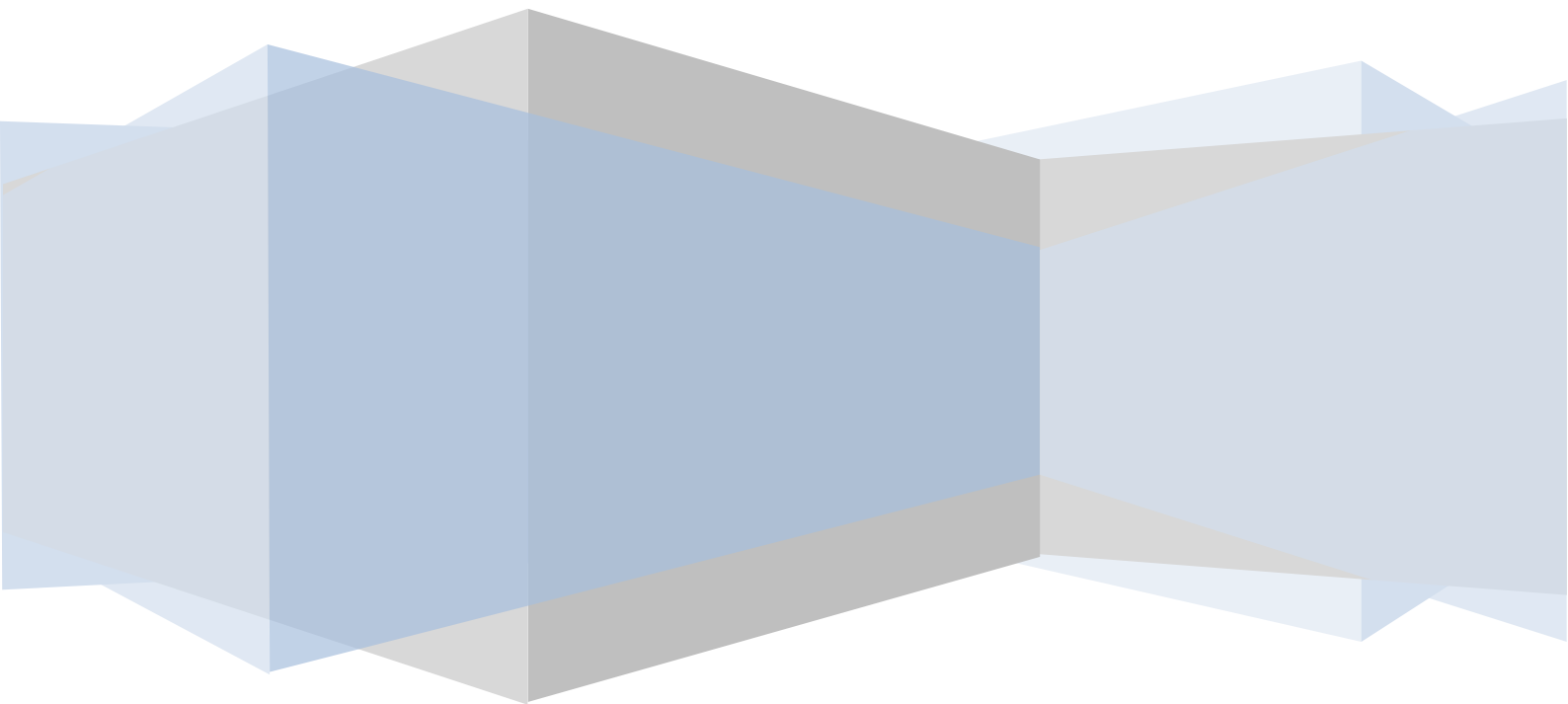


Chapter 3: Soil Profile and Major Crops

Short Answers

CSM 05: Agriculture

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This chapter contains:

- Timeline of Agriculture in India
- Status of Agriculture in India
- Soil
- Soil Profile
- Types of soil
- Soil process
- Crops
- Major crops in India
- Other crops
- System and patterns in agriculture

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1. Timeline of Agriculture in India

Early History

- By 9000 BCE, **Wheat & Barley** were domesticated in the Indian subcontinent. This was soon followed by domestication of sheep and goat.
- During the Indus Valley Civilization, **cotton** was well developed & **rice** was also cultivated.
- **Mixed farming** was developed. Around 4500 BCE, irrigation developed.

Vedic period & Post Mahajanapadas period

- In the later Vedic texts, there are evidences of use of **iron**, this led to cultivation of a wide range of **cereals, vegetables, and fruits** are described. The soil was ploughed several times.
- **Meat and milk products** were part of the diet as animal husbandry was important.

The Mauryan Empire

- Soils were **categorized and meteorological observations for agricultural** use were prepared.
- In addition, the administration facilitated construction and maintenance of **dams**, and provision of **horse-drawn chariots**.

Early Medieval

- The **Tamil people** cultivated a wide range of crops such as **rice, sugarcane, millets, black pepper, various grains, coconuts, beans, cotton etc.**
- **Systematic ploughing, manuring, weeding, irrigation and crop protection** was practiced for sustained agriculture.
- Spice trade involving gained momentum as India started **shipping spices to the Mediterranean**.

Medieval

- There were **advancements in Irrigation technologies** along with division of agricultural 'Zones' into producing rice, wheat or millets.
 - Cultivation of **tobacco (introduced by the Portuguese)** spread rapidly.
 - **Malabar Coast** became the home of spices, especially **black pepper**.
 - **New species of fruit**, such as the **pineapple, papaya, and cashew nut**, also were introduced by the Portuguese.
- Land management was particularly strong especially during the regime of Akbar, under whom Todarmal formulated and implemented elaborated methods for agricultural management.

Colonial Era

- Agriculture in India during this time was marked by a **downward spiral**. The new methods of land revenue system led to massive agrarian distress and poverty.

- In addition, deliberate **de-industrialisation** led to massive pressure of land leading to further poverty.
- The emphasis on **commercial crop over food crops** led to series of famines and increases risks for agriculture.
- The state of agriculture during the interwar period was even more tragic and marked by high population growth but almost **stagnant food output**. The crisis was most acute in Bengal leading to **infamous Bengal famine of 1943**.

Post-Independence

- India was faced problems initially, like of **food shortage, war with Pakistan** and **refugee crisis**. Thus, tackling food shortage became utmost priority and formed the basis of first five-year plan.
- Gradually, there was a more coherent and balanced approach to agricultural development.
 - **“Agenda of Land reforms”** → development of Dams → **“Temples of Modern India”**.
 - **Grow More Food Campaign** (1940s) and the **Integrated Production Programme** (1950s) focused on food and cash crops supply respectively.
 - Later, **land reclamation, land development, mechanization, electrification, use of chemicals-fertilizers** in particular, and development of agriculture oriented 'package approach' of taking a set of actions instead of promoting single aspect soon followed under government supervision.
 - **Production reforms from 1960s: Green Revolution; Yellow Revolution** (Oilseed 1986-1990), **Operation Flood** (Dairy 1970-1996), and **Blue Revolution** (Fishing 1973-2002) etc.
 - *Institutional support*- Indian Council of Agricultural Research; Dairy Development Board; National Bank for Agriculture and Rural Development
- **Post 1991**, Growth in agricultural sector benefiting from the earlier reforms and the newer innovations of Agro-processing and Biotechnology.

2. Status of Agriculture in India

Presently:

➤ **Food security** as well as export house for the world; **Contract farming** along with e-commerce in agriculture is propelling agricultural sector; **Organic farming** has become a major potential for export.

Challenges:

➤ **Declining public expenditure, small landholdings, exposure to global glut** in agri-commodities, **inadequate governance** capacity continue to create problems for India's farmers.

Ministries

Ministry of Agriculture and Farmers Welfare

- Department of Agriculture, Cooperation and Farmers Welfare
 - **Statutory:** Coconut Development Board, National Cooperative Development Corporation, Protection of Plant Varieties and Farmers' Rights Authority, Registrar of Multi State Cooperative Societies.
 - **Attached Office:** National Rainfed Area Authority.
 - **CPSE:** National Seeds Corporation Ltd. (NSC)
 - **Autonomous/ Cooperative bodies:** NAFED, Small Farmers Agribusiness Consortium (SFAC). Various boards/ institutes for horticulture, plant health management, Agro marketing etc.
- Department of Agricultural Research & Education
 - Autonomous body: Indian Council of Agricultural Research (ICAR)
 - Central Agro universities @Imphal (Manipur), Pusa (Bihar), Jhansi (UP)

Ministry for Fisheries, Animal Husbandry and Dairying

- Dept of Fisheries
- **Dept of Animal Husbandry and Dairying**
 - **Statutory:** National Dairy Development Board (NDDB)

3. Soil

Definition

- Soil is the thin top layer on the earth's crust comprising rock particles mixed with organic matter.
- **Pedology** is the study of soils in their natural environment.
- **Pedogenesis** is the natural process of soil formation that includes a variety of processes such as weathering, leaching, calcification etc.

