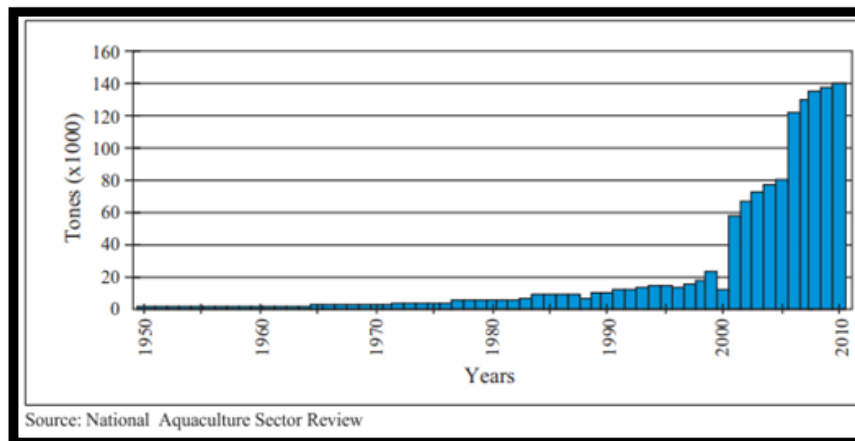
Marine Harbors

Pakistan's main marine harbors are:

- Almost 90% of fish and seafood in Pakistan is organized by Karachi Fish Harbor as well as 95% of seafood and fish exports from Pakistan.
- Karachi Fisheries Harbor is being functioned by Provincial Government of Sindh.
- Korangi Fish Harbor is being controlled by Federal Ministry of Food, Agriculture and Livestock.
- Provincial Government of Baluchistan is responsible for the operation of Pasni Fish Harbor.
- Federal Ministry of Communication operates the Gwadar Fish Harbor.

Aquaculture

Aquaculture or fish farming is quite recent in Pakistan. It has huge potential to grow and a little attention by the government can make a lot of difference in the development of this sector. Various sort of fish farming is practiced on a small scale in K.P, Punjab and Sindh. Due to fish farming, a rapid growth in production has been noticed. It was 10-15 thousand tonnes in 2000 while in 2007 it reached over 100,000 tonnes. However, Pakistan is rich in fish potential but for commercial purpose only two cold water species plus seven warm water species are domesticated. Irrespective of its vast fresh marine resources only carp culture is experienced in ponds. Apart from the trout culture in the northern regions of Pakistan, almost all fish farming consists of pond culture of numerous carp species. Aquaculture is grasping the attention around the world as this is a revenue generating sector for small and medium size investors. Ample amounts of investment in which different fish hatcheries and training facilities are included have been set up for fish farmers by the government. A glimpse of growth in aquaculture sector of Pakistan is shown in graph below:



Role of Fisheries in Pakistan's Economy

1. Through fishing, country earns a substantial amount of foreign exchange by exporting it to the other countries. By exporting fish and its products, Pakistan's foreign exchange earnings are more than 6%.
2. Fisheries sector plays an important role in eliminating poverty by providing employment to millions of people; approximately 400,000 people are employed in this sector during 2014-15.
3. Useless land that is affected with water logging and salinity can be utilized for fish farming in that way, it helps in the socioeconomic uplifting of the rural people.
4. Fish oil that is extracted from the fish is a source of nutrition to the human body.
5. Fish meat is very advantageous for human health because it is anti-cancerous and free of cholesterol and provide significant amount of protein to the human body.
6. Cold storage and ice factories in fish harbour areas provide indirect employment to indigenous people and bring development in the coastal areas.
7. Female participation rate is increasing in fish farming and related activities. Specifically, women living in fishing communities or coastal areas are involved in economic activities like processing, sorting and packing of fish, net making etc. Thus, women play a positive role in the development of the economy.
8. Waste material of fish is also used to make poultry feed and fertilizer.
9. There is a significant contribution of fish farming in national economy of the country. In 2006, the GDP contribution of agricultural sector was 17300 million USD while only fishing sector contribution in GDP was 232.5 million USD.
10. Because of the fishing sector, dependency on crop and livestock reduces.

