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# Understanding Agriculture

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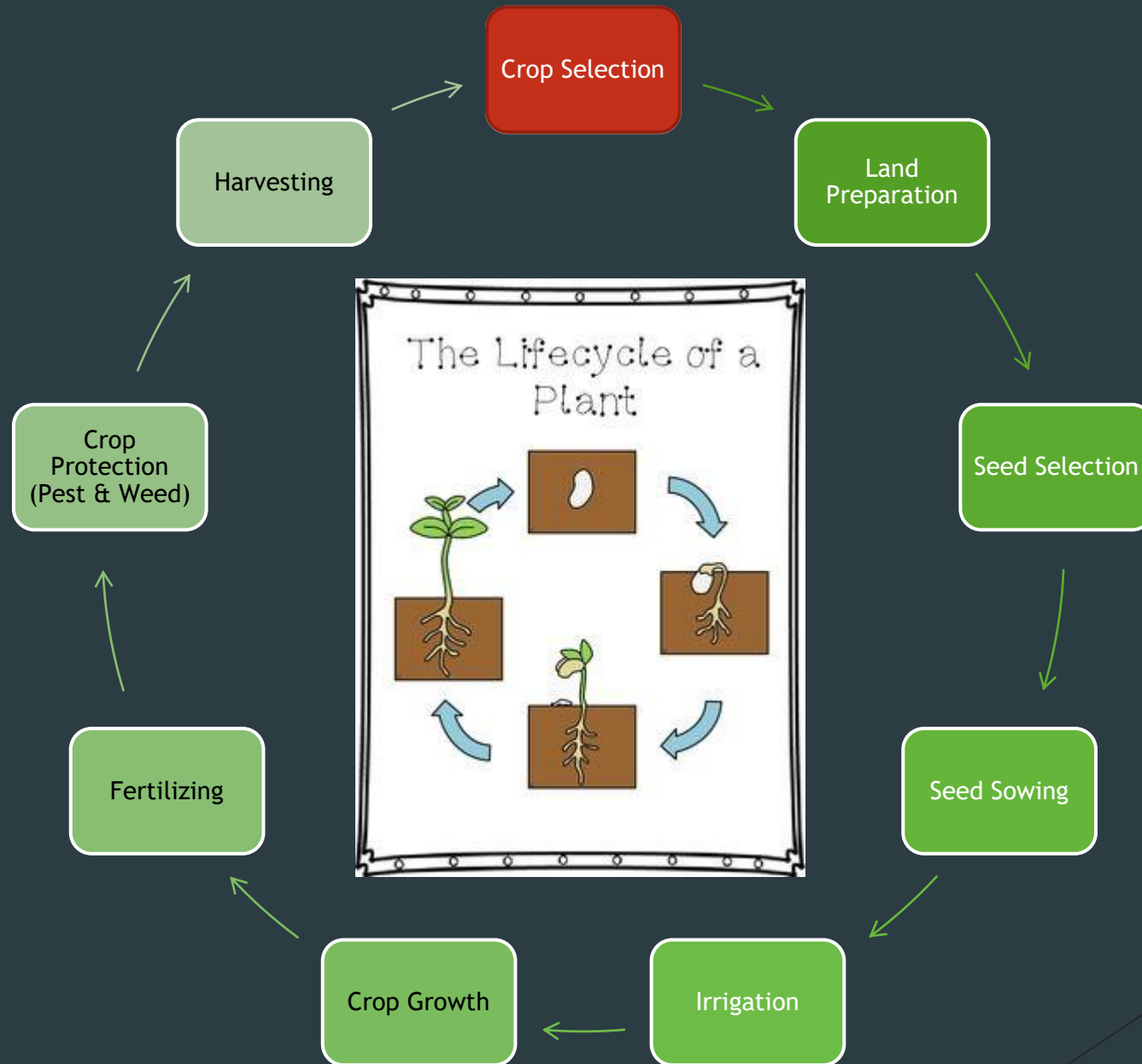
Presentation made for UA, Summer School,  
CEPT University

May, 2021

# Things we will learn today:

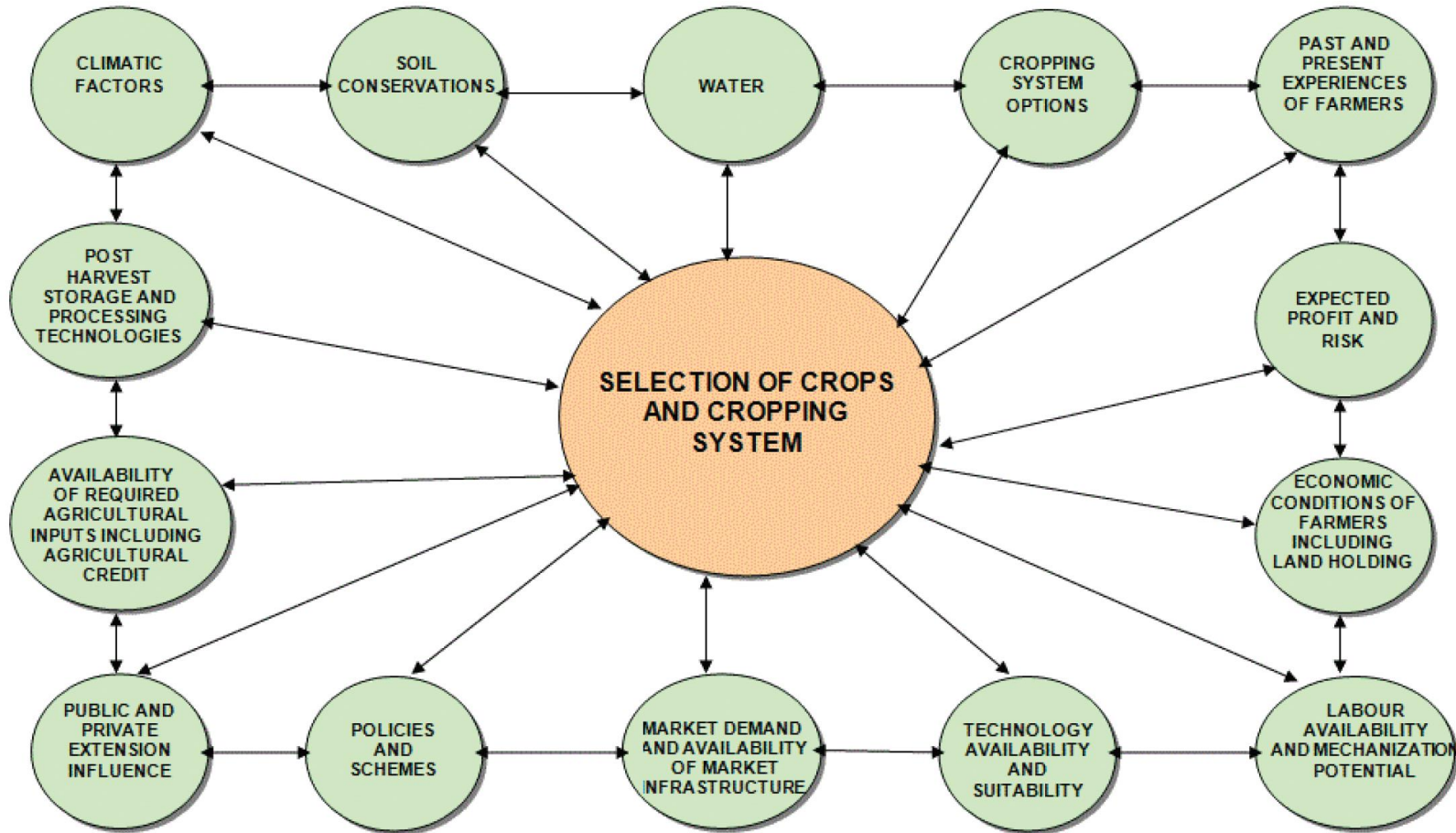
- ▶ Farming Life Cycles
- ▶ Farming Seasons
- ▶ Agro Climatic Zones
- ▶ Climate Change and its impacts

# Farming Life Cycle

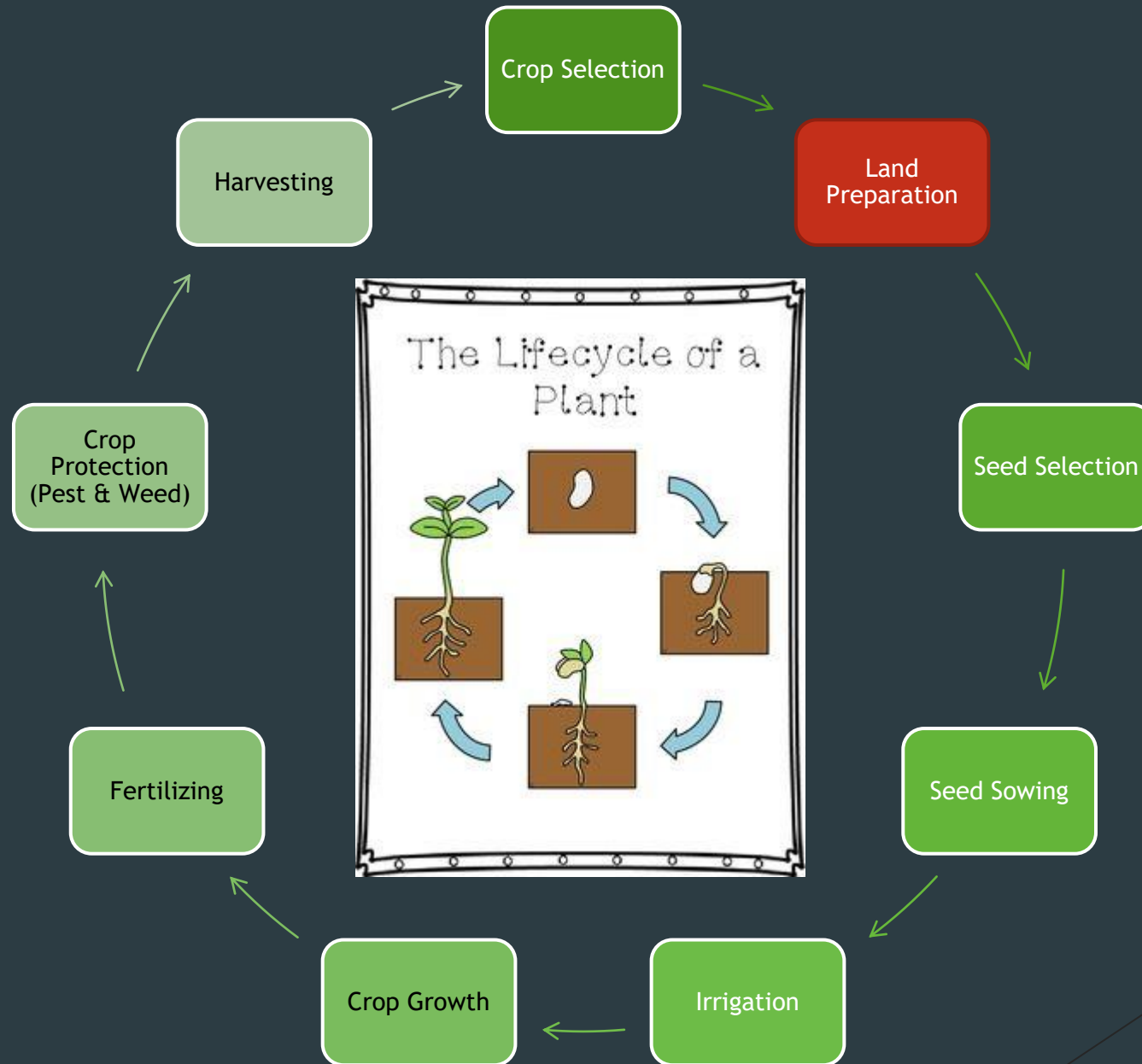


# Selection of Crop

## Factors influencing decisions on the selection of crops and cropping system



# Farming Life Cycle



# Land Preparation - What is Soil?

## Know your Soil

### 2.3. What is Soil?

Soil is a thin layer of earth's crust, which serves as a natural medium for the growth of plants. Rocks are the important sources for the parent materials over which soils are developed.

### Soil Constituents



Rocks, the source of parent material

Soil is a dynamic medium made up of minerals, organic matter, water, air and living creatures including bacteria and earthworms.

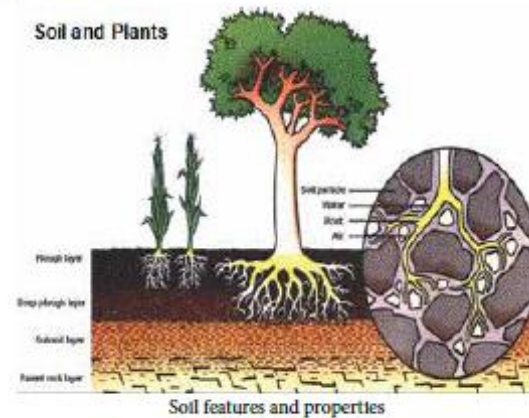
It was formed and is forever changing due to 5 major

physical factors: parent material, time, climate, organisms present and topography. The way in which we manage soil is another major factor influencing the character of the soil.



Soil Constituents

### Soil features, properties and their importance

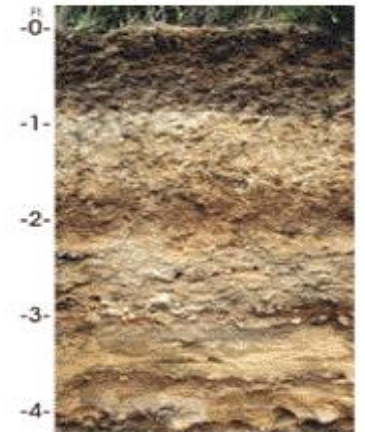
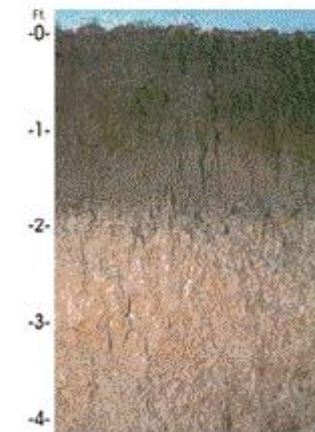
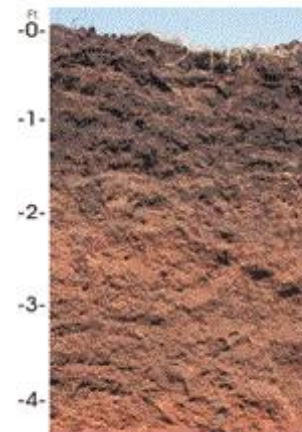


### Soil colour

- Dark colour indicates usually medium to high fertility due to high amount of organic matter. These soils have usually high amount of nutrients, good water holding capacity and structure and are well aerated.
- Light colour indicates medium to low fertility. These soils may have leaching issue (water makes organic matter and other nutrients move downward faster).