Factor Affecting Soils

Parent Material

- The **rocks from which soils are formed** are called parent materials. Mostly, it **determines the colouration, mineral composition and texture** of the soil.
- Exceptions, the soil formed may or may not have the same physical properties as the parent rock.
- Rocks come under the influence of many processes and factors that **changes the physical as well as chemical properties of rock** like weathering, climate change, etc.
- **In Indian Conditions**, parent material is generally categorized into:
 - Ancient crystalline and metamorphic rocks
 - Oldest rocks of **Pre-Cambrian era**, formed due to **solidification of molten magma** about 4 billion years ago.
 - **Features:** Forms the '**Basement Complex**' of peninsular India; basically **granites, gneisses and schists**; rich in **ferromagnetic materials** and give rise to red soils on weathering (due to the presence of iron oxide)
 - Cuddapah and Vindhyan rocks
 - **Ancient sedimentary rocks** (4000 m thick);
 - **Features:** Upon weathering, they give rise to **calcareous** (containing calcium carbonate) and **argillaceous** (consisting of or containing clay) soils; **devoid of metalliferous minerals**.
 - Gondwana rocks
 - **Sedimentary rocks**
 - **Features:** Much younger than others; upon weathering, they give rise to comparatively **less mature soils**; It is more or less of uniform character but of low fertility.
 - Deccan basalts
 - Formed due to a **volcanic outburst** over Peninsular India gave rise to Deccan Traps.
 - **Features:** formation of fissures; Rich in **titanium, magnetite, aluminium and magnesium**; upon weathering, they give rise to soils of darker colour; high moisture holding capacity → regur or black cotton soil.

Relief

- **Second most important factor** in places with steep slopes like the hilly regions, edges of plateaus etc.
- **Soil erosion** on barren slopes is rampant, and it **hinders soil formation**.
 - **Example:** Chambal ravines, higher reaches of the Himalayas where there is minimal or no forest cover (most on the steep southern slopes) etc.
- The areas of **low relief or gentle slope** generally **experience deposition** and have deep soils.
 - **Example:** Indo-Gangetic plain.
- Exceptions: river basins where the soil layers are sufficiently deep.

Climate (Again)

- **Temperature and rainfall** play most important role in soil formation; It determines the effectiveness of weathering of the parent material, the quantity of water seeping through the soil and the type of microorganisms present therein.
- As, two different parent materials may develop the same soil in the same type of climate. Similarly, the same parent material may produce two different types of soils in two different types of climates.
 - The **crystalline granites produce laterite** (reddish clayey soils) soil in relatively moist parts of the monsoonal region and non- laterite soil in drier areas.
 - **Hot summer and low rainfall** develop **black soil** as is found in **some parts of Tamil Nadu** irrespective of the parent rock.
 - In **Rajasthan**, both **granite and sandstone** give birth to **sandy soil** under arid climate.
 - In **arid and semi-arid regions**, **evaporation always exceeds precipitation**. There is **little vegetation**, and the soils badly lack humus content. Hence the soils are invariably of **light colour**.
 - In Rajasthan and the adjoining arid and semi-arid regions, an **excess of evaporation makes soils limeaccumulating**. Hence, the soil is **pedocal in nature**.
 - In cold climates of the **Himalayan region**, the process of **vegetation decay** is **very slow**, and the **soils are acidic** in nature.

Natural Vegetation

- It reflects the **combined effects of relief and climate**.
- It **influences formation & development of soil**: The decayed leaf material adds much-needed humus to soil thereby increasing its fertility; the densely forested areas contain some of the best soils in India.

Components

Clay

- Very **fine particles**; **Compacts easily**; Forms large, **dense clumps** when wet; **Low permeability** to water; therefore, **upper layers become waterlogged**.

Gravel

- **Coarse particles**; Consists of **rock fragments**.

Loam

- About equal **mixtures of clay, sand, silt, and humus**; **Rich in nutrients**; **Holds water** but does not become waterlogged.

Sand

- Sedimentary material **coarser than silt**; **Water flows through too quickly** for most crops; **good for crops** and plants requiring low amounts of water.

Silt

- Sedimentary material consisting of **very fine particles** between the size of sand and clay; **easily transported** by water.

4. Soil Profile

Basics

- The **vertical section of the soil showing the various layers from the surface to the unaffected parent material** is known as a **soil profile**. The various layers are known as horizons.
- Each layer differs in feel (texture), colour, depth and chemical composition.

O Horizon

- It is a **surface horizon** that is comprised of **organic material** at various stages of **decomposition**.
- It is most prominent in **forested areas** where there is the **accumulation of debris fallen from trees**.
- Layers dominated by **organic material**; Some O layers consist of **undecomposed or partially decomposed litter** (such as leaves, needles, twigs, moss, and lichens).

A Horizon

- It is a **surface horizon** that largely consists of **minerals (sand, silt, and clay)** and with appreciable amounts of **organic matter**. This horizon is predominantly the surface layer of many soils **in grasslands and agricultural lands**. It is part of the top soil.
- Here, organic matter is mixed with mineral matter.
- This layer is depleted of (eluviated of) iron, clay, aluminium, organic compounds, and other soluble constituents.

E Horizon

- It is a **subsurface horizon that has been heavily leached** (of clay, iron, and aluminium oxides, which leaves a concentration of resistant minerals, such as quartz, in the sand and silt sizes).
- It is typically **light in color** & is **present only in older, well-developed soils**, and generally, occur **between the A and B horizons**.

B Horizon

- It is a **site of deposition** of certain minerals that have leached from the layer(s) above.
- Thus, **iron, clay, aluminium and organic compounds accumulate in this horizon** (illuviation (opposite of eluviation)).

C Horizon

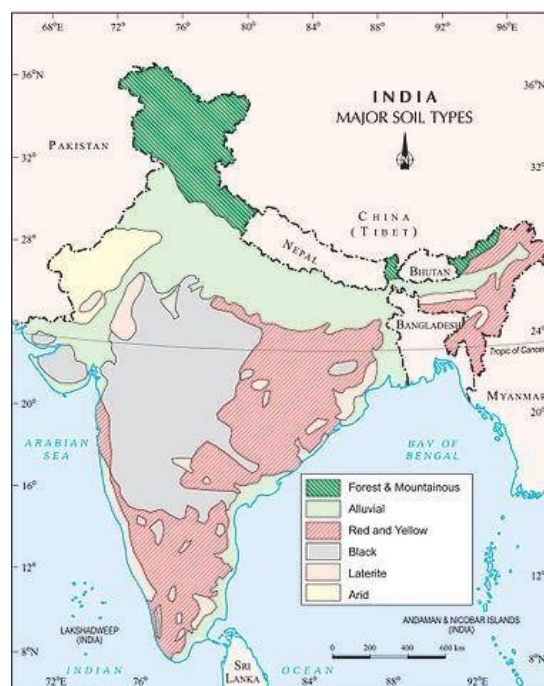
- A subsurface horizon; **least weathered**; aka **saprolite**; formed of **large unbroken rocks**.
- It may **accumulate more soluble compounds** (inorganic material).

R Horizon

- It largely comprises **continuous masses of hard rock**.
- Soils formed in situ will exhibit strong similarities to this **bedrock layer**.
- These areas of bedrock are **under 50 feet** of the other profiles.

5. Types of Soil

- The soil is classified on the basis of the **proportion of particles of various sizes**.
 - If the soil contains a greater proportion of big particles, it is called sandy soil.
 - ✓ **Water can drain quickly** through the spaces between the sand particles;
 - ✓ So, sandy soils tend to be **light in color, well aerated and dry**.
 - If the proportion of fine particles is relatively higher, then it is called clayey soil.
 - ✓ Clay particles, being much smaller, pack tightly together, leaving little space for air.
 - ✓ Unlike sandy soil, **water can be held in the tiny gaps** between the particles of clay.
 - If the amount of large and fine particles is about the same, then the soil is called loamy.
 - ✓ **Loamy soil is a mixture of sand, clay and another type of soil particle known as silt.**
 - ✓ The loamy soil also has **humus** in it. It **has the right water holding capacity** for the growth of plants.
- Crops vs Soils
 - Clayey and loamy soils are both suitable for growing cereals like wheat, and gram. Such soils are good at retaining water.
 - For paddy, soils rich in clay and organic matter and having a good capacity to retain water are ideal.
 - For lentils (masoor) and other pulses, loamy soils, which drain water easily, are required.
 - For cotton, sandy loam or loam, which drain water easily and can hold plenty of air, are more suitable.



Major Soil Groups

Basics

- Geologically, Indian soils can broadly be divided into soils of peninsular India and soils of extra- peninsular India.
- **The soils of the Extra-Peninsula** (Indo- Gangetic-Brahmaputra plains) are formed due to the **depositional work of rivers and wind**. They are **very deep**. They are often referred to as **transported or azonal soils**.
- **The soils of Peninsular India** are formed by the **decomposition of rocks in situ**, i.e. directly from the underlying rocks. They are **transported and redeposited** to a limited extent and are known as **sedentary soils**.