Issues of Pakistan's Fishing Industry

Undoubtedly, Pakistan has done a lot of progress in fishing industry since Independence, but still this sector is facing a lot of issues and challenges, some of them are explained below:

1. Pollution is one of the main issues affecting fishing sector. Our seawater is affecting badly day by day because of industrial waste and garbage, sewerage water and oil spillage.
2. Another issue is over fishing in sea and lower Indus River by foreign trawler who have updated fishing equipment and big vessels. It not only affects the ecosystem but it also causes fish to be unsustainable.
3. Cutting of mangroves in Sindh coastal area is another problem as they are the breeding grounds of shrimp and works as a barrier to the high and low tides that's why their cutting must be restricted.
4. Lack of literacy and training is another hurdle that affects fishing sector's production as fish farmers don't know how to use updated fishing equipment and can increase their earnings.
5. Local market also needs a lot of attention as the per capita consumption of fish is quite low so marketing is needed to increase awareness about the nutritious value of fish.
6. Urbanization, Industrial chemicals, pesticides also affects river water. Therefore, water purifying plants should be installed so that pollution could not affect the river water and sea.

8.7 Issues of Livestock Sector in Pakistan

1. Urbanization is one of the key issues affecting livestock sector due to increasing pressure of population the grazing plains for animals are disappearing as well as the size of the land holding is also reduced.
2. Lack of infrastructure is also a big hurdle between rural and urban market.
3. A method of animal keeping is out dated unsatisfactory which eventually affects the quality and production.
4. Lack of sufficient veterinary hospitals and vaccination facilities
5. Unhygienic conditions also affect the animal's health and their production level.
6. There is no substantial investment either national or international have been seen in this sector or sub- sectors of livestock such as in mutton, beef, dairy or carpet wool production.
7. There is a need to bring change in the production system of livestock. In our country, livestock production system is still orthodox and mainly for rural subsistence.
8. Lack of commercializing and marketing also affects the sale of livestock products at national and international level.
9. There is lack of extensive research in livestock sector, products processing which is quite important to make this sector economically viable for farmers and investors.
10. Inferior quality animals are produced due to primitive breeding methods and sub-standard breed animals.
11. There is no concept of bringing innovation in the value addition of farm commodities.

Development Strategy for the Betterment of Livestock Sector in Pakistan

Population of Pakistan is approximately 197 million and still it is growing rapidly so as the demands of the people. Livestock and dairy products are included in our basic necessities of life; therefore their importance cannot be neglected. This sector needs great attention and advancement in various spheres. Government of Pakistan is trying its best and devises a policy to improve the production and quality of livestock in the country. The measures taken by the government are given below:

1. Facilitate and encourage commercialization of livestock & livestock products
2. Encouraging private sector to investment in livestock and dairy farming
3. Facilitate and promote farmers to adopt improved technologies in livestock sector.
4. Government is facilitating and support to farmers to adopt latest methods of animal husbandry.
5. Providing Training to farmers in numerous aspects of dairy farming
6. Encouraging livestock sector to provide healthy and quality products at competitive prices with focus on market and poverty alleviation
7. Increasing awareness in farmers regarding animal and poultry diseases
8. Promoting livestock production by selective breeding and encouraging by providing the price incentives for chief livestock products.

Self Assessment Questions

1. Highlight the background of the livestock and dairy development in Pakistan.
2. Evaluate the classification of live-stock farming in Pakistan.
3. Discuss the role of livestock and dairy development department in Pakistan.
4. Elaborate the major livestock resources of Pakistan.
5. Highlight the role of poultry industry and its issues in Pakistan.
6. Discuss the fishing and fish farming in the recent years in Pakistan.