Soil

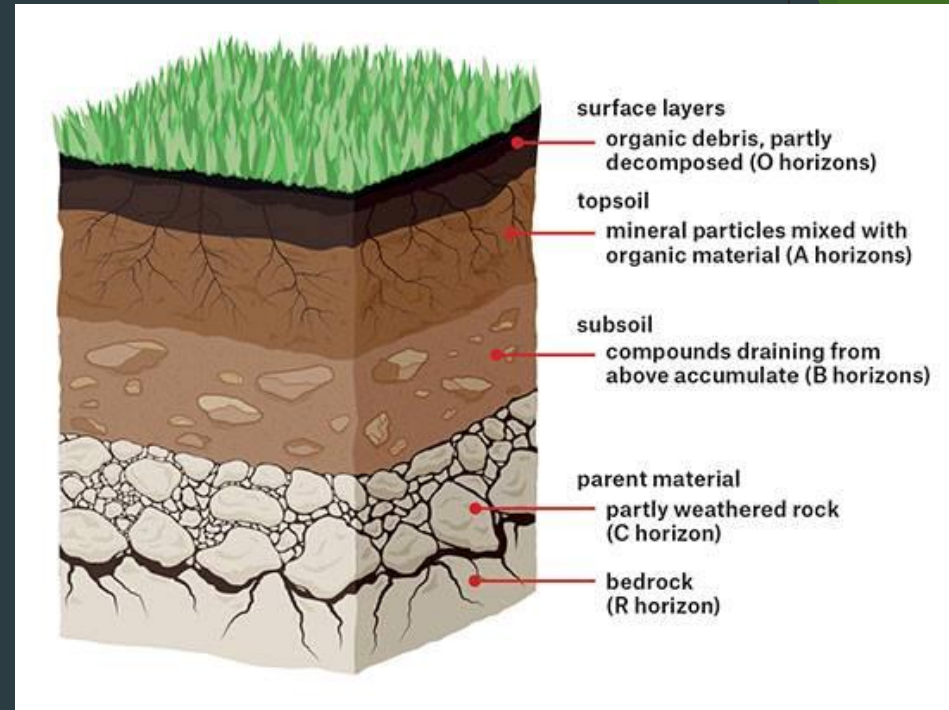
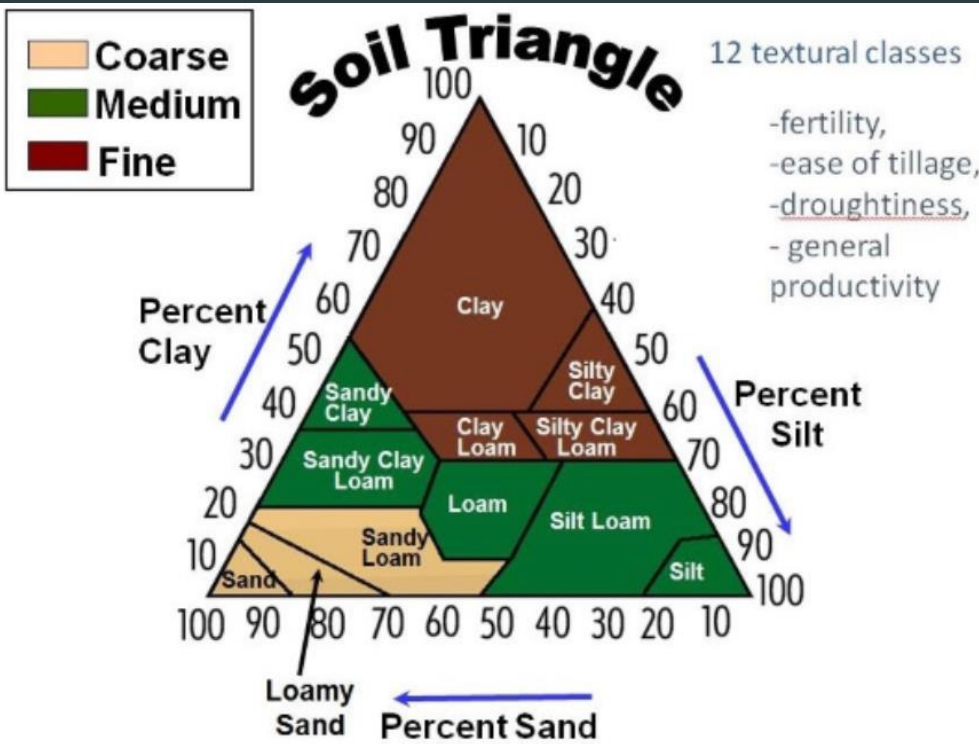


# Land Preparation - Soil Types

## TYPES OF SOIL



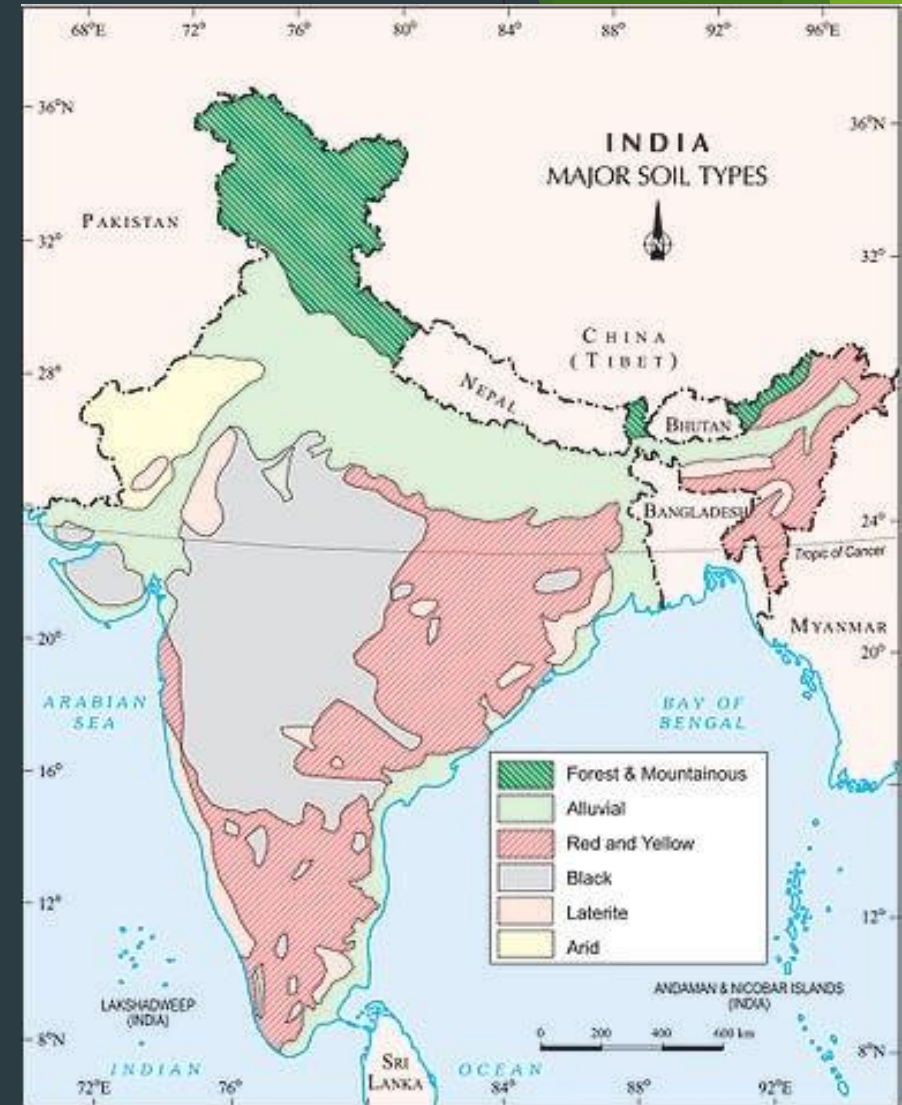
1 Sandy Soil | 2 Silty Soil | 3 Clay Soil | 3 Loamy Soil



# Land Preparation - Soil Map of India

## Alluvial soil:

- Mostly available soil in India (about 43%) which covers an area of 143 sq.km.
- Widespread in northern plains and river valleys.
- In peninsular-India, they are mostly found in deltas and estuaries.
- Humus, lime and organic matters are present.
- Highly fertile.
- Indus-Ganga-Brahmaputra plain, Narmada-Tapi plain etc are examples.
- They are depositional soil - transported and deposited by rivers, streams etc.
- Sand content decreases from west to east of the country.
- New alluvium is termed as **Khadar** and old alluvium is termed as **Bhangar**.
- **Colour:** Light Grey to Ash Grey.
- **Texture:** Sandy to silty loam or clay.
- Rich in: potash
- Poor in: phosphorous.
- Wheat, rice, maize, sugarcane, pulses, oilseed etc are cultivated mainly.





# Land Preparation - Soil Conservation

## 1.5. Soil and Water Conservation

Soil and water are our precious heritage. Hence, it is obligatory on our part to protect and hand over these resources to further generations. It is estimated that about 50% of the cultivated area in India suffers from severe soil erosion and requires remedial measures.

- Water resources are essential for increasing and stabilizing crop production.
- Wind erosion has been responsible for destroying the valuable top soil.

### 1.5.1. Degradation of soil and water takes place with water and wind erosion

- The main cause of water erosion is unmanaged runoff.
- Runoff is the portion of the rainfall or irrigation water applied which leaves a field either as surface or as subsurface flow.

### Several factors are responsible for runoff

- **Climatic factors:** Precipitation characteristics - duration, intensity, distribution, direction, temperature, humidity, wind velocity.
- **Watershed characteristics:** Geological shape of the catchments, size and shape of the catchments, topography, drainage pattern.
- Barren land without vegetation
- **Soil types:**
  - **Sandy soil:** Average rain – no problem of erosion. High intensity – More serious of less binding material i.e. fine soil particle.
  - **Clay soil:** Ordinary rain – more runoff in moderate and steep slopes but high water holding capacity.
  - **Silt loam, loamy and fine sandy loam:** More desirable soils from the point of view of minimizing soil erosion.

### How vegetation reduces runoff

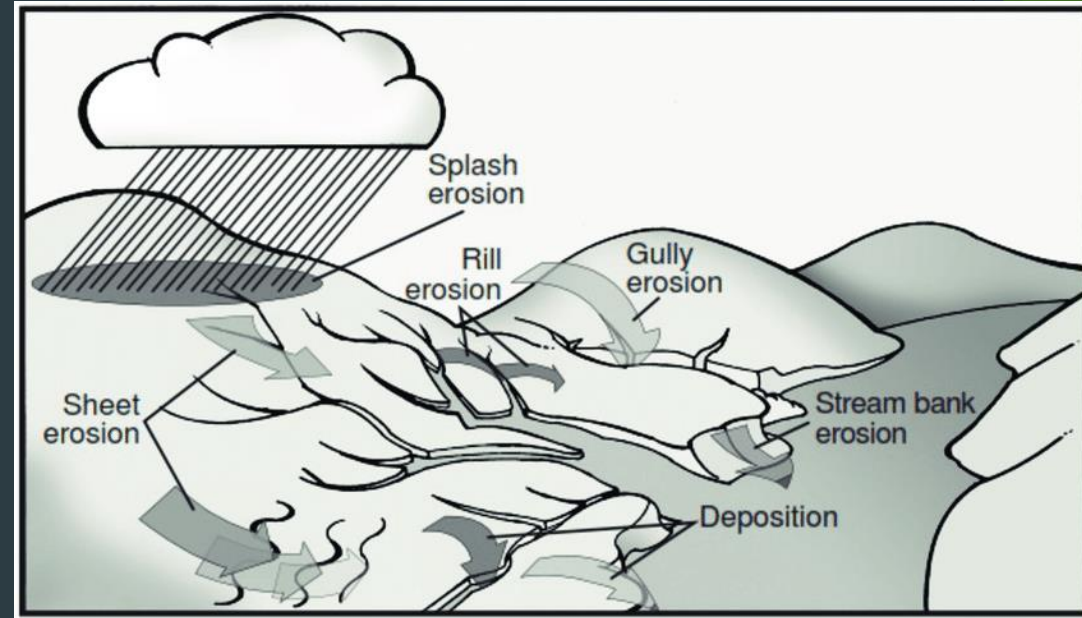
- Interception of rainfall
- Root structure
- Biological influences
- Transpiration effects
- Intercept, absorb the impact of raindrop
- Hindrance to runoff water slows down the rate at which travels down the slope
- Knitting and binding effect aggregates the soil into granules
- Die and decay increase pore space and water holding capacity
- One cubic meter of soil has several kilometres of root fibre
- More vegetative cover, most active soil fauna, channels of earth worm, beetles and other life
- Vegetation increases the storage capacity of the soil for rainfall by the transpiration of large quantities of moistures from the soil

# Land Preparation - Soil Erosion

## Soil erosion

Soil erosion is the detachment and transportation of soil material from one place to another through the action of wind, water in motion or by the hitting action of the rain drops.

- When the vegetation is removed and land is put under cultivation the natural equilibrium between soil building and soil removal is disturbed.
- The removal of surface soil takes place at a much faster rate than it can be built up by the soil forming process.