Alluvial Soils

- About
 - These are formed mainly **due to silt deposited by Indo-Gangetic-Brahmaputra rivers**[Rocks of the Himalayas forms the parent material]
 - In **coastal regions**, they are **formed due to wave action**.
 - It is the largest soil group covering about **45.6% the total area & supports > 40% of India's population**.
- Characteristics
 - **Immature**; have **weak soil profiles**; **loamy soil type- highly porous**; **Pebbly and gravelly soils are rare**; **Kankar** (calcareous concretions) beds are present along the river terraces; **Porosity and texture provide good drainage** and other conditions **favourable for agriculture; replenished itself**.
- Chemical properties
 - **Low in Nitrogen**; **Adequate in potash, phosphoric acid** (phosphate) and **alkalis** (lime); Wide range of Iron oxide and lime.
- **Distribution**
 - Along the **Indo-Gangetic-Brahmaputra plains** except in few places where the top layer is covered by desert sand.
 - Present in deltas of **the Mahanadi, the Godavari, the Krishna and the Cauvery**, where they are called **deltaic alluvium** (coastal alluvium).
 - Some alluvial soils are found in the **Narmada, Tapti valleys** and **Northern parts of Gujarat**.
- Crops
 - Best suited for **agriculture**; responds well to the **canal and well/tube-well irrigation**.
 - They yield splendid **crops of rice, wheat, sugarcane, tobacco, cotton, jute, maize, oilseeds**, etc.
- Geological Divisions

- Geologically, the alluvium of the Great plain of India is **divided into newer or younger khadar and older bhanger soils.**

Black Soils

- About
 - The **parent material= volcanic rocks** that were formed in the **Deccan Plateau.**
 - In **Tamil Nadu, gneisses and schists** form the parent material.
 - These are the region of **high temperature and low rainfall.**
- Characteristics
 - **Highly argillaceous** (containing clay) with a **large clay factor, 62% or more; uplands** type black soils have **low fertility** while those in the **valleys are very fertile; have high retentive of moisture; gets sticky during rainy season; shrinks during summers** (develops deep cracks).
 - The lower layers can still retain moisture. The cracks permit oxygenation of the soil to sufficient depths.
- Chemical properties
 - The black colour is due to the presence of a **small proportion of titaniferous magnetite or iron and black** constituents of the parent rock.
 - In **Tamil Nadu** and parts of **Andhra Pradesh**, the black colour is derived from crystalline schists and basic gneisses.
- Color
 - **10% of alumina; 9-10% of iron oxide; 6-8% of lime & magnesium carbonates; potash variable** (less than 0.5%); **phosphates, nitrogen & humus are low.**
- Distribution
 - Spread over **16.6% of the total area** across **Maharashtra, Madhya Pradesh, parts of Karnataka, Telangana, Andhra Pradesh, Gujarat and Tamil Nadu.**
- Crops
 - Best suited for **cotton crop** aka regur and black cotton soils.
 - Other major crops: **wheat, jowar, linseed, virginia tobacco, castor, sunflower and millets.**
 - **Rice and sugarcane** are equally important where irrigation facilities are available; Large varieties of vegetables and fruits are also successfully grown on the black soils.

Red Soils

- About
 - It forms one of the **largest soil group of India.**
 - The main **parent rocks** are **crystalline and metamorphic rocks** like acid granites, gneisses and quartzites.

- Characteristics
 - The **texture** of these soils can vary from **sand to clay**, the **majority being loams**.
 - Uplands are poor, gravelly, and porous | Lowlands are rich, deep dark and fertile.

- **Chemical properties**
 - Acidic with fair alkali content.
 - **poor in lime, magnesia, phosphates, nitrogen & humus; | Rich in potash & potassium.**

- Color
 - The red colour is due to the **presence of iron oxide**.

- Distribution
 - Found in regions of **low rainfall**; Covers **10.6 %** of the total area.
 - Spread across Tamil Nadu, Karnataka, south-east of Maharashtra, Telangana, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, Chota Nagpur plateau; parts of south Bihar, West Bengal, Uttar Pradesh; Aravallis and the eastern half of Rajasthan (Mewar or Marwar Plateau), parts of North-Eastern states.

- **Crops**
 - The red soils are **mostly loamy**, thus with the **proper use of fertilisers and irrigation techniques**, give a **goodyield** of cotton, **wheat, rice, pulses, millets, tobacco, oilseeds, potatoes and fruits**.

Laterite Soils

- About
 - **Formed due to weathering; under conditions of high temperature and heavy rainfall with alternate wet and dry periods.**
 - **Heavy rainfall promotes leaching** (nutrients gets washed away by water) of soil whereby lime and silica are leached away, and a soil **rich in oxides of iron and aluminium compounds is left behind**.
 - Laterite soils are **red in colour due to little clay and more gravel of red sand-stones**.

- Chemical properties
 - **Rich in bauxite or ferric oxides; Poor in lime, magnesia, potash and nitrogen; High phosphate content in some areas; Wetter areas may have high humus content.**

- Distribution
 - Covers 2.48 lakh sq km; spread across the **summits of Western Ghats at 1000 to 1500 m** above mean sealevel, **Eastern Ghats, the Rajmahal Hills, Vindhyan, Satpuras and Malwa Plateau**.
 - They are well developed in **south Maharashtra, parts of Karnataka** etc. and are widely scattered in other regions.

- Crops
 - **Low fertility** due to intensive leaching, but **when manured and irrigated**, they are **suitable for growing plantation crops like tea, coffee, rubber, cinchona, coconut, arecanut, etc.**
- Economic Value
 - Laterite and lateritic soils **provide valuable building material.**
 - These soils can be **easily cut into cakes but hardens like iron when exposed to air.**
 - As it is the end-product of weathering, it **cannot be weathered much further and is durable.**

Forest- Mountain Soils

- About
 - The desert soils **consist of aeolian sand (90 to 95%) and clay (5 to 10%).**
 - The formation of these soils is mainly governed by the characteristic deposition of organic matter derived from forests and their character changes with parent rocks, ground- configuration and climate.
- Chemical properties
 - **Rich in humus; deficient in potash, phosphorus and lime; require a good deal of fertilisers for high yields.**
- Distribution
 - Covers 2.85 lakh sq km or **8.67% of total area;**
 - In the **Himalayan region**, such soils are mainly **found in valleys, less steep and north facing slopes.**
 - The south-facing slopes are very steep & exposed to denudation and hence do not support soil formation.
 - Forest soils occur in **Western and Eastern Ghats** also.
- Crops
 - Suitable for **plantations of tea, coffee, spices and tropical fruits in the peninsular forest** region.
 - **Wheat, maize, barley and temperate fruits** are grown in the Himalayan forest region.

Arid- Desert Soils

- About
 - The presence of **sand inhibits soil growth.**
 - **Desertification of neighbouring soils is common** due to the intrusion of aeolian sand (wind action).
- Chemical properties
 - **Poor in organic matter;**

- They are alkaline with **varying degree of soluble salts** like **calcium carbonate**. **Calcium content increases downwards**, and the **subsoil hasten times more calcium**.
- **High phosphate content; Low Nitrogen** in most areas where nitrates are absent.
- Distribution
 - Cover a **total area of 1.42 lakh sq km (4.32%)**; Spread across **arid and semi-arid regions of Rajasthan, Punjab and Haryana**.
 - **Sandy soils without clay factor** are also common in **coastal regions of Odisha, Tamil Nadu & Kerala**.
- Crops
 - **Phosphates and nitrates make these soils fertile wherever moisture is available**.
 - In large areas, only the drought resistant and **salt tolerant crops such as barley, cotton, millets, maize and pulses are grown**.

Saline- Alkaline Soils

- About
 - Here, the **top soil is impregnated with saline and alkaline efflorescence's** (become covered with salt particles).
 - Undecomposed rock fragments, on weathering, give rise to sodium, magnesium and calcium salts and sulphurous acid. Some of the salts are transported in solution by the rivers.
 - In regions with the low water table, the salts percolate into subsoil and in regions with good drainage, the salts are wasted away by flowing water.
 - But in places where the drainage system is poor, the water with high salt concentration becomes stagnant and deposits all the salts in the topsoil once the water evaporates.
 - In regions with the high sub-soil water table, injurious salts are transferred from below by the capillary action as a result of evaporation in the dry season.
- Distribution
 - Spread across 68,000 sq km of area.; **found in canal irrigated areas and areas of a high sub-soil water table**.
 - Parts of **Andhra Pradesh, Telangana, Karnataka, Bihar, Uttar Pradesh, Haryana, Punjab** (side effects of improper or excess irrigation), **Rajasthan and Maharashtra** have this kind of soils.
 - The **accumulation of these salts makes the soil infertile and renders it unfit for agriculture**.

Peaty- Marshy Soils

- About
 - Have **large amount of organic matter** and a **considerable amount of soluble salts**.
 - The most humid regions have this type of soil.
- Chemical properties

- **Deficient in potash and phosphate; They are black, heavy and highly acidic.**

- **Distribution**
 - Spread across **Kottayam and Alappuzha districts of Kerala.**
 - Also occur in the coastal areas of Odisha and Tamil Nadu, Sundarbans of West Bengal, in Bihar and Almora district of Uttarakhand.

- **Crops**
 - **Most of the peaty soils are under water during the rainy season** but as soon the rains cease; they are put under paddy cultivation.

6. Soil Process

Podzolization

- A process of **soil formation: formation of Podzols and Podzolic soils.**
- Podzolization is the **negative of calcification** [The calcification process tends to concentrate calcium in the lower part of the B horizon, whereas podzolization leaches the entire solum of calcium carbonates]
- The **other bases along with calcium are also removed** and the whole soil becomes distinctly acidic. In fact, the process is essentially one of the processes of acid leaching.

Laterization

- The term laterite meaning **brick or tile** and was originally applied to a group of high clay Indian soils found in Malabar hills of Kerala, Tamil Nadu, Karnataka and Maharashtra.
- It refers specifically to a particular cemented horizon in certain soils which when dried, become very hard, like a brick.
- **Laterization is the process that removes silica, instead of sesquioxides from the upper layers and thereby leaving sesquioxides to concentrate in the solum.**

Gleization

- It is a process of **soil formation resulting in the development of a glei** (or gley horizon) in the lower part of the soil profile above the parent material due to poor drainage condition (lack of oxygen) and where waterlogged conditions prevail. Such soils are called **hydro-orphic soils.**

Salinization

- It is the process of **accumulation of salts**, such as sulphates and chlorides of calcium, magnesium, sodium and potassium, in soils in the form of a salty (salic) horizon. It is quite **common in arid and semi-arid regions.**
- It may also take place **through capillary rise of saline ground water** and by **inundation with seawater in marine and coastal soils.**
- Salt accumulation may also result from irrigation or seepage in areas of impeded drainage.