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Unit-9

MINERAL RESOURCES OF PAKISTAN

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Introduction

In the present mechanical age, minerals have a basic job in the modern and financial improvement of a nation. Minerals are utilized as crude material in industries. Minerals give the material used to make the greater part of the things of modern based society. Interest for minerals is expanding worldwide as the populace increments and the utilization requests of distinctive individuals increment. More than 2,000 minerals have been distinguished and the vast majority of these contain inorganic mixes framed by different blends of the eight components (O, Si, Al, Fe, Ca, Na, K, and Mg) that make up 98.5% of the earth surface. A mineral reserve is a convergence of normally happening solid, fluid, or vaporous material, in or on the World's outside layer in such structure and sum that its extraction and its transformation into helpful materials is financially possible. Like other assets, mineral resources are unevenly conveyed around on the earth. A few nations are plentiful in mineral resources and different nations have no resources. Pakistan has extensive reserves of metallic and non-metallic minerals including Iron-metal, Copper, Chromite, Rock salt, Gypsum, Limestone, Sulfur and Marble. Pakistan is not self-sufficient in mineral fuels. A certain quantity has to be imported. The main sources of energy in Pakistan are, in order of importance, petroleum, natural gas and coal. Petroleum products are at the top of the imports list. The bulk of petroleum is consumed by the transport and power sectors.

Objectives

After reading this unit, you will be able to understand:

1. definition of minerals
2. classification of minerals
3. methods of extraction of minerals
4. distribution of metallic minerals in Pakistan
5. distribution of non-metallic minerals in Pakistan
6. distribution of fuel minerals in Pakistan

9.1 Classification of Minerals

A mineral is an inorganic substance that occurs naturally in the earth's crust, usually crystalline with a definite chemical composition. A mineral resource is a resource that people can use to help them to carry out their economic activities. In the present industrial age, minerals have an essential role in the industrial and economic development of a country. Minerals are used as raw material in industries. Minerals provide the material used to make most of the things of industrial-based society. Demand for minerals is increasing world wide as the population increases and the consumption demands of individual people increase.

More than two-thousand minerals have been identified and most of these contain inorganic compounds formed by various combinations of the eight elements (O, Si, Al, Fe, Ca, Na, K, and Mg) that make up 98.5% of the Earth's crust. A mineral deposit is a concentration of naturally occurring solid, liquid, or gaseous material, in or on the Earth's crust in such form and amount that its extraction and its conversion into useful materials is economically feasible.

1. **Metallic minerals:** Copper, Iron, Nickel etc.
2. **Non-metallic Minerals:** Gypsum, Limestone, Marble etc.
3. **Mineral Fuels:** Coal, Petroleum, Natural Gas etc.

9.1.1 Metallic Minerals

Metallic minerals are the minerals that contain one or more metals. In general, they occur as mineral deposits and are a good conductor of heat and electricity, e.g. iron, copper, bauxite, manganese etc. They are malleable and ductile in nature so they can be easily pounded into thin sheets or stretched into wires to make new products. They are generally found in igneous rocks that are formed by cooling and solidification of lava or magma.

Metallic minerals are classified into two categories:

- i) **Ferrous Minerals:** The metallic minerals that contain iron are known as ferrous minerals. In the total production of metallic minerals, 75% is constituted by ferrous metallic minerals. Its common examples include iron ore, manganese, chromite and nickel.
- ii) **Non-Ferrous Minerals:** The metallic minerals that don't contain iron are known as non-ferrous minerals. They don't have magnetic properties and are generally more resistant to corrosion than ferrous minerals.

9.1.2 Non-Metallic Minerals

Non-metallic minerals are the minerals that do not contain metals, e.g. limestone, mica, coal, gypsum, dolomite, phosphate, salt, manganese, granite etc. They are used in various industries to produce a variety of products, e.g. mica is used in electrical industry, limestone is used in cement industry. Furthermore, they are also used in the production of fertilizers and manufacturing of refractories. They are generally found in sedimentary rocks that are formed by the aggregation of various materials like minerals, remains of organisms, rock particles etc.

Difference between Metallic and Non-Metallic Minerals

Metallic minerals	Non-metallic minerals
They are the minerals that contain one or more metallic elements.	They are the minerals that do not contain metallic elements.
They are generally hard and have a shiny surface.	They don't have a shiny surface and are not as hard as metallic minerals.
They are mostly found in igneous and metamorphic rocks.	They are mostly found in sedimentary rocks.
They are ductile and malleable, can be beaten into sheets and stretched to produce wires.	They are not ductile and malleable, so they break into pieces when hit hard.
They are a good conductor of heat and electricity.	They are a poor conductor of heat and electricity.
They are less abundant than non-metallic minerals.	They are more abundant than metallic minerals.
Examples: Copper, tin, iron, manganese, gold etc.	Examples: Carbon, gypsum, potash, precious stones, boron, sulphur, mica, quartz, dolomite, diamond etc.