Wind Erosion

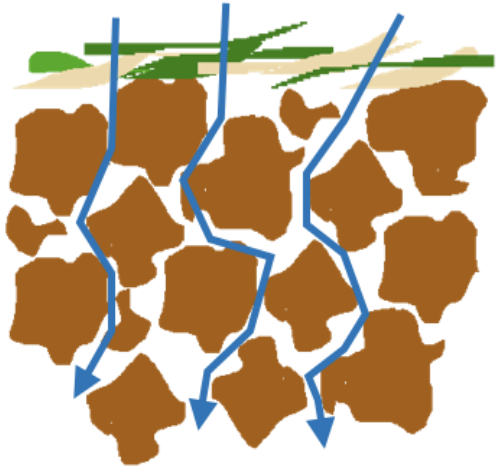


Gully Erosion



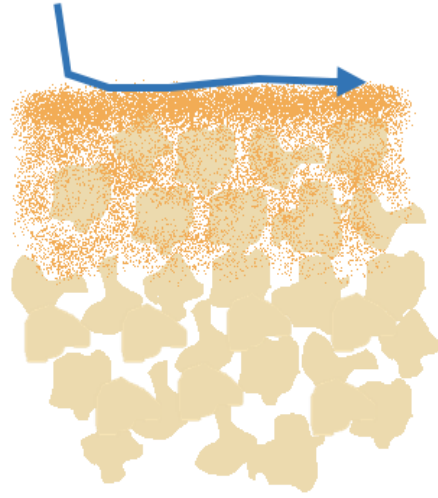
Sheet and Rill Erosion

# Land Preparation - Soil Conservation



## Healthy Soil

- Good structure
- Water infiltration into soil pores
- Slows water velocity
- Dark color
- High organic matter
- Soil surface is covered with dead vegetation



## Degraded Soil

- Weak structure
- No water infiltration soil pores clogged
- Water runs off quickly
- Light color
- Low organic matter
- Soil surface is covered with a soil crust

## 1.5.2. Conservation

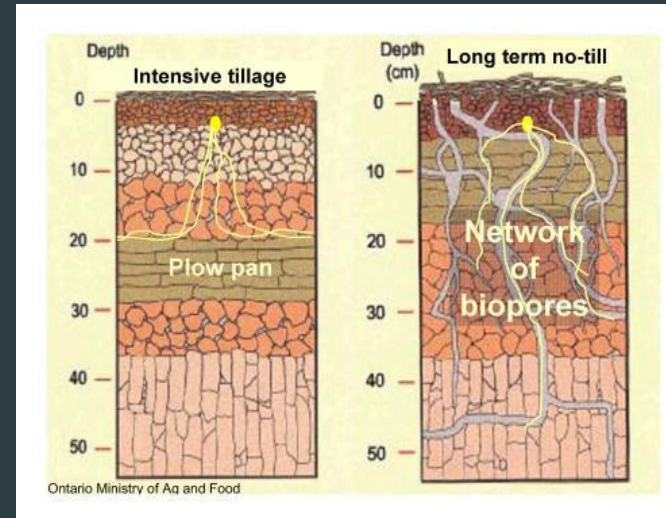
Conservation is the utilization without wastage of resources is required to ensure a high level of production.

### Important soil conservation measures are

- Conservation Tillage
- Minimum tillage
- Zero tillage
- Stubble mulching
- Trash farming



Shelterbelts for Moderating micro



# Land Preparation - Decision making!

## Wind erosion management

- Protect the soil surface with a cover of vegetation or vegetative residues.
- Produce or bring to the surface soil aggregates or clods which are large enough to resist the wind force.
- Roughen the land surface to reduce wind velocity and trap drifting soil.
- Establish barriers or trap strips at intervals to reduce wind velocity and soil drifting.

## Best practices to control soil blowing

- Deep ploughing
- Summer ploughing
- Surface roughness
- Conserving moisture
- Wind breaks and shelterbelts
- Mechanical or vegetative barriers

For instance: Shelterbelts for moderating micro-climate

- Shelterbelts reduce wind velocity
- Moderate temperature
- Reduce evaporative loss and conserve soil moisture

## Water erosion can be managed by

- In situ water harvesting
- Summer ploughing

## Overland flow management

- Contour bund
- Graded bund
- Broad based bund
- Bench terrace
- Water harvesting and recycling

## Zero tillage

- Several practices are in use such as zero tillage, minimum tillage and direct seeding.
- Planting crops in previously untilled soil by opening a narrow slot, trench or band only of sufficient width and depth to obtain seed coverage. No other soil tillage is done.

## Advantages of zero tillage farming

- Erosion control: Retained stubble and crop residue reduces soil erosion and enhances soil fertility
- Moisture conservation: Stubble traps water, reduce runoff water, better infiltration leading to improved soil moisture condition
- Higher nitrogen availability
- Seedling protection: Stubbles protects young seedling from wind and heat
- Crop yields will be on par with traditional tillage system. However good yield can be harvested during dry years
- Reduce labour and save time
- Savings on equipment cost
- Savings on oil/fuel cost

## Mulching: Benefits of crop residue mulching are

- Increased availability of water and organic matter
- Less erosion
- Environment protection

# Land Preparation

## Land Preparation



Wooden Plunk



Bullock Drawn Country Plough

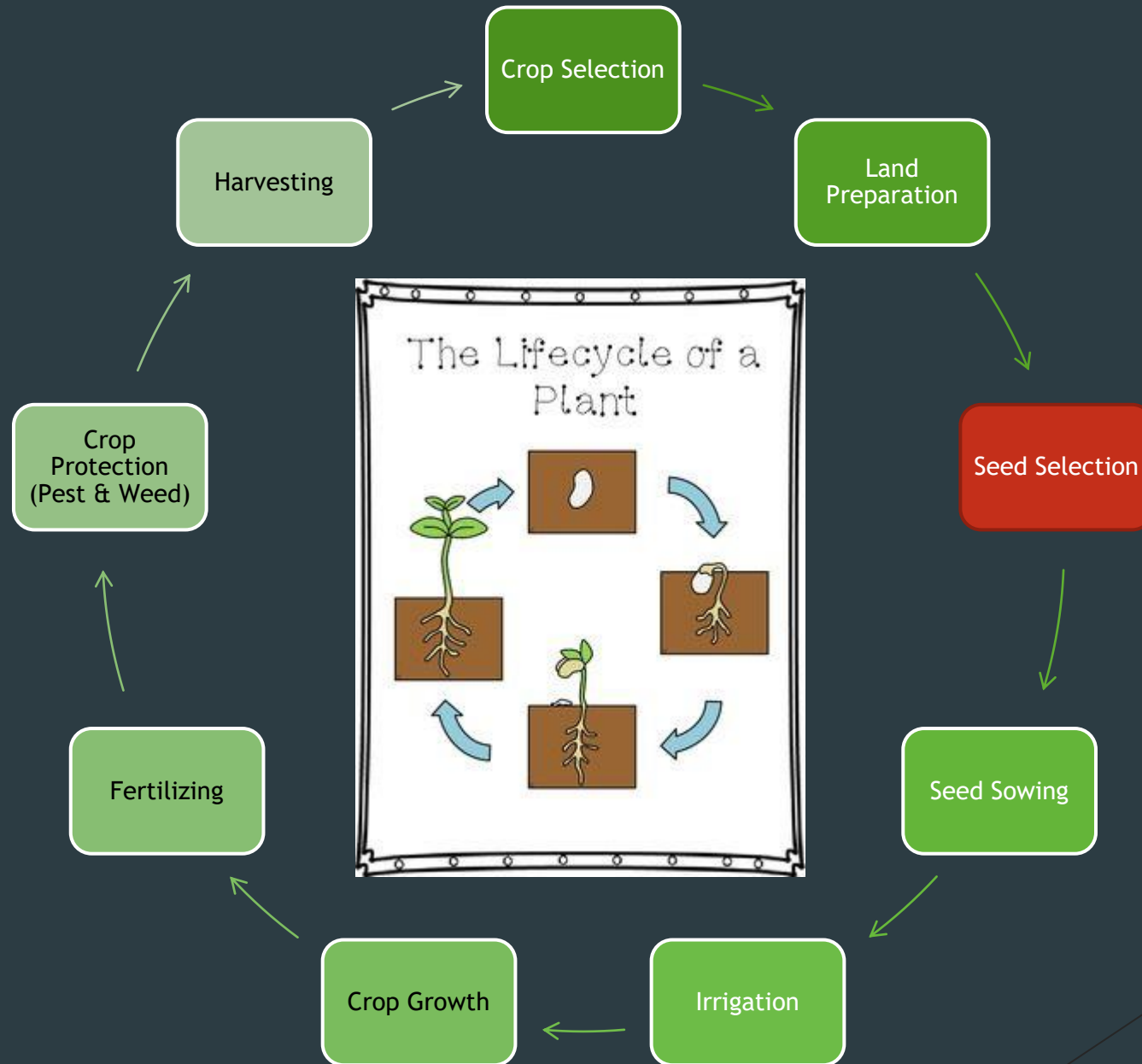


Laser Guided Land Leveller

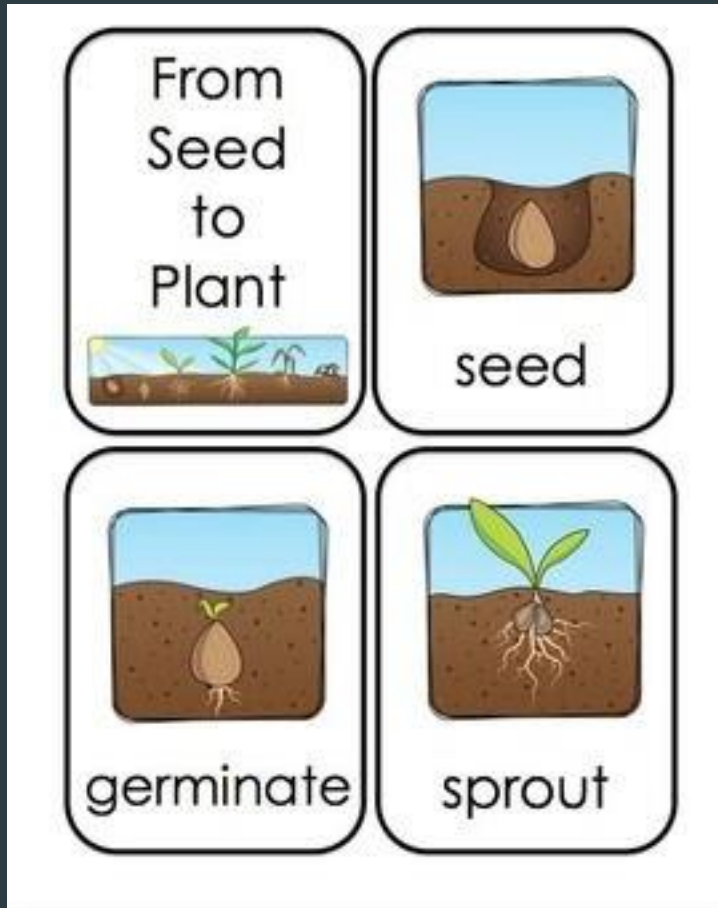


Field Operation of Tractor Drawn Disc Plough

# Farming Life Cycle



# Seed Selection



## 1.7. Seed

A 'seed' (in some plants, referred to as a 'kernel') is a small embryonic 'plant' enclosed in a covering called the seed coat, usually with some 'stored food'. Seeds fundamentally are a means of reproduction and most seeds are the product of 'sexual reproduction', which remixes genetic material and 'phenotype variability' that 'natural selection' acts upon.

The seed is the basic input in agriculture upon which other inputs are applied. A good vigorous seed utilizes all the resources and realizes a reasonable output to the grower. It is wealth to the farmer since yesterday's harvest is tomorrow's hope. Good seed in good soil realizes a good yield. Moreover, it is the link between two generations.

### Functions of seeds

- Nourishment of the embryo
- Dispersal to a new location
- Dormancy during unfavourable conditions

### Characteristics of good seed

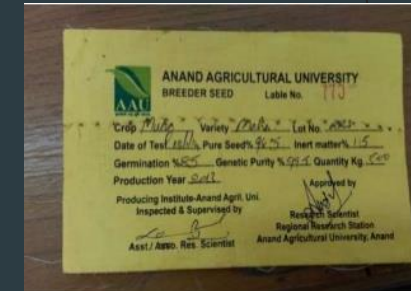
- Genetically pure

- Breeder /Nucleus - 100%
- Foundation seed - 99.5%
- Certified seed - 99.0%
- Required level of physical purity for certification
  - All crops - 98%
  - Carrot - 95%
- High pure seed percentage
  - Bhendi - 99.0 %
  - Sesame, soybean & jute - 97.0 %
  - Ground nut - 96.0 %
- Free from other crop seeds
- Free from designated diseases like loose smut in wheat
- Free from objectionable weed seed like wild paddy in paddy
- Have good shape, size, colour, etc. according to specifications of variety
- Have high physical soundness and weight
- Posses high physiological vigour and stamina
- Posses high longevity and shelf life
- Have optimum moisture content for storage
  - Long term storage: 8% and below
  - Short term storage: 10-13%
- Have high market value

# Seed Selection - Types of Seeds

## Seed types and characteristics

Seed Type	Characteristics	Genetic Purity	Tag Colour
Nucleus Seed	Produced by the breeder and it is genetically pure seed	100%	-
Breeder Seed	Produced by the breeder from nucleus seed	100%	Yellow
Foundation Seed	Produced by the breeder seed under the supervision of the concerned seed certification agency	99.5%	White
Certified Seed	<p>Certified seed is the progeny of foundation seed and its production is supervised and approved by certification agency.</p> <p>The seed of this class is normally produced by the State and National Seeds Corporation and Private Seed Companies on the farms of progressive growers.</p> <p>This is the commercial seed which is available to the farmers.</p>	99.0%	Azar Blue





# Seed Selection - Treatment

## Seed treatment

Seed treatment is usages of specific products and specific techniques to improve the growth environment for the seed, seedlings and young plants. It ranges from a basic dressing to coating and pelleting.

**Seed dressing:** This is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation. Dressings can be applied at both, the farm and industries. Low cost earthen pots can be used for mixing pesticides with seed or seed can be spread on a polythene sheet. The required quantity of chemical can be sprinkled on the seed lot and mixed mechanically by the farmers.

**Seed coating:** A special binder is used with a formulation to enhance adherence to the seed.

**Seed pelleting:** The most sophisticated Seed Treatment Technology changes the physical shape of a seed to enhance pelletability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive application.

## The farmer must take care of the following while buying the seeds

- When purchasing the seed farmer should obtain a bill/cash memo wherein the lot number and seed tag number is mentioned.
- After purchasing the seed, empty bag/packet (pouches) and receipt should be kept safely.
- Out of purchased seed, 100 seeds are taken from each purchased variety to test them for germination before sowing in the field. Knowing the germination percentage, the farmer can decide the seed rate when sowing in the field.