Desalinization

- It is the **removal of excess soluble salts by leaching from horizons or soil profile** (that contained enough soluble salts to impair the plant growth) by ponding water and improving the drainage conditions by installing artificial drainage network.

Solonization or Alkalinization

- The process involves **the accumulation of sodium ions on the exchange complex of**

the clay, resulting in the formation of sodic soils (Solonetz).

- All cations in solution are engaged in a reversible reaction with the exchange sites on the clay and organic matter particles.

Solodization or dealkalization

- The process refers to the **removal of Na⁺ from the exchange sites**. This process **involves dispersion of clay**. Dispersion occurs when Na⁺ ions become hydrated.
- **Much of the dispersion can be eliminated if Ca⁺⁺ and or Mg⁺⁺ ions are concentrated in the water**, which is used to leach the soil. These Ca and Mg ions can replace the Na on exchange complex, and the salts of sodium are leached out.

Desertification

- **Definition:** Productive potential of arid or semi-arid land falls by at least 10% due to human activity and/or climate change.
- **Symptoms:** Loss of native vegetation; increased wind erosion; salinization; drop in water table; reduce surface water supply.
- **Remediation:** Reduce overgrazing; reduce deforestation; reduce destructive forms of planting, irrigation, and mining. Plant trees and grasses to hold soil.

Salinization

- **Definition:** Water that is not absorbed into the soil and evaporates **leaves behind dissolved salts** in topsoil.
- **Symptoms:** Stunned crop growth; lower yield; eventual destruction of plant life.
- **Remediation:** Take land out of production for a while; and/or install underground perforated drainage pipes; flush soil with freshwater into separate lined evaporation ponds; plant halophytes (salt-loving plants) such as barley, cotton, sugar beet and/or semi-dwarf wheat.

Water logging

- **Definition:** Saturation of soil with water resulting in a **rise in the water table**.
- **Symptoms:** Saline water **envelops deep roots killing plants; lowers productivity; eventual destruction of plant life**
- **Remediation:** Switch to less water-demanding plants in areas susceptible to water logging; utilize conservation-tillage farming; plant water logging-resistant trees with deep roots; take land out of production for a while; and/or install pumping stations with drainage pipes that lead to catchment-evaporation basins.
 - Loam soils generally contain more nutrients and humus than sandy soils, have better infiltration and drainage than silty soils and are easier to till than clay soils.
 - If the topsoil is brown or black, it is rich in nitrogen and is good for crops. If the topsoil is grey, yellow, or red, it is low in organic matter and poor for crops.

Erosion

- **Splash Erosion:** 1st stage of erosion process; occurs **when raindrops hit bare soil**.
 - The explosive impact breaks up soil aggregates so that individual soil particles are 'splashed' onto the soil surface.
- **Sheet Erosion:** the uniform movement of a thin layer of soil across an expanse of land

devoid of vegetative cover.

- Raindrops detach soil particles, which go into solution as runoff occurs and are transported downstream to a point of deposition.
- *Rill Erosion*: When sheet flows begin to concentrate on the land surface, rill erosion occurs.
- While sheet erosion is generally invisible, rill erosion leaves visible scouring on the landscape. This type of erosion occurs when the duration or intensity of rain increases and runoff volumes accelerate.
- *Gully Erosion*: Rill erosion evolves into gully erosion as duration or intensity of rain continues to increase and runoff volumes continue to accelerate.
- It is generally defined as a scoured-out area that is not crossable with tillage or grading equipment.

Some Terms

Soil Texture

- It refers to the **relative proportion of particles or it is the relative percentage by weight of the three soil separates** viz., sand, silt and clay or simply refers to the size of soil particles.
- Loam: A type of soil texture with good water holding capacity and drainage suitable for cultivation of variety of crops.

Soil Structure

- The **arrangement and organization of primary and secondary particles in a soil mass** is known as soil structure.

7. Crops

Basics

Terms

- **Crops:** A crop is a plant or animal product that can be grown and harvested extensively for profit or subsistence. Crops may refer either to the harvested parts or to the harvest in a more refined state.
- **Cropping pattern** refers to the proportion of area under different crops at any given point of time in a unit area.
- Crop Arrangement:
 - **Temporal Arrangements** (time) refers to the yearly sequence of growing different crops on a piece of land.
 - **Spatial Arrangements** (space/land) refers to the arrangement of crop/s on a piece of land in various patterns.
- **Crop diversification** refers to the addition of new crops or cropping systems to agricultural production on a particular farm considering the different returns from value-added crops with complementary marketing opportunities
- **Crop rotation:** Crops are changed in the field from year to year according to a planned sequence rather than the same crop being grown in the same field again and again.
- **Cropping System** is a broader term than cropping pattern and includes the sum total of all crops and the practices used to grow those crops on a field or farm. It comprises of all components, such as water, soil, technology etc. required for the production of a particular crop and the interrelationships between them and the surrounding environment.
- **Cropping Intensity:** It refers to number of crops cultivated in a piece of land per annum.
- **Gross Cropped Area:** It is the total area sown once as well as more than once in a particular year.

Factor Affecting

- **Agronomic/Technical**
 - **Climate and soil type** (irrigation, topography, fertility, drainage etc.);
 - **Availability of required inputs** (fertilizer, chemical, credit, tractors etc.);
 - **Plant/seed of high genetic quality;**
 - **Management techniques** and quality managers;
 - Abundance of labour.
- **Economic**
 - **Flow of market signals and communication and information systems**, Ex: regarding prices in the market, supply- demand etc;
 - Venture capital and entrepreneurship;
 - **Transparency of input and output prices;**
 - Information on export standards, market demand and relative profitability;
 - Efficient marketing systems.

➤ **Government Policy**

- **Non-distortionary policy** to avoid discrimination among crops. (eg. MSP Policy);
- **Efficient research and extension programmes**, without any bias for major crops or against high value crops;
- Contract-farming opportunities;
- **Rural credit**;
- Off-farm employment opportunities;
- **Marketing systems** including quality standards;
- Involvement of the private sector.

Classification of Crops

Based on End Usage

➤ **Food Crops**

- The crops which are grown as **food for the producer's family or for the producer's own livestock**.
- Generally, produced at small scale (subsistence level) | Ex: wheat, rice, jowar etc.

➤ **Cash Crops**

- The crops that are especially used for **profit rather than consumption by a family**.
- They can be **consumed directly or processed** into other products, such as **sugar and biofuel**.
- They consist of foods like **tobacco, tea, coffee, cardamom, fruits and vegetables, grains**, etc.
- They are sold, but some are not edible. Cotton and tobacco are examples of non-edible cash crops.

➤ **Plantation Crops**

- It refers to those crops which are **usually cultivated as a single crop on an extensive scale** in a large contiguous area, owned and managed by an Individual or a company.
- These plantation crops are of **high value commercial crops of greater economic importance**. The crops include tea, coffee, rubber, cocoa, coconut, arecanut, oil palm, cashew, cinchona etc.

➤ **Horticulture crops**

- **The science and art of growing and caring for plants**, especially flowers, fruits, and vegetables.
- The word horticulture comes from Latin and means "**garden cultivation**"
- Whereas agronomy (a branch of agriculture) refers to the **growing of field crops**, horticulture refers to **small-scale gardening**.
- All food crops can be cash crops but not all cash crops can be food crops. Food crops can be eaten by someone somewhere and so have a cash value. Food crops can be sold, which would make them cash crops as well.

Based on Season

➤ **Kharif Crop:**

- The crops grown in monsoon months from **June to Oct-Nov**; **Require warm, wet weather at major period of crop growth**, also required short day length for flowering. Ex: *Cotton, Rice, Jowar, bajara*.

✓ **Northern States:** *Rice, Cotton, Bajra, Maize, Jowar, Tur*

✓ **Southern States:** *Rice, Maize, Ragi, Jowar, Groundnut*

➤ **Rabi Crop:**

- The crops grown in **winter season from Oct to March month**. Crops grow well in **cold and dry weather**. Require **longer day** length for flowering. Ex: *Wheat, gram, sunflower* etc.

✓ **Northern States:** *Wheat, Gram, Rapeseeds and Mustard, Barley*

✓ **Southern States:** *Rice, Maize, Ragi Groundnut, Jowar*

➤ **Zaid Crop:**

- The crops grown in **summer month from March to June**. Require **warm-dry weather** for major growth period and **longer day length for flowering**. Ex: *Groundnuts, Watermelon, Pumpkins, Gourds*.

✓ **Northern States:** *Vegetables, Fruits, Fodder*

✓ **Southern States:** *Rice, Vegetables, Fodder*

Based on Climate

➤ **Tropical Climate Crop:** They grow well in **warm & hot climate**. Ex: *Rice, sugarcane, Jowar* etc

➤ **Temperate Climate Crop:** They grow well in **cool climate**. Ex: *Wheat, Oats, Gram, Potato* etc

Based on Agronomics

➤ **Cereals**

- They are cultivated **grasses grown for their edible starchy grains**. Larger grains used as staple food are cereals.
- Ex: *Rice, wheat, maize, barley and oats*. The important cereal of world is rice.

➤ **Millets**

- They are also **annual grasses of the group cereals**. But they are grown in less area or less important area whose productivity and economics are also less.