9.1.3 Mineral Fuels

Mineral fuels are fuels that come from old life forms that decomposed over a long period of time. The three most important mineral fuels are coal, petroleum, and natural gas. Oil and gas are hydrocarbons (molecules that have only hydrogen and carbon in them). Coal is mostly carbon. These fuels are called fossil fuels because they are formed in the geological past from the remains of the living organisms.

9.2 Mining

The possession of minerals cannot decide the prosperity of a country; because existence of a mineral ore is not guaranteeing that it will be exploited. Major factors affecting exploitation of mineral resources in the world are as follows: (i) Grade of the Ore (ii) Size of Deposit (iii) Method of Mining (iv) Accessibility (v) Transportation Facilities (vi) Stage of Industrial Development (vii) Technology

Extraction of valuable minerals and other materials from the earth is called mining. Miners explore these hidden treasures from earth which is then used in different industries. Mining is regarded as industry and an important source of employment and progress of national economy.

9.2.1 Methods of Mining

Minerals are found in the rocks of the crust. To use these minerals, they to be taken out of the ground through mining.

The method of mining depends on the mode of occurrence of the ores. The open-cast mining is the cheapest, while shaft mines are very expensive. The cost of mining also depends on the scale of operations. If the mining has been done at a large scale, the capital and running costs can be offset. Some important methods of mining are described below:

a. Hand-Panning Mining:

Of the land-based techniques, panning is the simplest and most labour-intensive method of mineral extraction. Sometimes precious minerals such as gold are found in alluvial deposits. It can be mined by searching in the bed of a river or other stream of water and collected in a pan. When deposits are dried up, the grains of gold are separated from the sand. This is called panning or placer mining.

b. Shaft-Tunnel Mining:

It is a method of extracting minerals from great depth. According to this method, a shaft is used to drill vertically, after which mining process is started. It is also called shaft sinking. It is best suited for concentrated minerals such as iron, coal, etc. which can be found at the depth of the earth's surface.

c. Adit Tunnel Mining:

In this method horizontal tunnels are dug in hilly areas. Minerals slide down from slopes and gather in tunnels or ditches. Then digging is done in these ditches to extract the minerals. Adit tunnel mining is especially useful in the mining of Rock salt and coal.

d. Open-Pit Mining:

This method is used for the minerals which are located at the surface or at lesser depth. In this method overburden is removed little by little. Open-pit mining gained popularity throughout the 20th century and became the main way of coal mining. Over time, there will be a very large and deep hole in the ground. In Pakistan, open-pit mining method is adopted for the extraction of copper, chromite and limestone.

e. Drilling Mining:

This is a method of extracting the minerals from deeper layers by drilling a hole. Pipes are fitted in this hole. Then minerals are brought on surface through pipes. Drilling method is usually used to extract petroleum or natural gas from the ground. This could be done on the land or in the sea.

There are two types of drilling:

- i. Onshore Drilling:** refers to drilling deep holes under the earth's surface.
- ii. Offshore Drilling:** relates to drilling underneath the seabed. extracting oil from

below the surface of the ocean is much more difficult than the traditional onshore drilling method of making wells on land.

9.3 Distribution of Minerals in Pakistan

Like other natural resources, mineral deposits are unevenly distributed around on the earth. Some countries are rich in mineral deposits and other countries have no deposits. Pakistan has considerable deposits of metallic and non-metallic minerals including Iron-ore, Copper, Chromite, Rock salt, Gypsum, Limestone, Clay, Sulphur and Marble. Many of the mineral deposits are located in inaccessible areas. Major minerals of Pakistan are described below:

9.3.1 Metallic Minerals

Copper:

Copper is found as sulfides, oxides and carbonates. A lot of rocks must be mined before there is sufficient copper to be obtained. Usually, rocks contain 2% copper considered economically valuable to be mined. Copper is used largely in the electrical industry as it is one of the best conductors. It is made into cables, wires and many other components connected with the generation of power and electrical equipment. It is also very useful for making cooking pots as it heats up very quickly. Many countries use a mixture of copper and other metals for making coins. It is mixed with tin to make much harder metal called bronze.