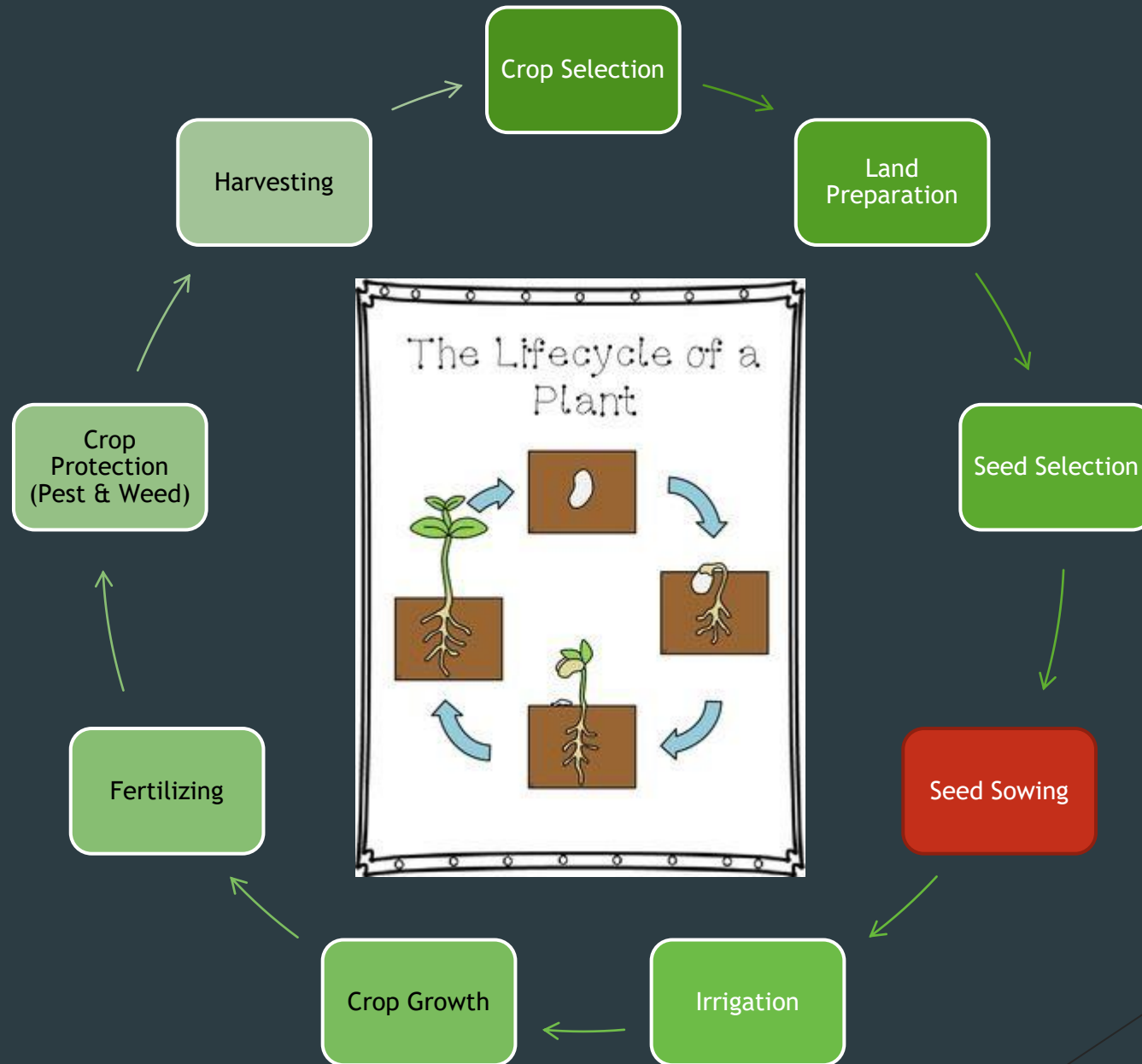


Seed Dressing



Pelleted Onion Seed

# Farming Life Cycle



# Seed Sowing - Non-Mechanized Methods



# Seed Sowing -Mechanized Methods

## Seeding and Planting Machinery



CRIDA 2 Row Planter



Seed Treating Drum



Field of Operation of Yanji Transplanter for SRI



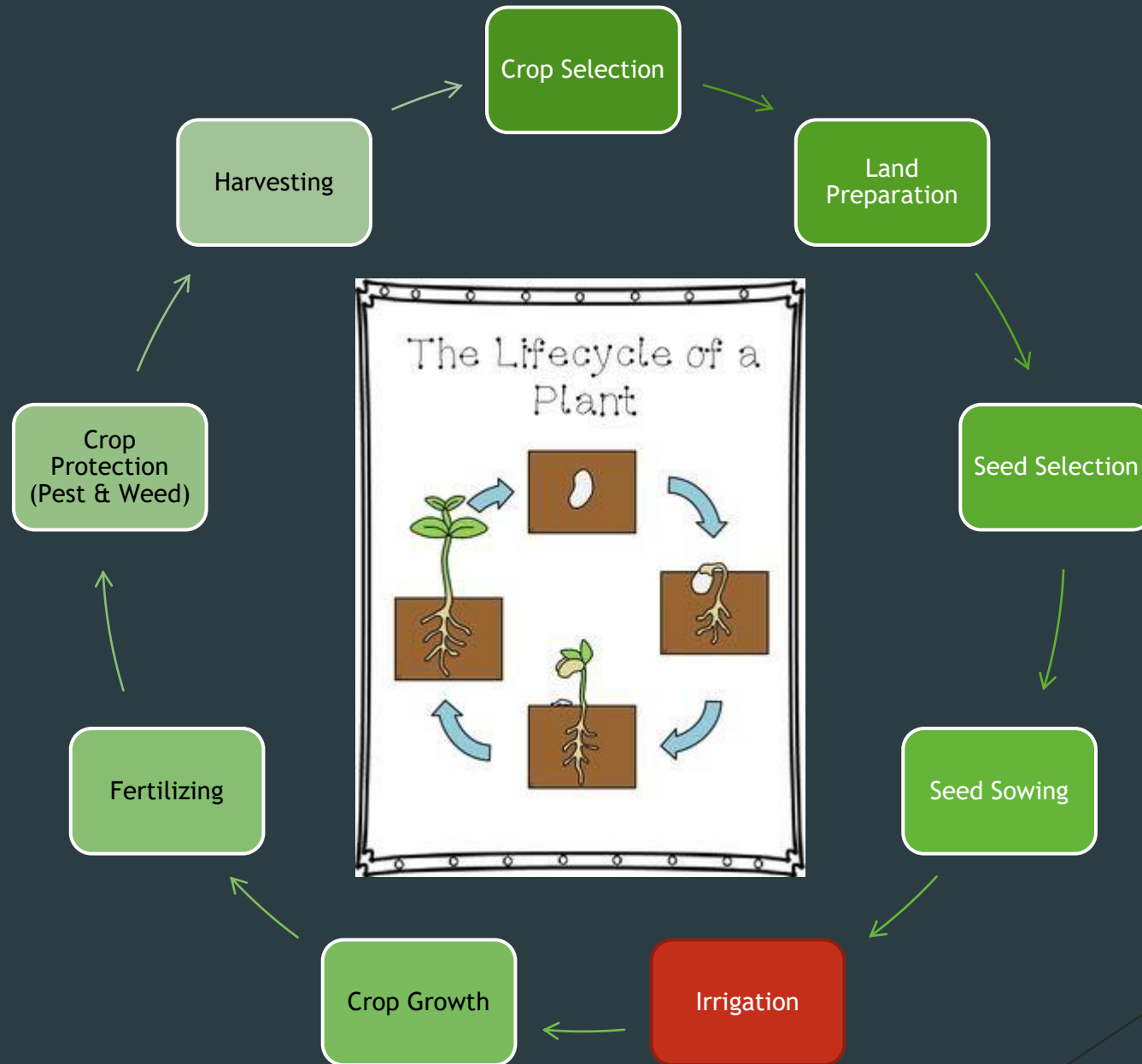
Tractor Drawn CRIDA 9 Row Planter

## Benefits of Agricultural Mechanization

Benefits	Value, %
Saving in seed	15-20
Saving in fertilizer	15-20
Saving in time	20-30
Reduction in labours	20-30
Increase in cropping intensity	5-20
Higher productivity	10-15

Substantial reduction in drudgery of farm workers especially that of women

# Farming Life Cycle



# Irrigation

## 1.6. Irrigation

An adequate water supply is important for plant growth. When rainfall is not sufficient, the plants must receive additional water from irrigation.

### Points consider for irrigation decisions

- Land suitability for irrigation like slope
- Effective rainfall: Part of the total rain is useful for crop production
- When to irrigate: Decide based on soil, crop and climatic condition
- How much to irrigate: Decide based on crop water requirement
- How to irrigate: Select appropriate method for irrigation
- Quality of irrigation water

### 1.6.1. Various methods can be used to supply irrigation water to the plants

- Surface irrigation:
  - Basin irrigation
  - Furrow irrigation
- Sprinkler irrigation
- Drip irrigation



Basin Irrigation



Sprinkler Irrigation



Furrow Irrigation



Drip Irrigation

# Irrigation - Drip System

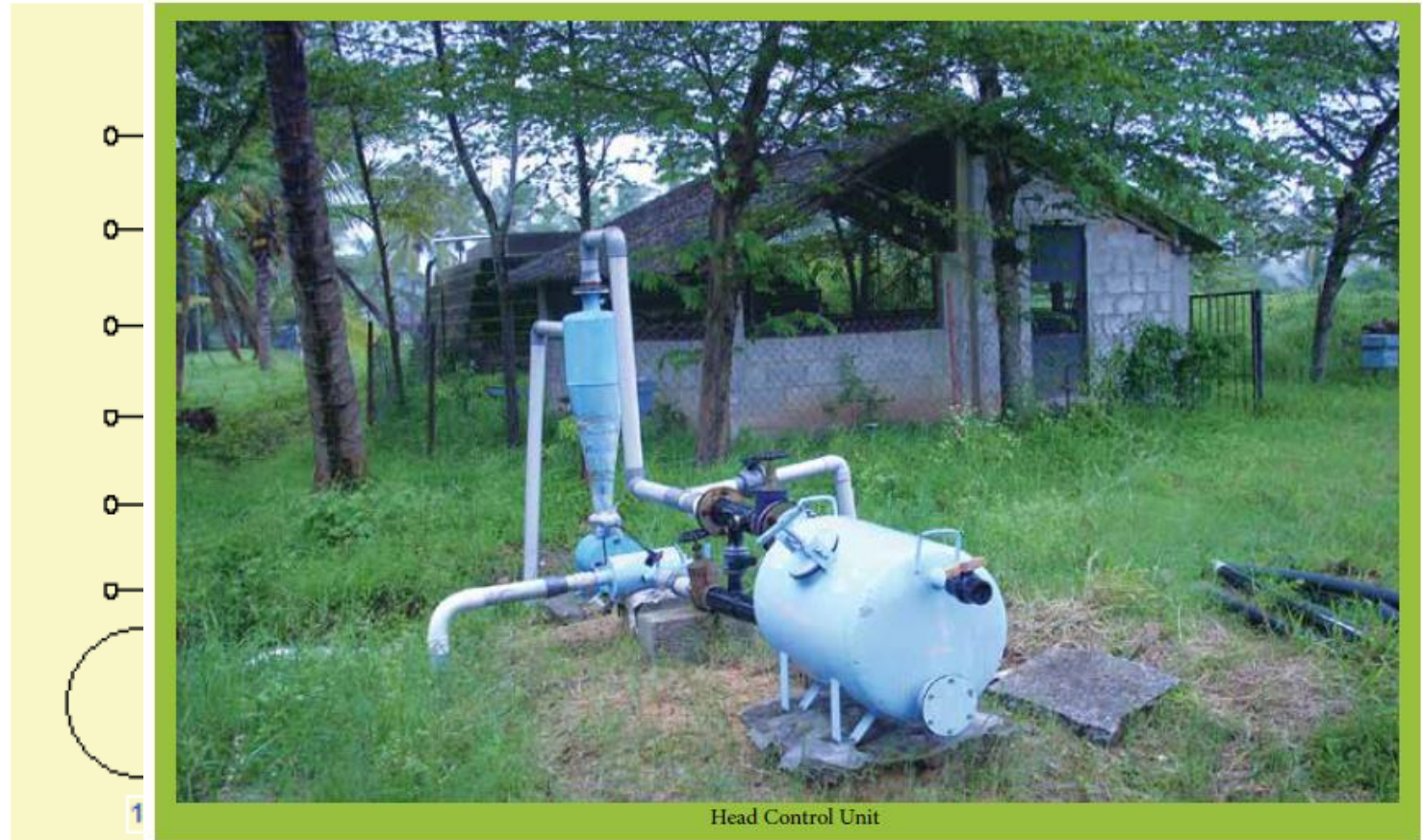
## Drip irrigation

Water is conveyed under pressure through a pipe system to the fields, from where it is discharged slowly or at a pre designed rate. The latter can be matched to the soil infiltration capacity through emitters or drippers that are located close to the root zone of the plants.