- These are staple food of poor people. In India pearl millet is a staple food in Rajasthan
- ✓ **Major millets** (based on area production and productivity and grain size)
- *Sorghum /Jowar; Pearl Millet /Bajra/cumbu; Finger millet or ragi, etc*
- ✓ **Minor millets** (based on area production and productivity and grain size)
- *Fox tail millet; Little millet; Common millet; Barnyard millet; Kodomillet, etc*

- **Pulses or Grain Legumes**
 - Major source of protein in Indian diet; economically, **pulses are cheapest source of protein.**
 - It is cultivated to **enrich the soil**, to **utilize the residual moisture** and to give **revenue in a shorter period.**
 - Ex: Red gram; Black gram; Green gram; Cowpea; Bengalgram; Horsegram; Dewgram; Soyabean; Peas, etc

- **Oil Seed Crops**
 - These crops are **cultivated for the production of oil.**
 - Either for **edible or industrial or medicinal purpose.** They **contain fat.**
 - *Groundnut or peanut; Sesamum or gingelly; Sunflower; Castor; Linseed or flax; Niger; Safflower; Rapeseed & Mustard; 45 – 50% oil content is present in these seeds.*

- **Sugar Crops:** Juice extracted from
- ✓ **Sugar stem** used for jaggery or sugar
- ✓ Number of by products like *Molasses, bagasse, press-mud;*
- ✓ Molasses used for **alcohol and yeast formation; Bagasse** for paper making and fuel;
- ✓ Press- mud used for **soil amendment; Trash (green leaf + dry foliage)-** the waste is used for cattle feed;

- **Sugar beet:** Tuber for extraction of sugar
- ✓ *Tubers and tops* are used as a fodder for cattle feed.

- **Starch Crops or Tuber Crops**
- ✓ *Potato; Tapioca or cassava; Sweet potato, etc*

- **Fibre Crops**
 - **Epidermal hairs of seed coats are the economic portion;** Lint (cappas- seed) has industrial value (fibre);
 - Stalk is of fuel nature, garment purpose, seed for cattle feed and Oil is edible;

- **Cotton**
 - Karunganni; Uppam cotton; American cotton or Cambodiam cotton; Egyptian cotton

or Sea island cotton

➤ **Stem Fibres**

- Jute; Mesta; Sun hemp; Sisal hemp, etc

➤ **Narcotics**

- Stimulates Nervous System- Tobacco; Betelvine; Arecanut, etc

➤ **Forage and Fodder Crops**

- The entire **vegetative part** is used as **green fodder**;
- The **stalks and leaves** are the major economic portion for hay making;
- Hay is cut into pieces and mixed with concentrated animal feed and is fed to animals.

➤ **Grasses**

- *Napier grass; Para grass; Bermuda grass; Guinea grass; Rhodes grass, etc*

➤ **Legumes**

- Lucerne (Alfalfa); Egyptian clover (Berseem); Indian clover (Fodder senji); Sirato; Stylo; Subabul, etc

➤ **Plantation Crops**

- Tea (leaf); Coffee (seed); Rubber (milk exudation); Cocoa (Seed).

➤ **Spices and Condiments**

- Products of crop plants are used to flavor taste and sometime color the fresh preserved food. Ex: *ginger, garlic, chili, cumin onion, coriander, cardamom, pepper, turmeric* etc.
- Medicinal plants include cinchona, isabgoli, opium poppy, senna, belladonna, rauwolfra, iycorice.
- Aromatic plants such as lemon grass, citronella grass, palmorsa, Japanese mint, peppermint, rose, jasmine, henna etc.

Based on Duration of Crops

- **Seasonal crops:** A crop completes its life cycle in one season. Ex: *rice, Jowar, wheat*, etc.
- **Two seasonal crops:** Crops complete its life cycle in two seasons. Ex: *Cotton, Turmeric, Ginger*.
- **Annual crops:** Crops require one full year to complete its life cycle. Ex: *Sugarcane*.
- **Biennial crops:** Crops requires two year to complete its life cycle Ex: *Banana, Papaya*.
- **Perennial crops:** Crops live for several years. Ex: *Fruit crops, mango, guava* etc.

Based on Cultural Method/Water

- **Rain fed:** Cultivation of crop mainly based on the **availability of rain water**. Ex:

Jowar, Bajara, Mung etc.

- **Irrigated crops:** Crops cultivated with the help of **irrigation water**. Ex: *Chili, sugarcane, Banana, papaya etc.*

Based on Root System

- **Tap root system:** The main **root goes deep into the soil**. Ex: *Tur, Grape, Cotton etc.*
- **Fiber rooted:** The crops whose roots are **fibrous shallow & spreading into the soil**. Ex: *Cereal crops, wheat, rice etc.*

Based on Economic Importance

- **Cash crop:** Grown for **earning money**. Ex: *Sugarcane, cotton.*
- **Food crops:** Grown for **raising food grain for the population and & fodder for cattle**. Ex: *Jowar, wheat, rice etc.*

Based on No. of Cotyledons

- **Monocots or monocotyledons:** Having **one cotyledon in the seed**. Ex: *all cereals & Millets.*
- **Dicots or dicotyledonous:** Crops having **two cotyledons in the seed**. Ex: *all legumes & pulses and almost all the trees.*

Based on length of photo period required for floral initiation

- **Photoperiodism:** The effect of light on plant. Most plants are **influenced by relative length of the day & night**, especially for floral initiation, depending on the length of photoperiod required for floral ignition, plants are classified as:
 - **Short-day plants:** Flower initiation takes place when days are short **less than ten hours**. Ex: *rice, Jowar, green gram, black gram etc.*
 - **Long day's plants:** require long days are **more than ten hours** for floral initiation. Ex: *Wheat, Barley, etc.*
 - **Day neutral plants:** Photoperiod does not have much influence for phase change for these plants. Ex: *Cotton, sunflower, etc.*

8. Major Crops in India

Wheat

➤ **About**

- 2nd most important crop; **Main food crop in north and north-western India; Rabi Crop.**

➤ **Climatic Conditions**

- Requires a cool growing season and a bright sunshine at the time of ripening.
- **Winter temperature from 10°-15° C and summer temperature from 21°-26° C; 50-75 cm of annual rainfall** evenly distributed over the growing seasons.

➤ **Extra**

- The **Ganga-Satluj plains** in the northwest and black soil region of the Deccan.
- The **major wheat-producing states** are **Punjab, Haryana, Uttar Pradesh, Bihar, Rajasthan and parts of Madhya Pradesh.**
- India is 4th largest wheat producer with about 1/8th of world output.

Rice

➤ **About**

- **Staple food crop** of India; **Kharif Crop; Aus, Aman and Boro** are varieties of rice in Kharif, Rabi and Zaid seasons.

➤ **Climatic Conditions**

- **High temperature (above 25° C); High Humidity with average rainfall above 100 cm.**

➤ **Extra**

- Plains of **North and North-Eastern India, coastal areas and the deltaic regions.**
- With help of **Irrigation: Punjab, Haryana, West UP and Parts of Rajasthan.**
- Other areas: **West Bengal, Andhra Pradesh, Tamil Nadu.**
- **Staple food crop** of India; India is the **second largest producer** after China.

Pulses

➤ **About**

- Major source of **protein in a vegetarian diet**; Major Pulses: **Tur (arhar), urad, moong, masur, peas and gram.**

➤ **Climatic Conditions**

- **less moisture and survive even in dry conditions**; Gram prefers **20°-25° temperature and 40-50 cm rainfall.**

➤ **Extra**

- Major pulse producing states in India are **Madhya Pradesh, Uttar Pradesh,**

- Rajasthan, Maharashtra and Karnataka.
- India is the largest producer and consumer.
- Leguminous plants-Help in restoring fertility.

Millets

➤ **About**

- **Jowar, bajra and ragi are important millets in India; Have high nutritional value.**

➤ **Climatic Conditions**

- **Jowar** is a rain-fed crop mostly grown in the moist areas which **hardly needs irrigation. (Kharif- 26°-33° C; Rabi- above 16°C).**
- **Bajra** grows well on sandy soils and shallow black soil (**Temperature- 25°- 30° C; rainfall- 40-50 cm).**
- Ragi is a crop of dry regions and grows well on red, black, sandy, loamy and shallow black soils (Temperature- 20°-30° C; rainfall- 50-100 cm).

➤ **Extra**

- **Major Jowar producing States** were **Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh.**
- **Major Bajra producing States** were: **Rajasthan, Uttar Pradesh, Maharashtra, Gujarat and Haryana.**
- **Major ragi producing states** are: **Karnataka, Tamil Nadu, Andhra, Himachal Pradesh, Uttarakhand, Sikkim, Jharkhand and Arunachal Pradesh.**
- **Alternative to rice;** India leads world production in millets.

Maize

➤ **About**

- Is used both as **food and fodder; A Kharif Crop;** In some states like Bihar-Rabi crop also.

➤ **Climatic Conditions**

- Temperature between **21°C to 27°C** and grows well in **old alluvial soil; 50-100 cm rainfall.**
- **Requires four and a half frost free months in a year.**

➤ **Extra**

- **Major maize-producing states** are **Karnataka, Uttar Pradesh, Bihar, Andhra Pradesh, Telangana, Rajasthan and Madhya Pradesh.**
- Used as Food and fodder crop; Production of crop increased due to use of HYV seeds, fertilisers and irrigation; **Rich in protein.**

Cotton

➤ **About**

- Fibre Crop; **Kharif Crop** and requires **6 to 8 months to mature**.
- Cotton grows well in drier parts of the black cotton soil of the **Deccan Plateau**.

➤ **Climatic Conditions**

- It requires **high temperature (21° -30° C)**, **light rainfall (50-100 cm)** or irrigation, **210 frost-free days** and **bright sun-shine** for its growth.