In Pakistan reserves of copper are found at Chaghi, Sandak, Reko-diq, Qalat, Lasbela and Zhob areas of Balochistan. In Khyber Pakhtunkhawa copper reserve are found in Dir, Chitral and Hazara. Chaghi and Lasbela districts are capable of becoming important copper producer of the world.

Iron Ore:

Iron ores are rocks and minerals from which metallic iron can be economically extracted. Iron is one of the most abundant rock-forming elements. Iron ore is an important mineral resource from which iron and steel are produced. It makes up about 5% of the Earth's crust. It is the second most abundant and widely distributed metal. Iron is found in various forms of oxides such as Magnetite, Hematite, Limonite and Siderite. Iron ores consist mainly of hematite (Fe_2O_3), which is red; magnetite (Fe_3O_4), which is black; limonite ($2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$), which is brown; and siderite (FeCO_3), which is pale brown. Hematite and magnetite are by far the most common types of ore.

Pure magnetite contains 72.4 percent iron, hematite 69.9 percent, limonite 59.8 percent, and siderite 48.2 percent, but, since these minerals never occur alone, the metal content of real ores is lower. Deposits with less than 30 percent iron are commercially unattractive, and, although some ores contain as much as 66 percent iron, there are many in the 50–60 percent range. Iron ore is the source of primary iron for the world's iron and steel industries. It is therefore essential for the production of steel, which in turn is essential to maintain a strong industrial base. It is needed in making machines, equipments, tools, other utensils used in our modern life and as construction materials.

Production of iron ore in Pakistan started in 1957. Major iron ore reserves are found at Kalabagh in Punjab, Chitral, Kohat in Khyber Pakhtunkhwa and Chaghi in Balochistan.

Chromite:

Chromite, relatively hard, metallic, black oxide mineral of chromium and iron (FeCr_2O_4) that is the chief commercial source of chromium. The other naturally occurring member is magnesiochromite, oxide of magnesium and chromium (MgCr_2O_4). Chromite is commonly found as brittle masses in peridotites, serpentines, and other basic igneous and metamorphic rocks; an unusual occurrence is as a crystalline inclusion in diamond.

There are more than 25 big reserves of chromite in Pakistan. It is exported to different countries and used in the local industry. Chromite reserves are found in Muslim Bagh, Zhob, Chaghi and Kharan in Balochistan. Some reserves are also found in Malakand and Mohmand Agency in Khyber Pakhtunkhwa. Probable Reserves of Chromite are approximately 4.5 million metric tons.

Lead:

Lead is used to make motor car batteries. It is also used in building, X-ray equipment and for making bullets. Lead deposits are found in Khuzdar, Lasbela and Quetta districts of Balochistan. In Khyber Pakhtunkhwa it is found in Chitral, Swat and Mardan. In Punjab lead deposits are found in Sargodha district. The Lasbela and Khuzdar regions hold great promise for further exploration of deposit.

Zinc:

Zinc is a metal which is used to plate, very thinly, sheets of corrugated iron or steel which is often used as a cheap form of roofing. Zinc will not rust and thus prevents the iron underneath it from doing so. Zinc is also used in making torch batteries and is an ingredient in many medicines too. Zinc reserves are also found in the Khuzdar and Lasbela districts of Balochistan.

Gold:

Gold is the best conductor of all metals in the world and will never rust. Today, gold is used in scientific equipment, especially for making important connections in computers and other electronic equipment. Gold is widely used in electronic equipment in satellites. Because it will not tarnish. It is also used for making jewellery.

RekoDiq, which means sandy peak in the local language and is the name of an ancient volcano, has long been known as one of Pakistan's most mineral-rich regions, with a string of gold mines, copper mines and shale gas reserves. It holds about 5.9 billion tonnes of ore, making it the world's fifth largest deposit of gold and copper.