A typical drip irrigation system consists of the following components:

- Pump unit
- Control unit
- Filtering unit
- Mainline and sub mainlines
- Laterals
- Emitters

## Layout of micro irrigation system



Head Control Unit

o Mainline

# Irrigation - Sprinkler System

Use of Sprinklers for different crops

Crop Type	Crop Example
Cereals	Maize, Sorghum, Wheat, Jowar
Flowers	Carnation, Jasmine, Marigold
Oilseeds	Groundnut, Mustard, Sunflower
Vegetables	Onion, Potato, Radish, Carrot
Fodders	Asparagus, Pastures
Pulses	Gram, Pigeon pea, Beans
Plantation	Coffee, Rubber, Tamarind
Fibre	Cotton, Sesame
Spices	Cardamom

Response of different crops to sprinkler irrigation

Crop	Water saving (%)	Yield increase (%)
Bajra	56	19
Barley	56	16
Bhendi	28	23
Cabbage	40	3
Cauliflower	35	12
Chillies	33	24
Cotton	36	50
Cowpea	19	3
Fenugreek	29	25
Garlic	28	6
Gram	69	57
Groundnut	20	40
Jowar	55	34
Lucerne	16	27
Maize	41	36
Onion	33	23
Potato	46	4
Sunflower	33	20
Wheat	35	24

Benefits of drip irrigation over surface irrigation

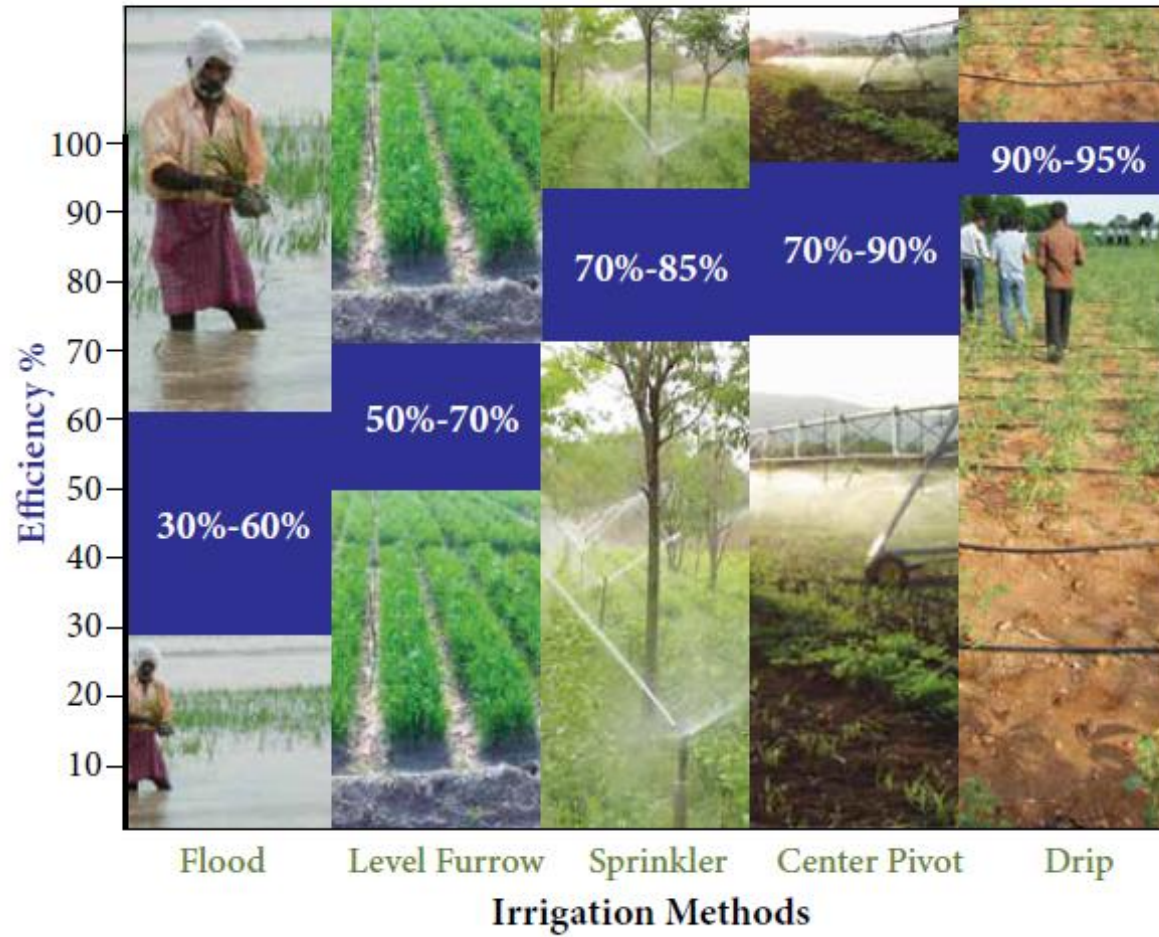
Crop	Yield increase (%)	Water saving (%)
Mango	80.0	34.8
Banana	52.0	45.0
Grapevine	23.0	48.0
Lady's finger	16.0	40.0
Brinjal	14.0	53.0
Chillies	44.0	62.0
Papaya	75.0	68.0
Pomegranate	98.0	45.0
Tomato	50.0	39.0
Watermelon	88.0	36.0
Sugarcane	133.3	49.3
Cotton	88.0	46.6
Onion	53.8	46.1
Potato	79.5	54.1



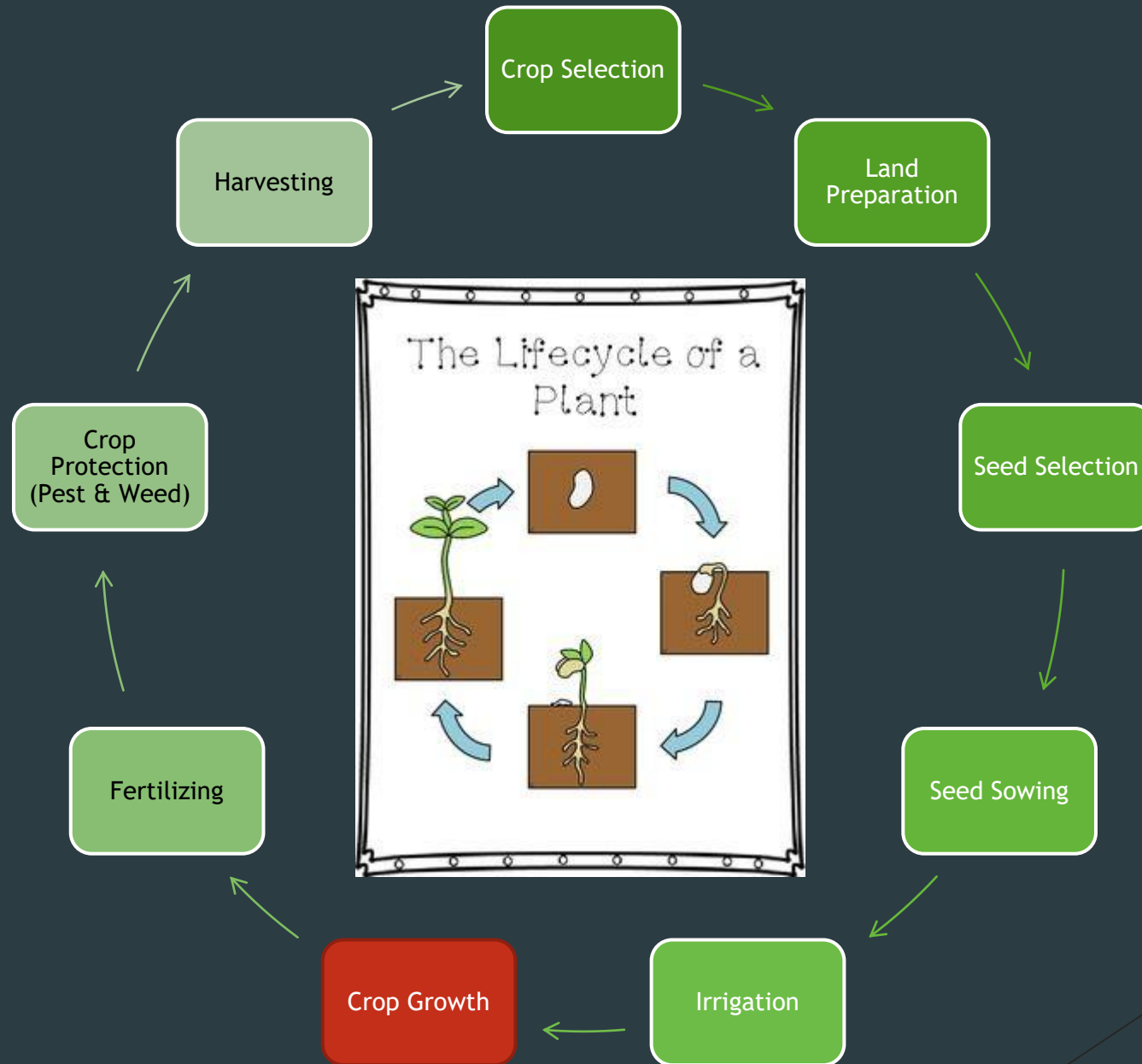


# Irrigation - Efficiency

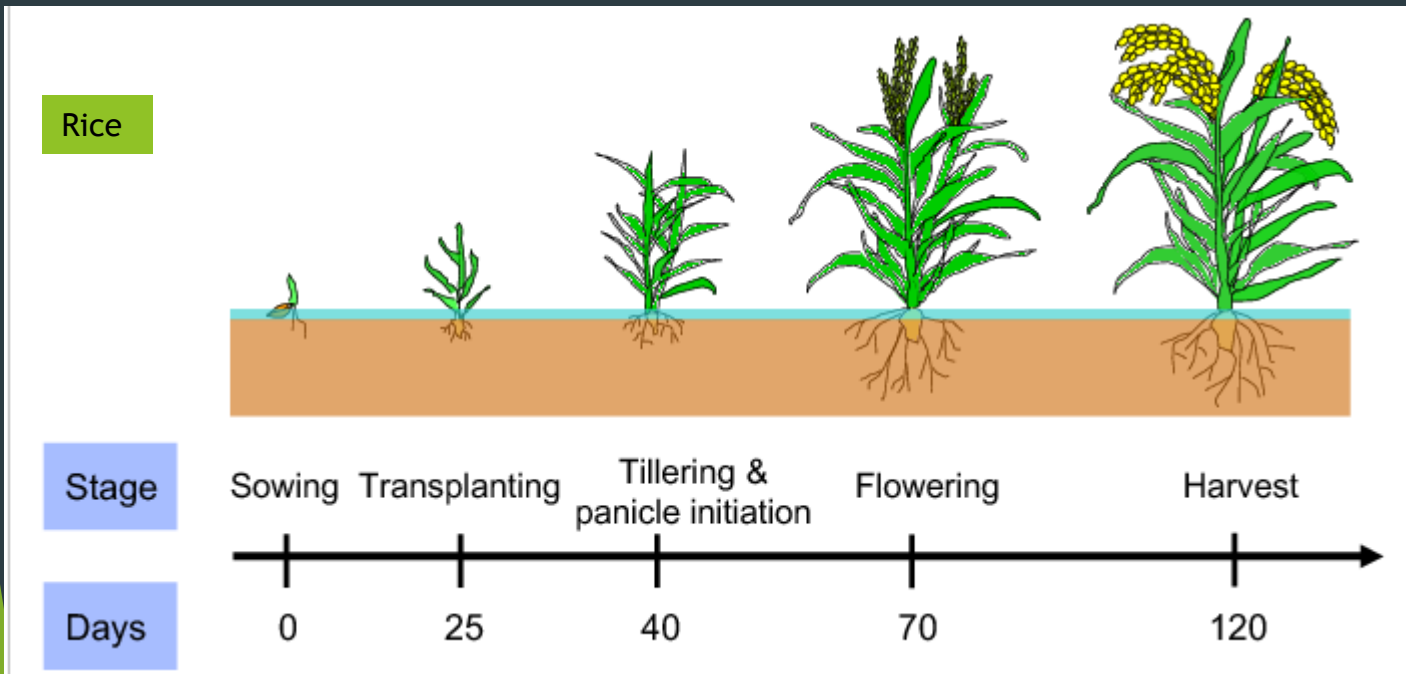
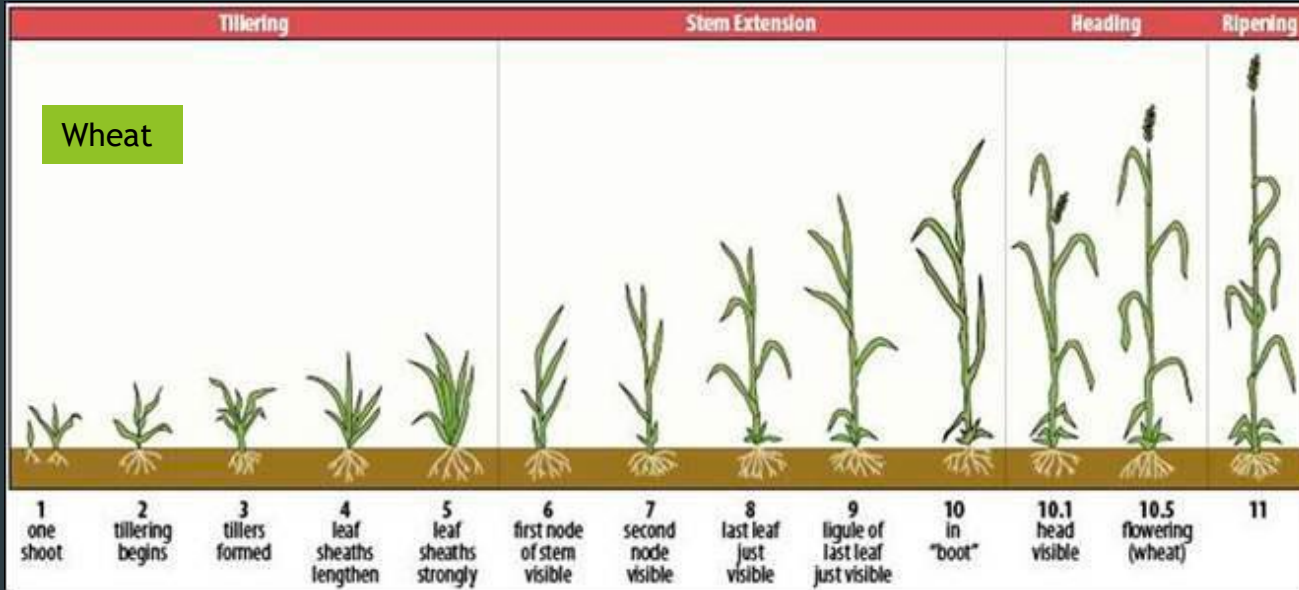
On-farm irrigation efficiency of different irrigation methods