➤ **Extra**

- **Major cotton-producing states** are-Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Punjab, Haryana and Uttar Pradesh.
- Originated in India; **2nd largest producer in world**; **Light weight crop**; **Non-perishable raw material**.
- Cotton quickly exhausts fertility of soil; hence regular use of manure and fertilisers is required.

Tea

➤ **About**

- **Plantation Crop**

➤ **Climatic Conditions**

- Grows well in **tropical and sub-tropical climates** endowed with **deep and fertile well-drained soil, rich in humus and organic matter**.
- Ideal temperature- **20°-30° C**; Requires **warm and moist frost-free climate** all through the year.
- **Frequent showers (150-300 cm)** evenly distributed over the year ensure continuous growth of tender leaves.

➤ **Extra**

- Tea is a labour-intensive industry; It requires abundant, cheap and skilled labour.
- **Major tea-producing states** are **Assam, hills of Darjeeling and Jalpaiguri districts, West Bengal, Tamil Nadu and Kerala. Himachal Pradesh, Uttarakhand, Meghalaya, Andhra Pradesh and Tripura** are also tea-producing states in the country.
- **Tropical and sub-tropical climates**; **Well drained soil** where does not stagnate; One of the **major foreign exchange earners** of India.

Coffee

➤ **About**

- The **Arabica variety** initially **brought from Yemen** is produced in the country.
- **Climatic Conditions**
 - Requires **hot and humid climate** with temperature varying between **15°-28° C** and rainfall from **150-250cm**; **Hot and humid climate.**
 - **Harmful: Prolonged drought& frost; Stagnant water.**
 - **Soil: Iron and calcium, humus and minerals** rich soil ideal- well drained rich friable loams Must be properlymanured (to retain & replenish fertility).
- **Extra**
 - Initially, its cultivation was introduced on the **Baba Budan Hills** and even today its cultivation is confined tothe **Nilgiri in Karnataka, Kerala and Tamil Nadu.**
 - India produces about **4% of world coffee production**; Arabica variety is popular.
 - Almost **50% of Indian production is exported.**

Rubber

- **About**
 - **Equatorial Crop**, but under special conditions it's also grown in **tropical and sub-tropical areas.**
- **Climatic Conditions**
 - **Moist and humid climate** with rainfall of more than 200 cm. andtemperature above 25°C.
 - **Harmful: Dry spell and low temperature.** Daily rainfall followed by strongsun is very useful.
- **Extra**
 - **Mainly grown in Kerala, Tamil Nadu, Karnataka and Andaman and Nicobar Islands and Garo hills of Meghalaya**; Rubber plantations were **first established in Kerala in 1902.**
 - **Important industrial raw material**; India is **3rd largest producer in world.**

Sugarcane

- **About**
 - **Tropical as well as subtropical crop**; **Main source of sugar, gur (jaggary), khandsari and molasses.**
- **Climatic Conditions**
 - **Hot and humid climate** with a temperature of **21°C to 27°C** and an annual rainfall between **75cm and 100cm**; Can be grown on a **variety of soils** and needs **manual labour from sowing to harvesting**;
 - **Soil:Black, Laterite**

- **Extra**
 - **The major sugarcane-producing states** are **Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Bihar, Punjab and Haryana**; Needs manual labour for its cultivation; Perishable.

Jute

- **About**
 - Known as **Golden fibre**
- **Climatic Conditions**
 - Grows well on **well-drained fertile soils** in the flood plains where soils are renewed every year.
 - **Temp: 27°C; Rainfall: 120-150 cms | Soil: Light sandy or clayey loams.**
- **Extra**
 - **Major jute producing states** are **West Bengal, Bihar, Assam, Odisha and Meghalaya**.
 - Used for making **gunny bags, mats, ropes, yarn, carpets** etc.
 - **Jute getting replaced by synthetic fibres** due to low cost and durability of artificial fibres.

Gram

- **About**
 - **Rabi crop**; best grown on **loamy soil**.
- **Climatic Conditions**
 - Temp: **20-25°C**; Rainfall **40-50 cm**.
- **Extra**
 - **Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana and Maharashtra**
 - Most important of all pulses; Single or mixed crop with wheat, barley, linseed or mustard.

Tur

- **About**
 - **Kharif crop** chiefly; **Dry crop mixed** with other kharif crops
- **Climatic Conditions**
 - Temp: **20-25°C**; Rainfall **40-50 cms**
- **Extra**
 - **Uttar Pradesh, Madhya Pradesh, Maharashtra, Gujarat, Karnataka**.
 - **2nd** most important millet of India; Seldom grown as single crop.

Tobacco

- **About: Tropical and sub- tropical climate;** Freedom from frost Needs fertile soils and heavydoses of fertilisers.
- **Climatic Conditions:** Temp: **16-35°C**; Rainfall: **100cms**.
- **Extra: Andhra Pradesh and Gujarat;** 4th largest producer and 6th largest exporter of tobacco.

9. Other crops

Groundnut

- **About:** Kharif crop
- **Climatic Conditions:** Temp: **21-27°C**; Rainfall: **50- 75cms**;
- **Extras:**
 - **Enemies:** Frost, **Prolonged drought, Continuous rain, Stagnant water**
 - **Producing States:** **Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Maharashtra**
 - Accounts for more than 50% of the oilseeds produced in the country Serves as an important rotation crop because it synthesizes atmospheric nitrogen and increases soil fertility

Seasmum

- **About:** Rabi crop
- **Climatic Conditions:** Temp: **21-23°C**; Rainfall: **45- 50cms**; Soil: **Well drained light loam**
- **Extras:** **Odisha, Rajasthan, West Bengal, Maharashtra, Gujarat and Madhya Pradesh**

Mustard

- **About:** Rabi crops
- **Climatic Conditions:** **Cool climate** is suitable
- **Extras:** **Rajasthan, Uttar Pradesh**; Single crop or mixed with wheat, barley and gram

Linseed

- **About:** Rabi Cool; Dry crop
- **Climatic Conditions:** Temp:**20°C**; Rainfall:**75cms**; Soil: **Clayey, black, Alluvial**
- **Extras:** **Madhya Pradesh, Uttar Pradesh & Maharashtra**

Castor Seed

- **About:** Almost whole area of castor seed is rain-fed Kharif crop (north) Rabi crop (South)
- **Climatic Conditions** Temp: **20-25°C**; Rainfall: **50- 75cms**; Soil: **Sandy loams** (peninsula) & **Alluvial** (Satluj- Ganga plains)
- **Extras:** **Gujarat, Andhra Pradesh and Rajasthan**;

Pepper

- **About:** **Tropical crop**
- **Climatic Conditions:** Temp: **10-30°C**; Rainfall: **200- 300cms**; Soil: **Loamy**
- **Extras:** **Kerala, Karnataka, Tamil Nadu**; The plant progresses as a vine and needs support of othertrees

Cardamom

- **Climatic Conditions:** Temp: **15-32°C**; Rainfall: **150- 300cms**; Soil: **Red, Laterite and**

Loamy

- **Extras:** Kerala, Karnataka, Tamil Nadu; Shade loving plant and grown under shade-trees Used in Ayurveda

Chillies

- **Climatic Conditions:** Temp: **10-30°C**; Rainfall: **60- 125cms**; Soil: **Black and Loamy**
- **Extras:** Andhra Pradesh, Maharashtra and Odisha

Turmeric

- **About:** Tropical crop; Soil: **Sandy or loamy**
- **Producing States:** Andhra Pradesh, Karnataka and Tamil Nadu;
- **Extras:** King of spices; Used: Condiment, Healing remedy, Textile Dye

Ginger

- **About:** Tropical and sub-tropical crop
- **Climatic Conditions:** Temp: **10-25°C**; Rainfall: **125- 250cms**; Soil: **Sandy, clayey, Loamy; Red and Laterite**
- **Producing States:** Kerala, Meghalaya, Sikkim, West Bengal, Odisha and Mizoram
Origin: China

Cashew nut

- **Climatic Conditions:** Temp: **16-25°C**; Rainfall: **50-350cms**; Soil: **Laterite (West coast) and Sandy (East coast)**
- **Extras:** Goa, Kerala, Karnataka, Tamil Nadu, Andhra Pradesh & Maharashtra

Mango

- **Climatic Conditions:** Temp: **20-30°C**; Rainfall: **75-250cms**; Soil: prefer rich clayey loams
- **Extras:** Uttar Pradesh, Bihar, Andhra Pradesh, West Bengal, Odisha, Kerala, Tamil Nadu, Maharashtra, Gujarat, Karnataka

Apple

- **About:** Temperate fruit crop
- **Climatic Conditions:** Temp: **21-24°C**; Rainfall: **100-125cms**; Soil: **Loamy, Rich in organic matter**
- **Extras:** Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Arunachal Pradesh

Banana

- **About:** Tropical and sub-tropical crop and sub-tropical crop
- **Climatic Conditions:** Temp: **20-30°C**; Rainfall: **>150cms**; Soil: **Well drained, Rich in moisture and Humus**
- **Extras:** Spread all over India, Peninsular India provide ideal conditions **Tamil Nadu and Maharashtra**
 - Fruit ripens very quickly; Refrigerated boats to ship from tropics to US/EU market;

Banana producing regions nearest to major markets have trade advantage

Orange

- **Climatic Conditions:** Soil: **Textured sand loams, well- drained**; Root penetration up to 2-4 meters is best
- **Extras:** **Uttar Pradesh, West Bengal- Darjeeling, Himachal Pradesh- Kangra valley, Meghalaya- Khasi and Jaintia hills, Andhra Pradesh- Hyderabad and Aurangabad, Karnataka- Kodagu district, Kerala- Wayanad, Tamil Nadu- Nilgiri, Maharashtra- Nagpur and Pune.**
- Orange orchards are rain-fed grown at height of 600- 1500m

Grapes

- **About: Sub-tropical crop**
- **Climatic Conditions:** **Long summer and short winter; Low water supply** in growing period and bright sunshine in mature stage.
- **Extras: Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir and Punjab Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka** | The plant gives only one crop during summer but in South India the plant grows throughout the year and yields two crops a year.