Bauxite:

Aluminum is usually found in bauxite, sedimentary rocks with high aluminum content. **Bauxite**, rock largely composed of a mixture of hydrous aluminum oxides. It is the

principal ore of aluminum. Aluminum is the most abundant metallic element in Earth's crust and the most widely used nonferrous metal. Rocks containing aluminum are found in Muzaffarabad and Kotli in Azad Kashmir, in the central salt range and in the Loralai District in Balochistan. The total bauxite reserves of Pakistan are estimated at about 74 million tonnes and the annual production is about 22,000 metric tonnes.

Mineral	Reserves (in million tonnes)	Quality	Annual Production (metric tonnes)
Chromite	547	Low to medium grade	27,458
Copper	1352	Low to high grade	
Gold	2.24 (million ounces)	Low grade	
Iron ore	925	Low to high grade	24,322
Lead and Zinc	58	Low to medium grade	
Bauxite	74	Medium to high	22,360

9.3.2 Non-Metallic Minerals

Rock Salt (halite):

Rock Salt (halite), mineral substance of great importance to human and animal health. It is used in cooking as well as chemical industry. The rock salt is sometimes called common salt or table salt to distinguish it from a class of chemical compounds called salts. Salt is essential to the health of both people and animals.

Extensive reserves of Rock salt in Pakistan are found in Salt Range of Khewra, district Jhelum in Punjab. Salt Range, series of low mountains between the valleys of the Indus and Jhelum rivers, located in the northern part of the Punjab. It derives its name from extensive deposits of rock salt that form one of the richest salt fields in the world; they are of Precambrian age and range up to more than 1,600 feet (490 m) in thickness. The range is approximately 186 miles (300 km) long from east to west, and its width, in the central and eastern parts, is from 5 to 19 miles. Its average height is 2,200 feet, and its highest altitude, at Sakesar mountain, is 4,992 feet (1,522 m). In addition to the salt deposits, mined from ancient times, the Salt Range contains coal, gypsum, and other minerals.

Other reserves are in Kalabagh (District Mianwali), Warcha (District Khushab) and Bahadurkhail (District Karak).

Sea Salt: Sea salt is also a small source of common salt in Pakistan. It is produced at Karachi coast by trapping sea water in artificially formed ponds where the sea water evaporates with the help of sun. this sea salt is used for industrial purposes as it is not suitable for use as edible salt. The factors for the production of sea salt by the evaporation of seawater are (1) a hot, dry climate with dry winds, (2) land available and the sea nearby, (3) a soil that is almost impermeable, (4) large areas of flat ground at or below sea level, (5) little rainfall during the evaporating months, (6) no possibility of dilution from freshwater streams, and (7) inexpensive transportation or nearby markets.

Gypsum:

Gypsum, common sulfate mineral of great commercial importance, composed of hydrated calcium sulfate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). Gypsum is used as raw material in phosphate fertilizers. It is also important for cement, plaster of paris, Sulphuric acid, paper, paints and rubber industries. Gypsum has been used as a building material for a long time. Pakistan is endowed with vast reserves of Gypsum which are approximately more than 350 million tons. Most of the gypsum in Pakistan is found in salt range areas of Khewra, Dandot, Dauwdkhel, and Qadirabad. There are also some mines of gypsum in Rohri, Kohat, Dera Ghazi Khan, Loralai, and Sibbi.

Limestone:

Limestone, sedimentary rock composed mainly of calcium carbonate (CaCO_3), usually in the form of calcite. The calcium carbonate is originally produced by living organisms. Later, some of it goes into solution in sea water. Limestone rocks include mainly organic remains and precipitated carbonate. Limestone makes up about 10% of the total volume of all sedimentary rocks.

Limestone also has considerable commercial importance. Limestones enriched in phosphate by the chemical action of ocean waters constitute a principal source of raw materials for the fertilizer industry. Limestone is an extremely useful mineral. It is used in glass, soap, steel, bleaching powder, paints, chewing betel, lime and soda ash. It is also used to make iron in a blast furnace, to remove impurities from the iron ore.

Marble:

Marble is a metamorphic rock that developed from limestone. Most of the material is calcite (a crystalline form of calcium carbonate, CaCO_3) and dolomite. It is often used for sculptures, as a building material, monuments, interior decoration and for many other purposes. Commercially, it includes all decorative calcium-rich rocks that can be polished. Pakistan has a fairly large reserve of marble in different colors and some can compete the best quality marble in the world. The Mullagori deposits in the Khyber Agency are renowned for their high quality. White marble is also found at Swabi in the Mardan District and in Swat. Aside from white, marble in Pakistan is found in number of colors, including grey, yellow and brown. Onyx marble is found in the Chaghi area in Balochistan and is thought to be the result of the deposition of hot springs.