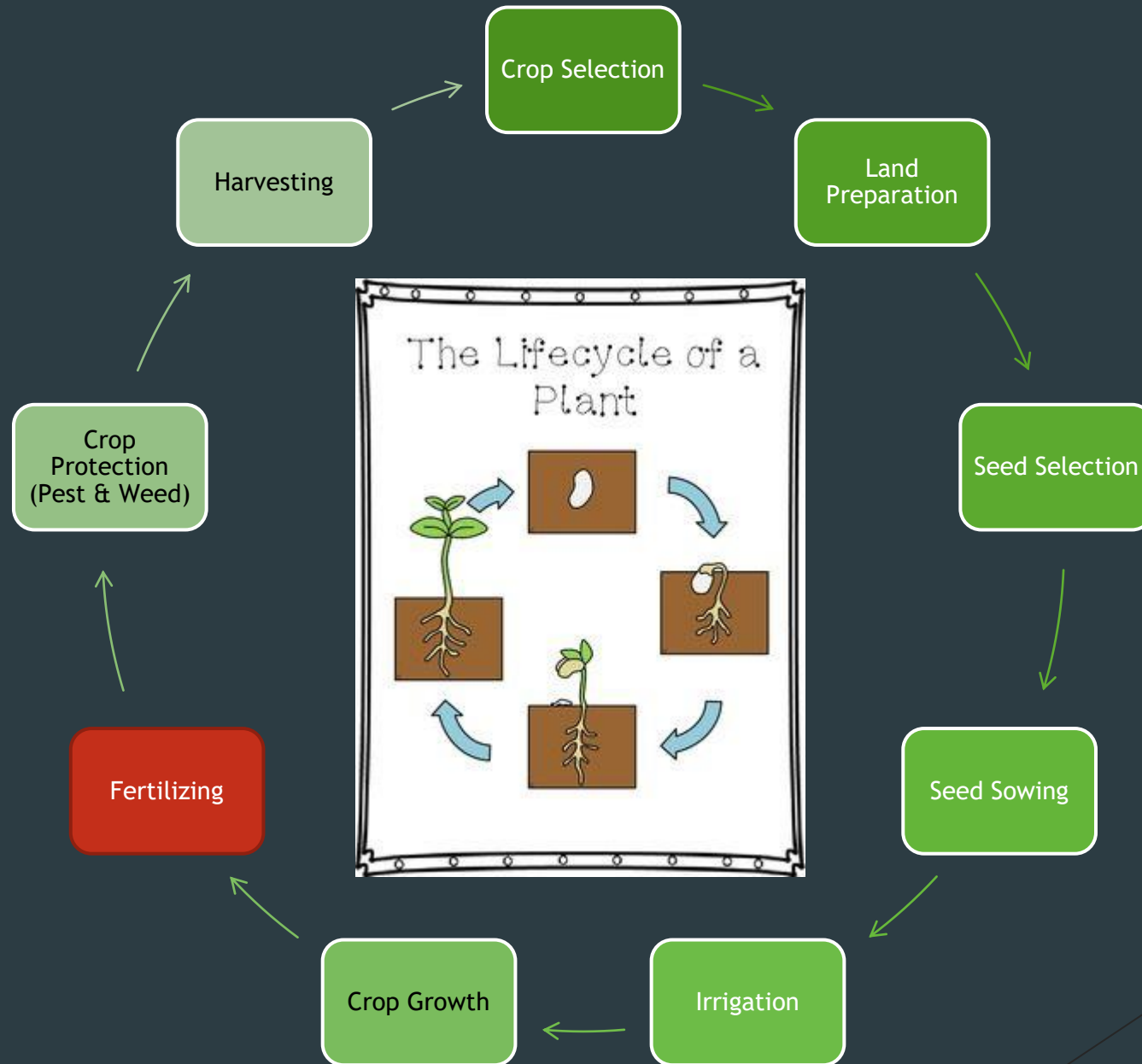
# Farming Life Cycle



# Plant Growth



# Farming Life Cycle



# Fertilizer - Soil Analysis

 Ministry of Agriculture & Farmers Welfare, Government of India

**SOIL HEALTH CARD  
MULTIPLE BENEFITS**

**Issue of 12 crore 'Soil Health Cards' for all the Holdings once in a cycle of 2 years.**

**All 2.53 crore samples collected and tested across the country in cycle-1, 2015-17.**

**Information to the farmers on optimal doses of fertilizer application to Crops.**

**9.63 Crore 'Soil Health Cards' distributed till 31<sup>st</sup> Oct., 2017. Balance distribution soon**

**Nation-wide program to improve soil health.**

**Informed choices to the farmers on soil health for increasing productivity.**





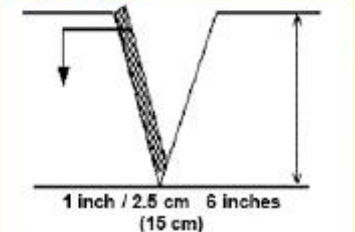

**SOIL HEALTH CARD**



**Swasth Dhara, Khet Haraa**

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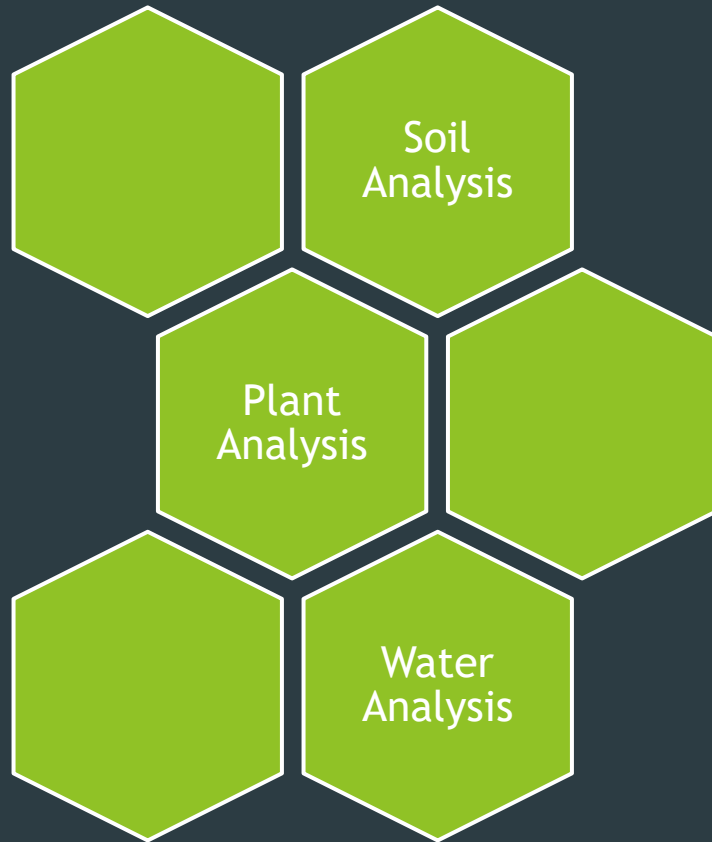
# Fertilizer - Soil Sampling for testing

Soil sampling: an illustration		
		
Selecting sampling spot	Remove the surface litter at the sampling spot	Make a 'V' shaped cut to a depth of 15 cm in the sampling spot
		
Collect soils - V shaped cut: Remove thick slices of soil from top to bottom of exposed face of the 'V' shaped cut and place in a clean container		Mix the samples thoroughly



		
Quarterming is done by dividing the thoroughly mixed sample into four equal parts	Two opposite quarters are discarded and the remaining is mixed	Collect the sample in a clean cloth or polythene bag
		
Process of collection	Label with required information: <ul style="list-style-type: none"> <li>Name of the farmer</li> <li>Location of the farm</li> <li>Survey number</li> <li>Previous crop grown, present crop</li> <li>Crop to be grown in the next season</li> <li>Date of collection</li> <li>Name of the sampler, etc</li> </ul>	Places for soil testing: <ul style="list-style-type: none"> <li>Krishi Vigyan Kendra (KVK)</li> <li>State/district agricultural labs</li> <li>Agriculture University, Research Stations</li> <li>ATMA Officials/Agripreneurs</li> </ul>

# Fertilizer - Dosage



## C. Recommended Fertilizer Dose for Important Crops

	N (kgs/ha)	P <sub>2</sub> O <sub>5</sub> (kgs/ha)	K <sub>2</sub> O (kgs/ha)	Remarks
Banana	110	35	330	Apply 50% extra fertilizers at 2nd , 4th, 6th & 8th months after planting for tissue culture banana
Cotton	120	60	60	(TCHB – 213)
Citrus (sweet orange)	0.6 kgs	0.2 kgs	0.3 kgs	From 6th year onwards
Mango	1.0 kg	1.0 kg	1.5 kg	Kg of NPK/tree for 6th year onwards
Sugar cane	275	-	112.5	
Sun flower	60	90	60	Irrigated Hybrid
	40	50	40	Rainfed/Varieties

# Fertilizer - Chemical v/s Organic

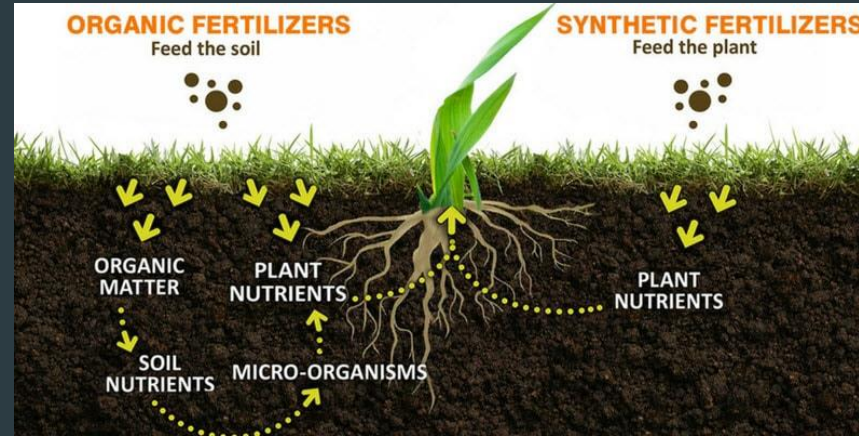
## Organic fertilizers

### Advantages:

- Balanced nutrient supply.
- Enhance the soil biological activity.
- Help in improving soil structure.
- Increase the organic matter content.
- Slow release of nutrients makes soil on the long run fertile.
- Help in combating plant diseases.

### Disadvantages

- Low nutrient content.
- Only effective in the long run.
- It may not supply all the nutrients required for plant growth.
- High cost.
- Bulkiness.



## Chemical fertilizers

### Advantages:

- Nutrients are immediately available for plant uptake.
- Price is lower as compared to organic fertilizer.
- Small quantities are required because they are nutrient rich.

### Disadvantages:

- Over application usually results in economic and environmental losses.
- Over supply makes plant tissues soft and vulnerable to diseases and pathogens.
- Increased rate of soil organic matter decomposition resulting in soil degradation.
- Many nutrients applied are easily lost through different chemical reactions.





# Fertilizer - Application

## Fertilizer application methods

**Broadcasting:** fertilizer is distributed manually over the cropped field.

- The most common fertilizer application method.
- Highly inefficient method
- High economic and nutrient losses



Broadcasting

**Placement:** application in band or packets near the plants.

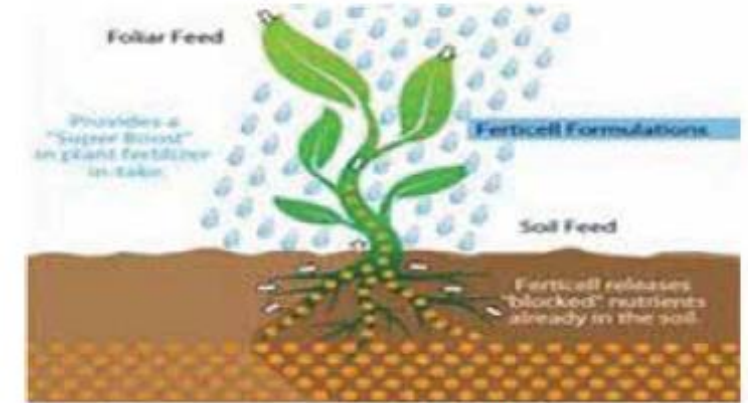
- Two sub-types:
  - i. Band application
  - ii. Spot Application
- The fertilizer use efficiency is high.
- Labour intensive.
- Efficient method but with high labour input.

**Ring application:** Spread the fertilizer around the tree at a distance of about one meter.



Ring Application

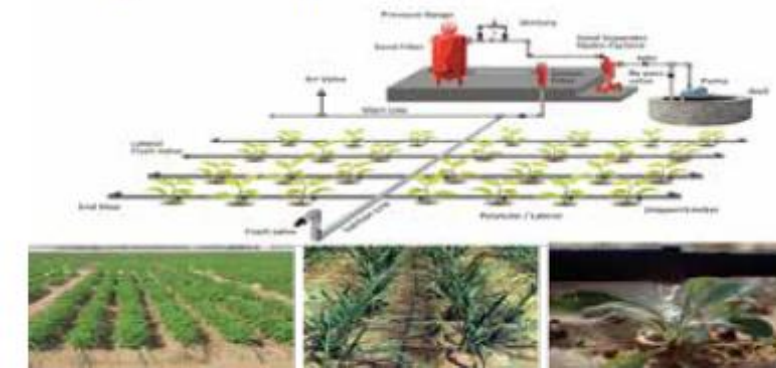
**Foliar application:** liquid fertilizers are sprayed on the crops.



Foliar Application

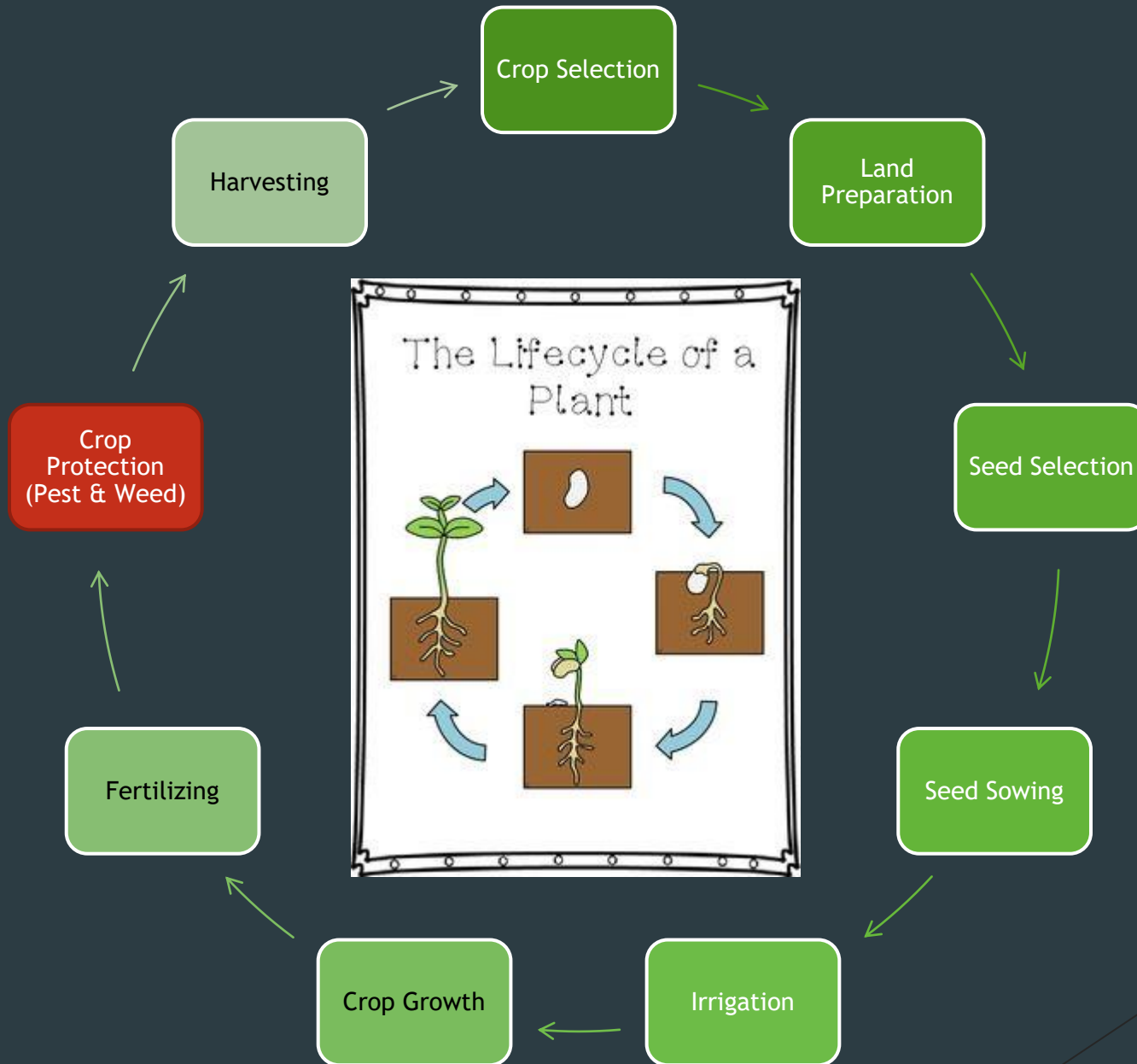
- Highly efficient
- Special equipment required
- High cost
- Only selected fertilizers can be applied