Minor Forest Produce

- **About**
 - MFP is defined under **The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, popularly known as the Forests Rights Act (FRA)**
 - The definition of MFP includes **bamboo and cane**, thereby changing the categorization of bamboo and cane as “trees” under the Indian Forest Act 1927.
 - PESA, 1996 and Recognition of Forest Rights Act, 2006 conferred ownership of MFP to forest dwellers.
 - Forest Rights Act also recognizes and vests individual forest-dwellers with forest rights to own and dispose minor forest products from forests where they had traditional access.
- **Mechanism** for marketing of **Minor Forest Produce (MFP) through Minimum Support Price (MSP) and development of value chain for MFP**
 - Launched in 2014, the scheme is designed as a social safety net for improvement of livelihood of MFP gatherers by providing them fair price for the MFPs they collect and ensure sustainable harvesting of MFPs.
 - These tribals’ then sell the MFPs in village marketplaces.
 - If the market prices fall below MSP, the state government agencies move in to procure the produce
 - Ministry of Tribal Affairs is the nodal ministry for this scheme.
- **Significance of MFP in India**
 - Around 100 million forest dwellers depend on Minor Forest Produces for food,

shelter, medicines and cash income. (Report of the National Committee on Forest Rights Act, 2011)

- Trials' derive **20-40% of their annual income from Minor Forest Produce** on which they spend major portion of their time
- As per the **Haque Committee Report**, May 2011, the procurement value of **14 major MFPs is estimated Rs1900 Crores (including tendu & bamboo)**
- This activity has strong linkage to women's financial empowerment as most of the Minor Forest Produces are collected and used/sold by women.

➤ **Extra**

- Recently, **Centre revised the minimum support price (MSP) for minor forest produce**, offering much-needed support to tribal gatherers in view of the "exceptional and very difficult" circumstances prevailing in the country due to the coronavirus pandemic
- **Ministry of Tribal Affairs increased the MSP of 49 products** which are collected by tribals from forests
- This is **done under a Centrally Sponsored scheme** known as "**Mechanism for marketing of Minor Forest Produce (MFP) through Minimum Support Price (MSP) and development of value chain for MFP**" as a measure of social safety for MFP gatherers.
- **Tribal Cooperative Marketing Development Federation of India (TRIFED)**, the nodal agency for the scheme, had recommended the increase to ensure more disposable income for tribals.
- MSP for MFPs is revised once in every 3 years by Pricing Cell constituted under the Ministry of Tribal Affairs.

10. Systems & Patterns in Agriculture

Farming Systems

Basics

- Farm is a piece of land with specific boundaries, where crop and livestock enterprises are taken up under common management
- **Farming** is the **process of harnessing solar energy in the form of economic plant and animal products**
- System is a set of components which are interdependent and interacting

Wetland Farming

- **Wet land**: soils flooded or irrigated through lake, pond or canal and land is always in submerged condition
- **Wetland farming**: is the practice of **growing crops in soils flooded** through natural flow of water for most part of the year

Garden Farming

- **Garden land**: soils irrigated with ground water sources
- **Garden land farming**: Growing crops with supplemental irrigation by lifting water from underground sources.

Dryland Farming

- **Dry land**: soils purely depend on rainfall for moisture
- **Dryland farming**: is the practice of crop **production entirely depending upon rainfall** and the moisture conserved in the soil
 - This is practiced in areas where **annual rainfall is less than 750mm**.
 - The crops may face moisture stress frequently due to erratic distribution or failure of monsoon

Rainfed Farming

- Crop production in areas where **rainfall is more than 750mm** (i.e. assured rainfall areas).
- Here **moisture stress will be minimum**. Soil conservation is given more importance

Mixed Farming

- **Mixed farming** is defined as a **system of farming on a particular farm which includes crop production, raising livestock, poultry, fisheries, bee keeping etc.** to sustain and satisfy as many needs of the farmer as possible.
- **Subsistence is important objective of mixed farming**. While higher profitability without altering ecological balance is important in farming system.
- **Advantages**
 - It **offers highest return** on farm business, as the **by-products** of farm are
 - **properly utilized**

- [The crop by-products such as straw, fodder etc. is used for feeding of livestock and in return they provide milk; Manures available from livestock to maintain soil fertility]
- It provides **work throughout year; Efficient utilization** of land, labour, equipment and other **resources**.
- It helps in **supplying all the food needs of the family members**.

Specialized Farming

- The farm in which **50% or more income of total crop production is derived from a single crop** is called specialized farming

Diversified Farming

- A diversified farming has several production enterprises or sources of income but **no source of income equal as much as 50% of the total income**. It is also called as **general farming**.

Cropping Systems

About:

- The cropping system of a region is a cumulative result of long-term agricultural practices, social customs and traditions, physical conditions, Government policies, monetary considerations and historical factors.
- The **change in land use pattern and cropping pattern is vastly affected by irrigation expansion, infrastructure development, penetration of rural markets, development and spread of short duration and drought resistant crop technologies, rapid urbanization**.
- The higher cultivable area has been achieved by bringing large acreage of uncultivable land into cultivation.

Mono-Cropping

- It refers to growing of only one crop on a piece of land year after year.
- It may be **due to climatic and socio-economic conditions** or due to **specialisation of a farmer** in growing a particular crop.
- Ex: Groundnut or cotton or sorghum are grown year after year due to limitation of rainfall, while in canal irrigated areas, under a waterlogged condition, rice crop is grown as it is not possible to grow any other crop.
- **Sole cropping**: One crop variety grown alone in a pure stand at normal density.
- **Monoculture**: Repetitive growing of the same sole crop in the same land.

Multiple Cropping

- It is the practice of growing two or more crops in the same field within a given year.
- It is the **intensification of cropping in time and space dimensions**, i.e. a greater number of crops within year and a greater number of crops on same piece of land in any given period.

Mixed cropping

- **Growing of two or more crops simultaneously intermingled without row arrangement** is known as mixed cropping.
- It is a **common practice in most of dryland tracts** in India.
- The objective is **subsistence farming**; to meet the family requirement of cereals, pulses and vegetables.
- Ex: Sorghum, Bajra and cowpea are mixed and broad- casted in rainfed conditions (with low rainfall situations) to avoid complete crop failures and with ascertaining the minimum yields

Inter-cropping

- **Base crop**: The primary crop which is planted/ sown at its optimum sole crop population in an intercropping situation.
- **Intercrop**: This is a second crop planted in between rows of base crop with a view to obtain extra yields with intercrop without compromise in the main crop yields
- **Requirements**:
 - The **timing of peak nutrient demands** of component crops **should not overlap**.
 - **Competition for light should be minimum** among the component crops.
 - The **difference in maturity** of component crops **should be at least 30 days**.
 - Ex: Maize + Cowpea (1:1); Sorghum + Redgram (2:2); Groundnut + Redgram (6:1); Potato + Mustard (3:1); Wheat + Mustard (8:1)

Row intercropping

- Growing two or more crops simultaneously where one or more crops are planted in rows.
- It is a variation in space dimension.
- Ex: maize + greengram (1:1), maize + blackgram (1:1), groundnut + redgram (6:1).

Strip-intercropping

- Two or more crops are planted in the same field in alternate strips.
- Strips are **wide enough to permit independent cultivation** but **narrow enough for the crops to interact**.
- Ex: groundnut + redgram (6:4) strip.

Parallel cropping

- Growing of **two crops simultaneously which have different growth habits and no competition** among themselves
- Ex: Blackgram with maize; Soybean with cotton

Synergistic Cropping

- Yields of both crops are higher than of their pure crops on unit area basis
- Ex: Sugarcane + Potato

Multi storey cropping

- Cultivation of more than **two crops of different heights simultaneously on a piece of**

- **land** in any certain period
- Ex: Coconut + Pepper + cocoa + pineapple

Sequential Cropping

- It can be defined as **growing of two or more crops in a sequence on same piece of land in a farming year.**
- The **succeeding crop is planted after the preceding crop has been harvested.** There is no competition
- Its various types are:
 - **Double Cropping:** Growing two crops on the same land in a year in sequence. Ex: rice→cotton
 - **Triple Cropping:** Growing three on the same land in a year in sequence. Ex: Triple cropping: rice→rice→pulses
 - **Quadruple:** Growing four crops on the same land in a year in sequence. Ex:tomato→ridgegourd→amaranthus greens→baby corn.

Alley cropping

- It is a system in which **food crops are grown in alleys formed by hedge rows of trees or shrubs.**
- The essential feature of the system is that **hedge rows are cut back at planting and kept pruned during cropping to prevent shading and to reduce competition** with food crops.
- **The space between two rows called alleys;** The intercrops are raised in the alley space
- Ex: cotton, sorghum, blackgram | Ex: Subabul raised at 6 m row spacing;

Relay cropping

- ❑ In a **long duration base crop, growing two sets of inter-crops one after another** is called relay intercropping
- ❑ Ex: Redgram- base crop 180 days; Groundnut/onion/coriander-I set of intercrops; Samai/thenai/panivaragu- 2nd set of intercrops

Ratoon cropping

- Ratooning is a method of harvesting a crop which leaves the roots and the lower parts of the plant uncut to give the ratoon or the stubble crop. Crop regrows out of roots or stalks after harvest of crops.
- **Benefit:** The crop **matures earlier** in the season+ It can also **decrease the cost of preparing the field and planting.**
- Ratooning is most often used with crops which are known to give a steady yield for three years under most conditions eg sugarcane, banana, pineapple.
- However, this method cannot be used endlessly as the yield of the ratoon crop decreases after each cycle.
- Ex: Sugarcane (8 ratoons in Cuba)
 - **Banana- one plant crop** followed by two ratoon crops normally
 - **Sorghum and Lucerne fodder-** many ratoons 1stcutting 70 DAS and thereafter every

35-40 days

- **Pineapple crop** is extensively ratooned.