Granite:

Granite, coarse- or medium-grained intrusive igneous rock that is rich in quartz and feldspar; it is the most common plutonic rock of the Earth's crust, forming by the cooling of magma at depth. Because of its use as paving block and as a building stone, the quarrying of granite is a major industrial activity. Not specifically measured, however more than 1000 billion tons of granite reserves are generally estimated. Granite of red, black, grey, green and gold color are found in Pakistan. Deposits of granite are found in Gilgit, Dir, Chitral, Swabi, Kohistan, Nagarparker, Chaghi, Mansehra, Malakand and Swat. Nagarparkar (Sindh) and Mansehra (Khyber Pukhtoorkhwa) are only known sources of workable Granite in the country. Geology evidence shows Gilgit Region holds

great promise of the superior quality deposits.

Mineral	Reserves (in million tonnes)	Quality	Annual Production (metric tonnes)
Granite	Very large deposits	Medium to high	5,676
Gypsum	4850	Medium to high	384,513
Limestone	Large deposits	High grade	8,697,573
Rock salt	Very large deposits	High grade	1,212,366
Marble	Very large deposits	High grade	497, 317

9.4 Mineral Fuel

Coal:

Coal is a black or brownish-black hard sedimentary rock can be burnt for fuel. Coal is mostly carbon with variable amounts of other elements; chiefly hydrogen, sulfur, oxygen, and nitrogen. Coal is formed if dead plant matter decays and over millions of years the heat and pressure of deep burial converts into coal. As a fossil fuel burned for heat, coal supplies about a quarter of the world's primary energy and two-fifths of its electricity. Some iron and steel making, and other industrial processes burn coal. Coal can be roasted (heated very hot in a place where there is no oxygen) to produce coke. Coke can be used in smelting to reduce metals from their ores. Coal was the most important fuel of the industrial revolution but now it is declining in importance as fuel.

Different types of coal arise because of differences in the kinds of plant material and range of impurities. Four important types of coal are peat, lignite, bituminous and anthracite.

Pakistan's coal reserves are of poor-quality lignite and sub-bituminous dating from the tertiary period. The mining of coal in this region started in 1887. There are three major coal-producing regions in Pakistan:

1. the Salt Range and Makarwal coalfields;
2. the Quetta coalfields
3. the Lower Sindh coalfields

a. The Salt Range and Makarwal Coalfield:

This coalfield in the Salt Range is found on the eastern and central portions, covering an area of 260 square kilometers. The main mines are at Dandot and Paddh. The coal in this region is of poor quality, with a high Sulphur and ash content. The Makarwal coalfield is located at Trans-Indus Salt Range. The seams are slightly thicker, and the coal is somewhat better in quality.

b. The Quetta Coalfields:

The Quetta coalfields comprises of three major coalfields; Khost-SharigHarnai coalfield, Sor Range-Degari Coalfield and Mach Coalfield. They all are located within 80 kilometers of Quetta.

c. The Khost-SharigHarnai Coalfield:

The largest coalfield in Balochistan is at Khost-SharigHarnai coalfield and covers an area of 210 square kilometers. The coal is better than that produced in the other coalfields of Pakistan.

d. The Sor Range-Degari Coalfield:

The Sor Range-Degari coalfield is located 16 kilometer east of Quetta. It covers an area of 49 square kilometers. The coal is sub-bituminous contains ash and Sulphur.

e. The Mach Coalfield:

The Mach coalfield is located at 55 kilometers south of Quetta. The coal is of inferior quality and is comparatively closer to the surface. The field covers an area of 40 square kilometers.

f. The Lower Sindh Coalfield:

More than 96 percent of the total coal reserves of Pakistan are found in the four Lower Sindh Coalfields; Jhimpir, Lakhra, Thatta and Thar. The Jhimpir is located south of Hyderabad and covers an area of 900 square kilometers. The coal found here is of poor quality. The Lakhra coalfield is located north of Hyderabad. It has reserves of about 60 million tonnes. The coal is lignite.