**Fertigation** along with irrigation



Fertigation

# Farming Life Cycle



# Crop Protection - Weed

## 3.19. Weed and its relevance in crop production

- Weeds are the plants, which grow where they are not wanted
- Weeds compete with crops for water, soil nutrients, light and space
- Weeds reduce crop yields to the extent of up to 50 percent
- Critical period of weed competition is approximately 1/3rd of the duration of the crop

## Characteristics of weeds: “One year seeding, seven years weeding”

- Produces larger number of seeds compared to crops. E.g.: *Amaranthus retroflexus* produces 1,96,405 seeds/plant, whereas wheat & rice produces only 90 to 100 seeds/plant
- Most of the weed seeds are small in size
- Easy and diverse means of seed dispersion
- Seeds germinate earlier and grow faster
- Flower earlier and mature ahead of the crop
- Germinate under tough conditions, season bound
- Seeds are dormant for long period and germinate during suitable season
- Good viability for years
- Tolerate moisture stress
- Possess stronger and deeper root system

## Effect of weed competition on crop growth and yield

- Crop suffers from nutritional deficiency
- Growth is reduced
- Water requirement will be more
- Lowers the input response
- Pest and disease incidence will be more
- Yield is affected
- Cost of production will increase

## 3.20. Critical period of weed competition for important crops

Crops	Days from sowing
Rice (lowland)	35
Rice (upland)	60
Sorghum	30
Maize	30
Cotton	35
Sugarcane	90
Groundnut	45
Soybean	45
Onion	60
Tomato	30

### Grassy Weeds



*Acrachne racemosa*



*Brachiaria reptans*



*Dactyloctenium aegyptium*

### Broad Leaved Weeds



*Abutilon hirtum*



*Acalypha indica*



*Aerva lanata*

### Sedges



*Cyperus compressus*



*Cyperus halpan*



*Cyperus polystachyos*  
Syn: *P. odoratus*

# Crop Protection - Weed

## Inter-Cultivation Equipments



Grubber Weeder

Cost savings of up to 60% are possible at the early stages of crop growth.



Cono Weeder

Weeding under wetland paddy cultivation



Tractor – Operated Cotton Weeder



B.D. 3 Tyne Cultivator



Wheel Hoe

Reduces the cost of weeding up to 50%

Manual Removal



Spraying Herbicide



# Crop Protection - Pest

## 3.3. Crop pest and their importance

**P**est is any organism which is detrimental to crop production. Pest cause damage to the plant to the extent of 30 - 90 per cent, sometimes it even causes total loss. Pest includes insects, diseases and weeds. Non insect pest includes nematodes, snails and rodents.

Insect is any of many small invertebrate animals having a segmented body and three pairs of legs and usually two pairs of wings. Some insects are beneficial and some are harmful to agriculture.

## What is the difference between complete and incomplete metamorphosis in insects?

Incomplete and complete metamorphosis differs in the number of life cycle stages that insects go through during their transformation from egg to adult. The complete metamorphosis has 4 life cycle stages and an incomplete metamorphosis has 3 life cycle stages.

## 3.4. Life stages of insects

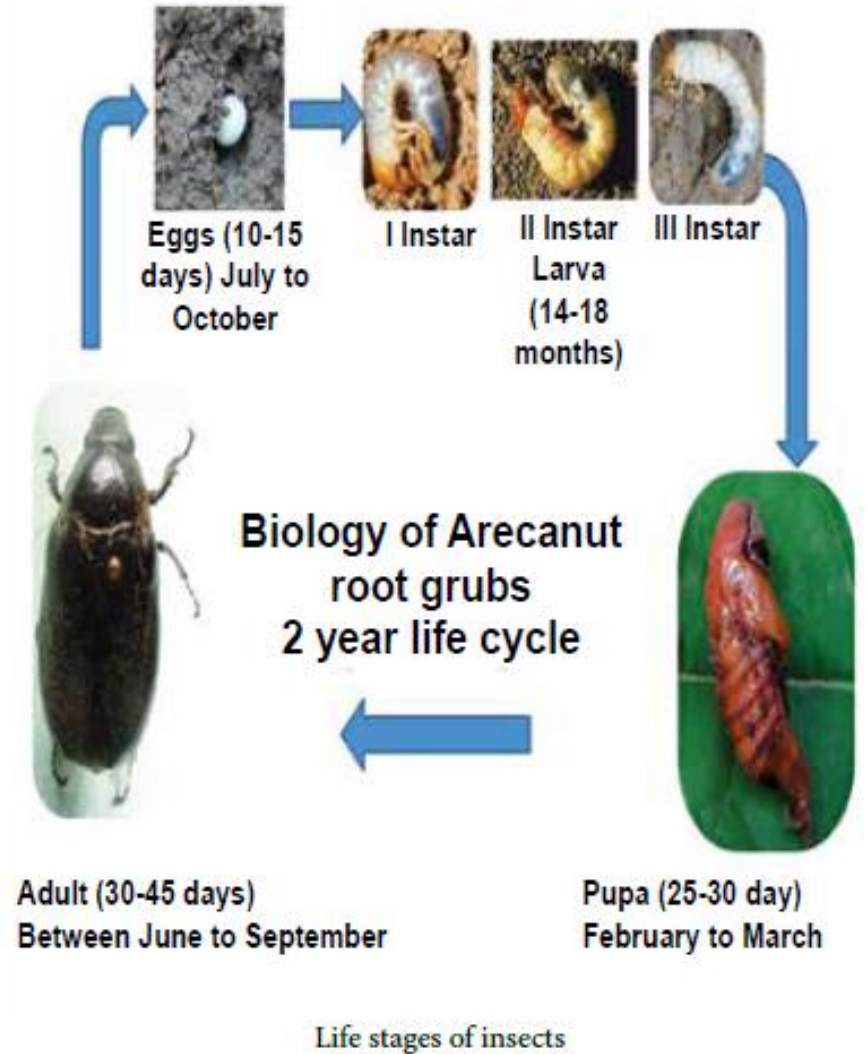
- EGG is the initial stages of the insect. Normally an insect lays at least 30 to 300.
- Egg hatch into LARVA or worms. Larva is the damaging stage of insect to any crop. This stage is normally seen in the field.
- PUPA is an inactive stage preparing itself to develop to an adult.
- Mostly ADULTS insects are harmless but many bugs and beetles are harmful to plants.



Mite damage in coconut buttons



Larva damaging leaves



# Crop Protection - Pest

## How the damage is visible?

- The larva eats the leaf, fruits or the whole plant parts. Hence the damage is visible.
- Some insects scrape the plant tissues. They also cut the growing parts. Beetles, bugs, thrips and hoppers usually suck the sap from the plants and growing parts, affecting the healthy plant.
- Not at all. HONEY BEES are also insects which help in pollination (brings pollen from one plant to another), thereby, increasing the yield.

They also provide us valuable HONEY and other products. Another example of “friendly” insects are SILK WORMS.

- NATURAL ENEMIES are insects that are beneficial to man since they feed from the egg or larvae and pupae of crop pest. They are called biological control agents. Examples are the trichogramma parasite for sugarcane borers, grub of green lacewing and ladybird beetle.



Grub of green lace wing



Ladybird beetle



Bollworm damaging cotton



Semilooper feeding on caster

# Crop Protection - Pest

## 3.5. Insect classification

Insects can be classified into 3 groups, depending on their behaviour in the farm such as

- Pests
- Beneficial insects
- Neutral insects

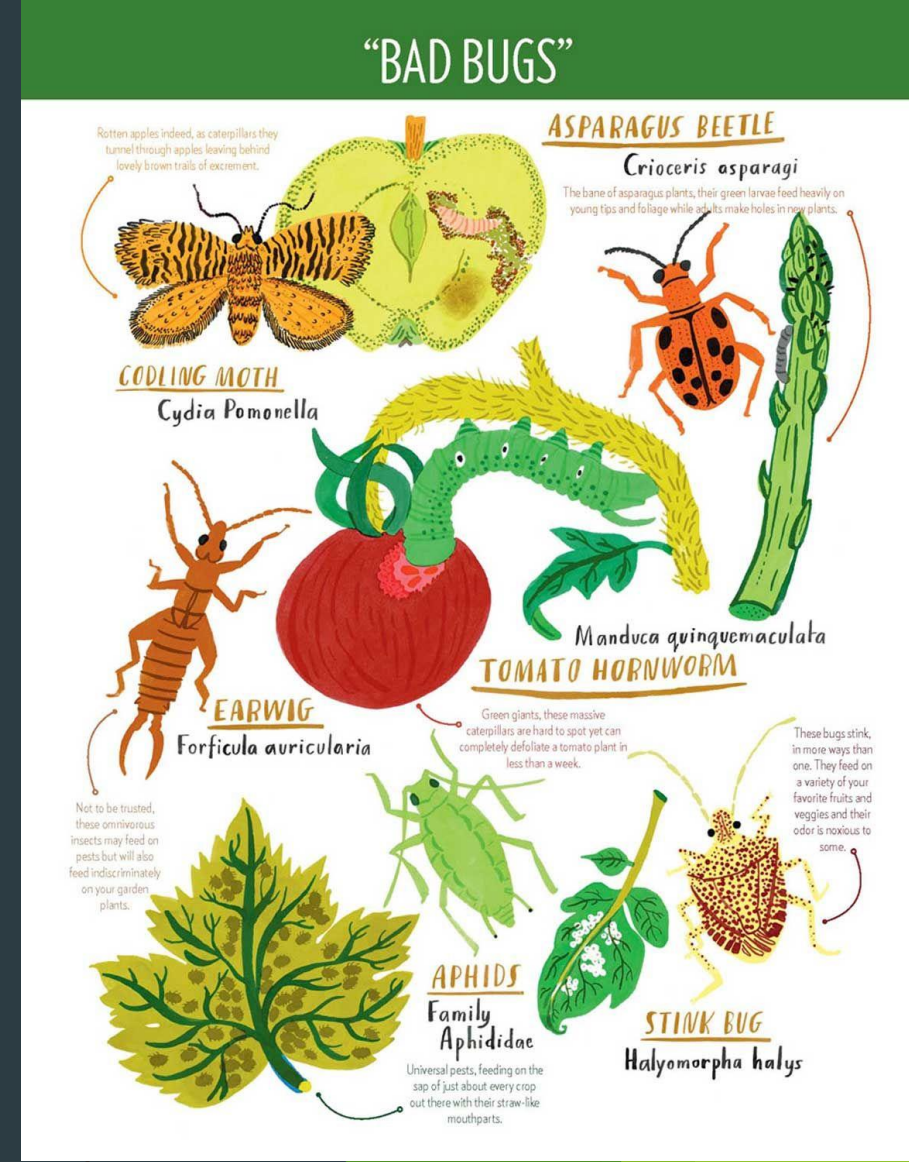
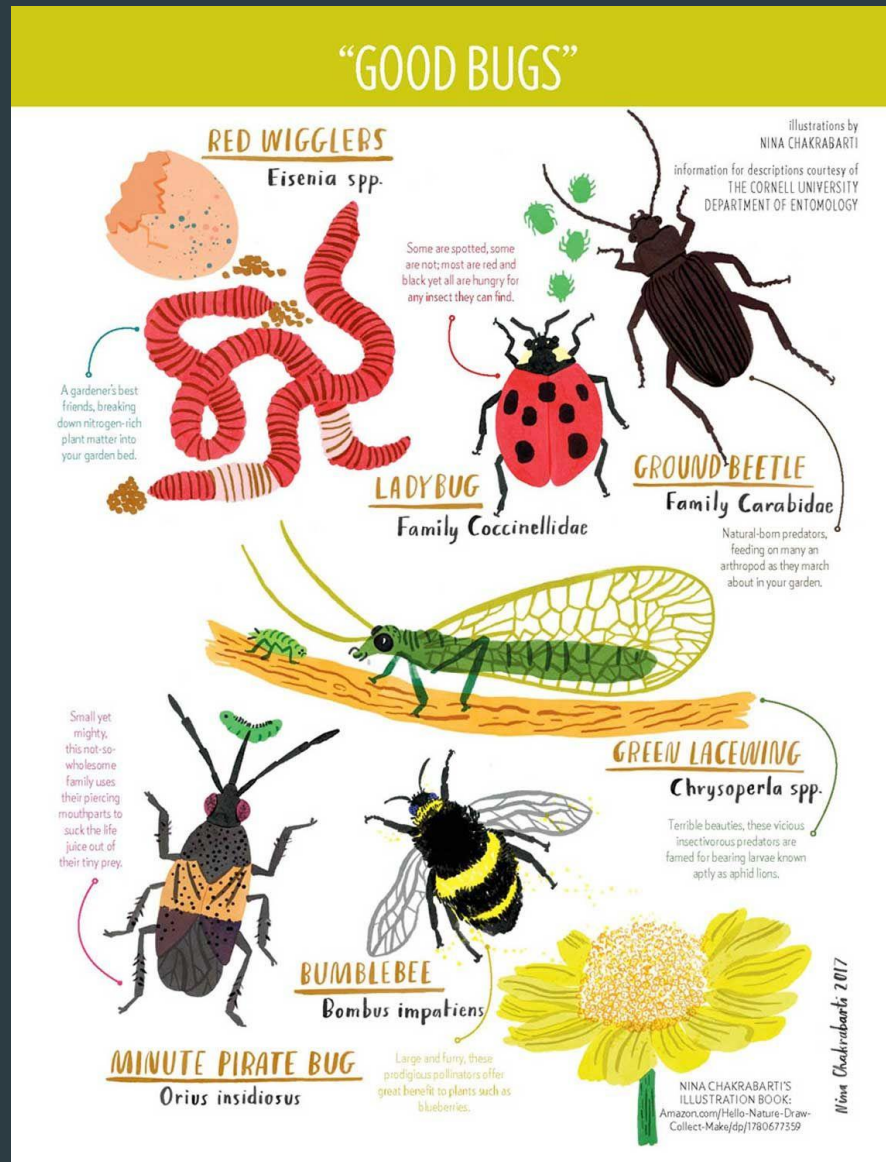
**Pest:** Whether an insect species is a pest or not depends on the situation. This means that a certain insect could be a pest in one situation but not in another situation. For example, the caterpillars of diamondback moth feed on cabbage and other plants of the cruciferae family. A farmer who grows cauliflower will therefore consider it a pest. Yet, for a farmer who grows potatoes or bananas, the diamondback moth is a neutral insect. When there is nothing to feed it will not even occur. In a paddy crop, black gram is a weed/pest since it is growing unnecessarily. In a black gram field, cow pea is a weed since it can grow. Pest will occur only if there is a host.