Crop Rotation

- The practice of growing of different crops on a piece of land is a pre-planned succession.
- The principle behind is to **utilise the available resources to the fullest extent** in order to harvest the maximum in a unit land without affecting the soil health. Ex- Rice-Red Gram –Banana

- **Practical examples of effective crop rotation:**
 - Leguminous crops should be grown before non-leguminous crops
 - ✓ Because legumes fix atmospheric N into the soil and add organic matter to the soil.
 - **Crops with tap roots** (deep rooted like cotton) **should be followed by those which have fibrous** (shallow rooted crops like sorghum or maize) **root system.**
 - ✓ This facilitates proper and uniform use of nutrients from the soil.
 - More exhaustive crops should be followed by less exhaustive crops
 - ✓ Because crops like potato, sugarcane, maize etc. need more inputs such as better tillage, more fertilizers, greater number of irrigations etc.
 - Selection of crop should be based on need or demand
 - **Crops of same family should not be grown in succession**
 - ✓ Because they act as alternate hosts for insect pests and diseases
 - The selection of crops should suit farmers financial conditions
 - **The crop selected should also suit to the soil and climatic condition**

Cropping Pattern

About

- Cropping pattern refers to the proportion of area under different crops at any given point of time in a unit area.

Factors

- **Geographical factors**
 - **Soil**
 - ✓ **Soil conditions:** soil pH, salinity, ground water table, soil topography and soil texture
 - ✓ **Soil pH:** tea grows in acidic soil where coconut needs alkaline soil to grow well
 - ✓ **Salinity:** Crops do not grow well in saline soil. So, we need to develop saline tolerant varieties for saline area. But few crops like tomatoes and broccoli may grow in moderately saline water
 - ✓ **Ground water table:** Shallow rooted crops do not grow well in that area where water table is low
 - ✓ **Soil topography:** Sesame, pineapple, zinger, turmeric etc., grows well in that land which are not under flood water but pulses, oil seeds grow well in those land where little flood water comes usually

- ✓ **Soil texture:** Sweet potato, groundnut, water melon grows well in sandy land but rice needs clay or sandy clay soil
- ✓ **Soil water:** Rice needs more soil water than any other crops

- **Terrain**
- ✓ Slope also **determine nature of crop** | Example: Tea in hilly areas whereas, rice and jute in plains

- **Climate**
- ✓ **Humidity:** Some crops like tea grow well in high humidity.
- ✓ **Day length:** Potato grows well in short day length whereas wheat, onion need long day length.
- ✓ **Rainfall:** Tea needs heavy rainfall whereas barley and chickpea grow in arid climate.
- ✓ **Temperature:** In temperate countries wheat grows well whereas in sub-tropical area rice is grows well.

- **Infrastructural facilities**
- Irrigation, transport, storage, trade and marketing, post-harvest handling and processing etc.

- **Social factors**- Land Tenancy, Size of land holdings, Size of fields, etc
- **Financial condition:** Poor farmer cannot grow expensive crops like sugarcane, Banana etc. (high initial cost)
- **Transport problem:** Poor communication as well as conveyance facility
- **Market price:** Good market price influence the farmer to grow more crops as well as diversify the set of crops to be grown (+technology + storage, etc.)
- **Food habit:** The crops that are not present in the food habit in a locality are usually not grown at that locality
- **Storage facility:** Where there is no storage facility, farmers of that locality usually do not grow vegetables(short life)
- **Attitude of farmer:** Sometimes farmers do not want to adopt modern technology

- **Economic factors**
- **MSP:** Minimum Support Price provided to farmers for production of crops Demand based cropping pattern: Cotton cultivation in Vidarbha, Maharashtra, Rice in Punjab and Jute in West Bengal

- **Technological factors**
- If there is no extraction facility, farmer will not cultivate oil seeds
- If there is no shelling facility farmer will not go for corn cultivation.
- Enhanced varieties, cultural requirements, mechanization, plant protection, access to information, etc. are the factors involved.

- **Areal factors**
 - It is determined on the basis of areal strength of individual crops.
 - The first, second and third ranking crops of an areal unit may be called as the dominant crops of that unit.
 - These crops, if occupying more or less the same percentage of the total cropped area, shall be competing for area with each other and the farmer will decide which crop may fetch him more profit in a given year under the prevailing rainfall and demand, supply and commodity price condition.
 - Or in the determination of cropping patterns of an area, the minor crops (crops occupying insignificant proportion of the total cropped area) are eliminated.

- **Relative yield:** With respect to the size of the field + other important factors (input cost, etc.)
- **Imbalance in pattern of food grain:** Change in **consumption pattern**; Race for **remunerative returns**; Sowing of one type of crops
- **Government Policies:** MSP; Promotion of cash crops; Nature of policy, crop insurance schemes and facilities to influence farmer to grow a particular crop of a certain area
- **Production Inputs:** It is the direct regulator of cropping pattern of region. If there are no available inputs, farmer will not go for production.
- **Role of man:** The role of man in the cultivation of certain crops in a region is also quite important. Man, by his technological advancement, can ameliorate the physical limits.

Cropping Zones

Wheat Zone

- This region covers the **entire north-western** India including the state of Punjab, Haryana, Uttar Pradesh and Rajasthan.
- The major sub-regions are:
 - **Wheat-Maize-Sugarcane:** This region comprises a great part of wheat regions, covering **West Uttar Pradesh, Himachal Pradesh and Jammu.**
 - **Wheat-Jowar-Bajra** in Indus Plain covering **Punjab and Haryana.**
 - Wheat-Jowar-Bajra in Vindhyan scarp land and Malwa Bundelkhand plateau.

Rice zone

- Rice is considered as the major crop in the vast region stretching from lower Gangetic plain to Brahmaputra valley in the east and the circum-coastal alluvial tracts of the peninsula region.
- Though rice displays overall dominance, considering the secondary importance of other crops, this region may be subdivided into following zones:

- Rice-Jute-Tea: This association of crops occurs in far east, near Assam Valley, north-west Bengal and lower Gangetic plains.
- Rice-Pulses-Millet:-: This association occurs in the western section of the former zone, covering central Bihar, eastern Madhya Pradesh and eastern Uttar Pradesh.
- Rice-Millet: This zone comprises the entire Andhra Pradesh, southern Orissa and some parts of Tamil Nadu.
- Rice-Coffee-Spices: This zone is found in the southern extremity of Kerala and Tamil Nadu.

Jowar Bajra Zone

- This crop combination is practised in drought prone region (rainfall 50-100 cm).
 - Jowar-Cotton in Maharashtra.
 - Jowar-Cotton-Oilseeds-Millet in Karnataka and Maharashtra.
 - Jowar-Wheat in entire Rajasthan, Haryana and some parts of Uttar Pradesh.
 - Bajra-Jowar-Pulses in Rajasthan desert and semi-desert areas.

Cotton Zone

- It predominates in the black cotton soil (regur) region in the North West India.
- It covers the Deccan trap region and Gujarat plain.
- The different sub-regions are
 - Cotton-Jowar-Bajra grows in close association with one another in the Maharashtra and Western Madhya Pradesh
 - Cotton-Oilseeds combination developed in Gujarat
 - Cotton-Pulses-Rice region developed in Narmada banks and Eastern Gujarat.

Millet- Maize Zone

- The cultivation of millet, maize and ragi are found in close association with other major cereals like bajra, wheat, rice etc.
- Maize cultivation dominates in Rajasthan, Gujarat, and Madhya Pradesh. In Himachal Pradesh, Maize- Barley-wheat combination has developed, particularly in the foothills of the

Himalayas. Some parts of the Aravalli have the peculiar crop combination of Maize-Cotton-Oilseeds-Millet-Wheat. Ragicultivation predominates in South of Karnataka.

- Maize has wide adaptability and compatibility under diverse soil and climatic conditions.
- It is cultivated in sequence with different crops under various agro-ecologies of the country

Fruit & Spice Zone

- This is the smallest region among the different crop regions.
- High-altitude hilly areas come under the territory of this region. The 'Duns' and valleys in Himalayas, foothills of Nilgiri, Annamalai, Palni and Cardamom hills in Tamil Nadu and Kerala may be classified as fruit and spice region. Here, the dominant agricultural activity is fruit orchards and plantations.

Others

- Plantation and Other Commercial Crops Crops under this category include sugarcane, tobacco, potato, jute, tea, coffee, coconut, rubber and other crops, such as spices and condiments.
- Some of them are seasonal, some annual and some perennial. Most of them require specific environmental conditions and from the point of view of cropping patterns, they are concentrated in some particular regions. Besides, certain horticultural crops, such as apple, mango and citrus, are important.
- In the case of plantation-crops, intercropping with pulses and fodder crops is common.
- Spices and condiments are generally grown on fertile soils. Chillies are rotated with jowar, whereas onion, coriander, turmeric and ginger are grown as mixed crops with other seasonal crop