In Pakistan coal is used thermal power production, brick kilns and for domestic needs. The total coal reserves of Pakistan are estimated at 185 billion tonnes of which 175 billion tonnes is found in the Thar coalfield alone. Presently coal is being mined in Baluchistan from Khost, Sharag, Digari, Sherin, Aab, Macch, Bolan and Harnai. In Punjab, coal mining areas are Dandot, Paddh and Makarwal. In Sindh coal mines are in Thar, Jhampir, Sarang and Lakhra. In Khyber Pakhtunkhawa coal reserves are found in Hangu.

Province	Reserves (billion tonnes)
Sindh	184.5
Punjab	0.235
Balochistan	0.217
KPK	0.092
Total	185

Coal Reserves of Pakistan

Natural Gas:

Natural gas, colorless highly flammable gaseous hydrocarbon consisting primarily of methane and ethane. It is a type of fuel that commonly occurs in association with crude oil. A fossil fuel, natural gas is used for electricity generation, heating, and cooking and as a fuel for certain vehicles. It is important in the manufacture of plastics and is necessary for a wide array of other chemical products, including fertilizers and dyes.

Natural gas is a cheap source of energy. In Pakistan natural gas was discovered in Sui, Balochistan in 1952. That's why it is called Sui Gas in Pakistan. The commercial exploitation of the natural gas at Sui gas field began in 1955. Sui gas field is the biggest natural gas field in Pakistan with 89 installed gas producing wells. Sui gas field accounts for 6% of Pakistan's gas production. Remaining reserves are estimated to be at about 2 trillion cubic feet and the daily production is around 400 million cubic feet. The operator of the field is Pakistan Petroleum Limited (PPL).

This gas is used for commercial as well as domestic purposes. Reserves of Natural gas are also found in Khairpur, Mazrani, Sari, Kandhlot and Sarang in Sindh. Natural Gas is also found at Dhodhak, Pirkoh, Dhallian and Mial in Punjab. The total natural gas reserves of Pakistan are estimated about 31 trillion cubic feet.

Petroleum:

Petroleum, also called crude oil, is a thick and black liquid. It is a natural material mainly made of hydrocarbons. Most petroleum is found by drilling down through rocks on land or off-shore on the continental shelf. Petroleum and its products have now gained dominating economic importance. It is the most important world fuel source. It supplies 38% of the world's energy and is also used to make petrochemicals. Petrochemicals are chemical products that are made from petroleum, natural gas or other hydrocarbons. In the course of refining the thick black sludge many chemicals are taken out from it and made into different things as cosmetics, fertilizers, paints and medicines. Some important petrochemicals include alcohol, antiseptics, artificial rubber, detergents, drugs, explosives, insecticides, perfume, plastic, and textile fiber. Petroleum is separated into simpler, more useful mixtures by fractional distillation in oil refineries to give separate chemicals. Major products of petroleum include petrol, diesel, naphtha, kerosene, wax, coal-tar etc.

After the establishment of Oil and Gas Development Corporation Limited (OGDCL) in 1975, oil exploration process got a motivation. Pothohar Plateau in Pakistan is an ancient area for the production of mineral oil where oil wells are located in Balkasar, Khor, Dhallian, Joyamir, Manwal, Tut, Kot Sarang, Mial, Aadhi and Qazian. In lower Sindh, important areas of oil production are Khaskheli, Kunar, TandoAllahyar and Zamzama. These reserves are playing important role in catering domestic oil demand.

Mineral Fuel	Reserves	Quality	Annual Production
Coal	185 (billion tonnes)	Low grade	3,037,080 (metric tonnes)
Crude oil	765.237 (million barrels)	Good quality	23.195
Natural gas	41.97889 (million CFT)	Good quality	0.923758 (million CFT)

Self Assessment Questions

1. Define the term mineral. Discuss the classification of minerals in detail.
2. What do you understand by the term mining? Also discuss the important methods of mining.
3. Discuss the distribution of minerals in Pakistan.
4. Highlight the need and importance of mineral fuel in Pakistan.

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