## Beneficial insects

Some insects are beneficial to the farmer, because they are the natural enemies of harmful insects. Predators feed on other insects and hence control the pest. For example, the assassin bug kills caterpillars and ladybird beetles feed on aphids. Some other insects are beneficial as they help in pollination of plants, e.g. honey bees. There are commercially beneficial insects such as silkworm, which produces silk.

## Neutral insects

A neutral insect is neither a pest nor beneficial. Yet again, it really depends on the context. A mosquito in the rice field can be considered as neutral insect.



# Crop Protection - Pest



Manual Pesticide Spraying



Ladybird beetle



# Crop Protection - Disease Management

## 3.12. Disease

**D**isease is an impairment of the normal state of a plant that interrupts or modifies its vital functions. All species of plants, wild and cultivated alike are subject to disease. Although each species is susceptible to characteristic diseases, these are, in each case, relatively few in number. The occurrence and prevalence of plant diseases vary from season to season, depending on the presence of the pathogen, environmental conditions, and the crops and varieties grown. Some plant varieties are particularly subject to outbreaks of diseases.

## Disease of crops and their importance

- Plant become diseased when it is continuously disturbed by some causal agent including an abnormal process that disrupts the plants.
- There are more than 80,000 plant diseases.
- Diseases reduce the yield of the crops and sometimes lead to disaster e.g. late blight of potato, Panama of banana, etc.
- Managing outbreak of diseases is challenge to the farmer.

## Causes of plant disease

**Infectious diseases:** caused due to fungi, bacteria, viruses, nematodes, etc.

**Non-infectious diseases:** caused due to unfavourable extraneous condition such as scorching sunlight, high temperature, moisture stress or deficiency of micronutrients, pH, heavy metal toxicity, atmospheric pollution, etc.



Alternaria leaf spot of redgram



Wilt affected redgram plant



Bacterial blight of paddy



Red rot in sugarcane

# Crop Protection - Disease Management

## 3.17. Control measures - Tips for the farmers

- Correct identification of disease in your farm is essential for effective control of disease.
- With little experience, you can identify the disease. However you can contact agricultural officers of your area along with disease specimen and seek their help in identifying the disease.
- You can also give disease-affected plant parts to the Agri clinics for clinical test before undertaking control measures.
- Follow Integrated Diseases Management such as host plant resistance, agronomic practices, judicious use of fungicides, pesticides for vector control, bio-pesticides for pathogen control etc., as indicated below.

## 3.18. Integrated disease management practices in the field

- Select varieties and hybrids resistant to the most common or economically important diseases in consultation with agricultural officers of your area.



Tomato Crop with GMO Seed

# Crop Protection - Equipment

## Plant Protection Equipments



Knapsack Power Sprayer



Tree Sprayer

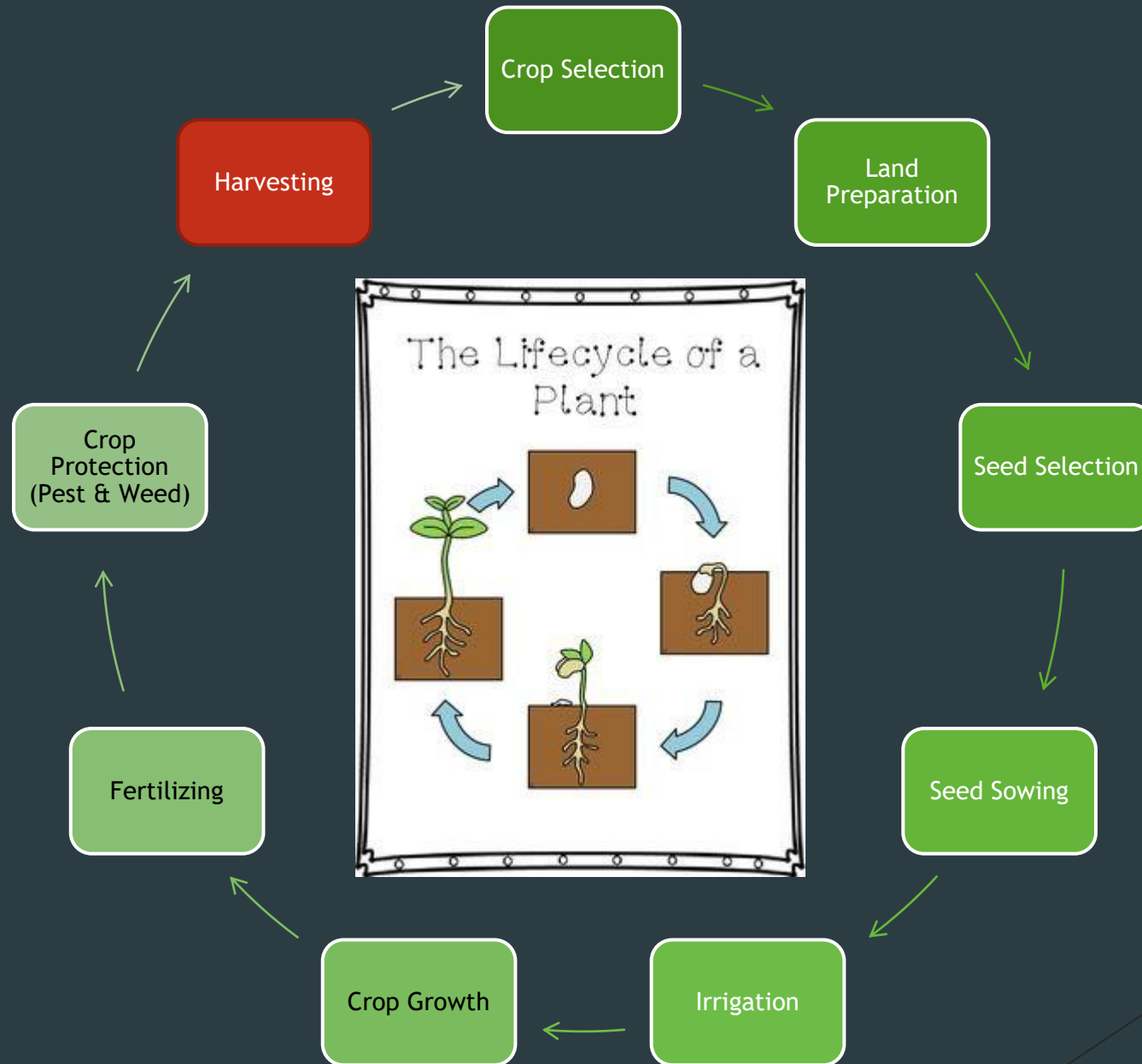


Blower Sprayer



Power Tiller Mounted Sprayer

# Farming Life Cycle



# Harvesting

## Harvesting Equipments



Coconut Tree Climber

- Used for picking of coconuts
- Average time taken for climbing up and down is about 6.30 min for a 13 m tree and time for fixing and removing the device on the tree is 4 minutes.



Austoft Chopper Harvester



Groundnut Digger



Banana Clump Remover



Cotton Stalk Puller



# Harvesting

## Threshing Equipments



Groundnut Pod Stripper



Castor Sheller

## Winnowing and Clearing Equipments

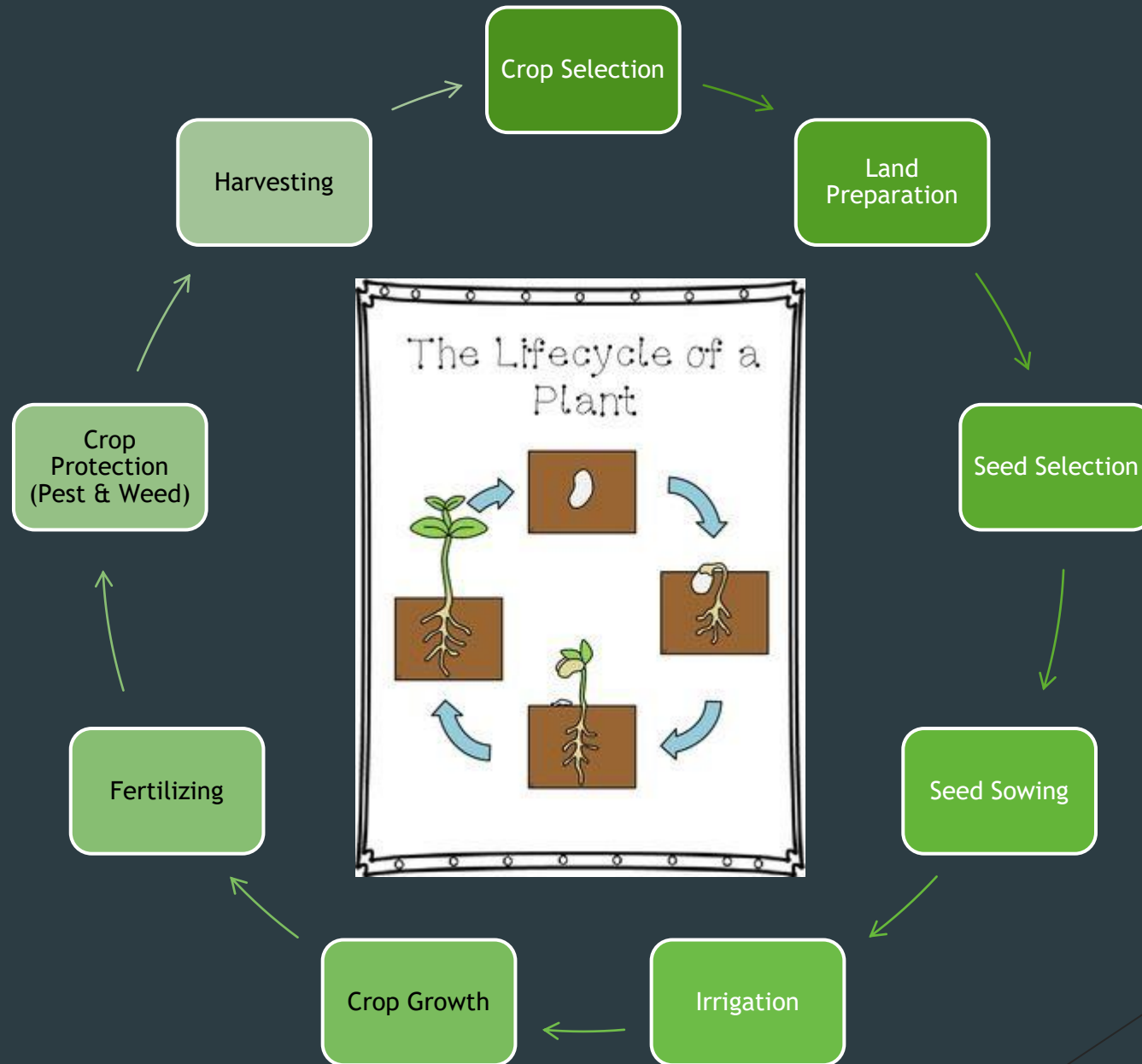


Winnowing Fan



Seed Cleaner

# Farming Life Cycle



# Cropping Seasons

## 1. The Kharif Season:

- Crops are sown at the beginning of south-west monsoon and harvested at the end of the south-west monsoon.
- **Sowing Season:** May to July.
- **Harvesting Season:** September to October.
- **Important Crops:** Jowar, Bajra, Rice, Maize, Cotton, Groundnut, Jute, Hemp, Tobacco etc.

## 2. The Rabi Season:

- Crops need cool climate during growth period but warm climate during the germination of seed and maturation.
- **Sowing Season:** October to December
- **Harvesting Season:** February to April
- **Important Crops:** Wheat, Barley, Gram, Linseed, Mustard, Masoor & Peas.

## 3. The Zaid Season:

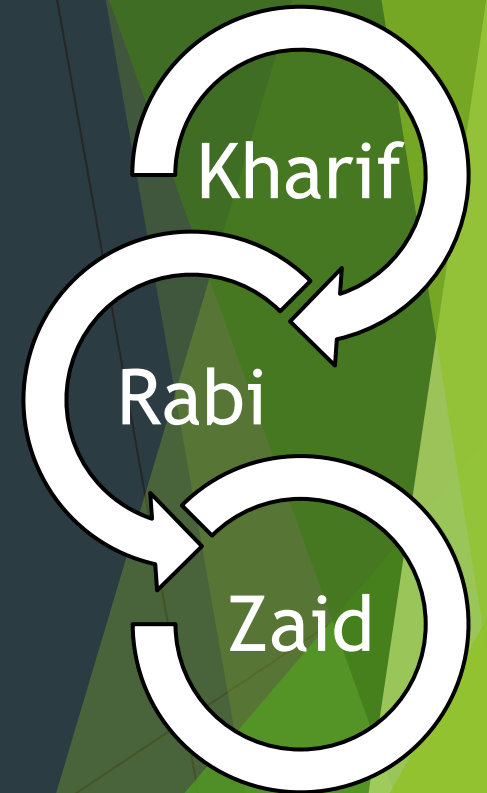
These Crops are raised throughout the year due to artificial irrigation.

### 1. Zaid Kharif Crops:

- **Sowing Season:** August to September
- **Harvesting Season:** December-January
- **Important Crops:** Rice, Jowar, Rapeseed, Cotton, Oilseeds.

### 2. Zaid Rabi Crops:

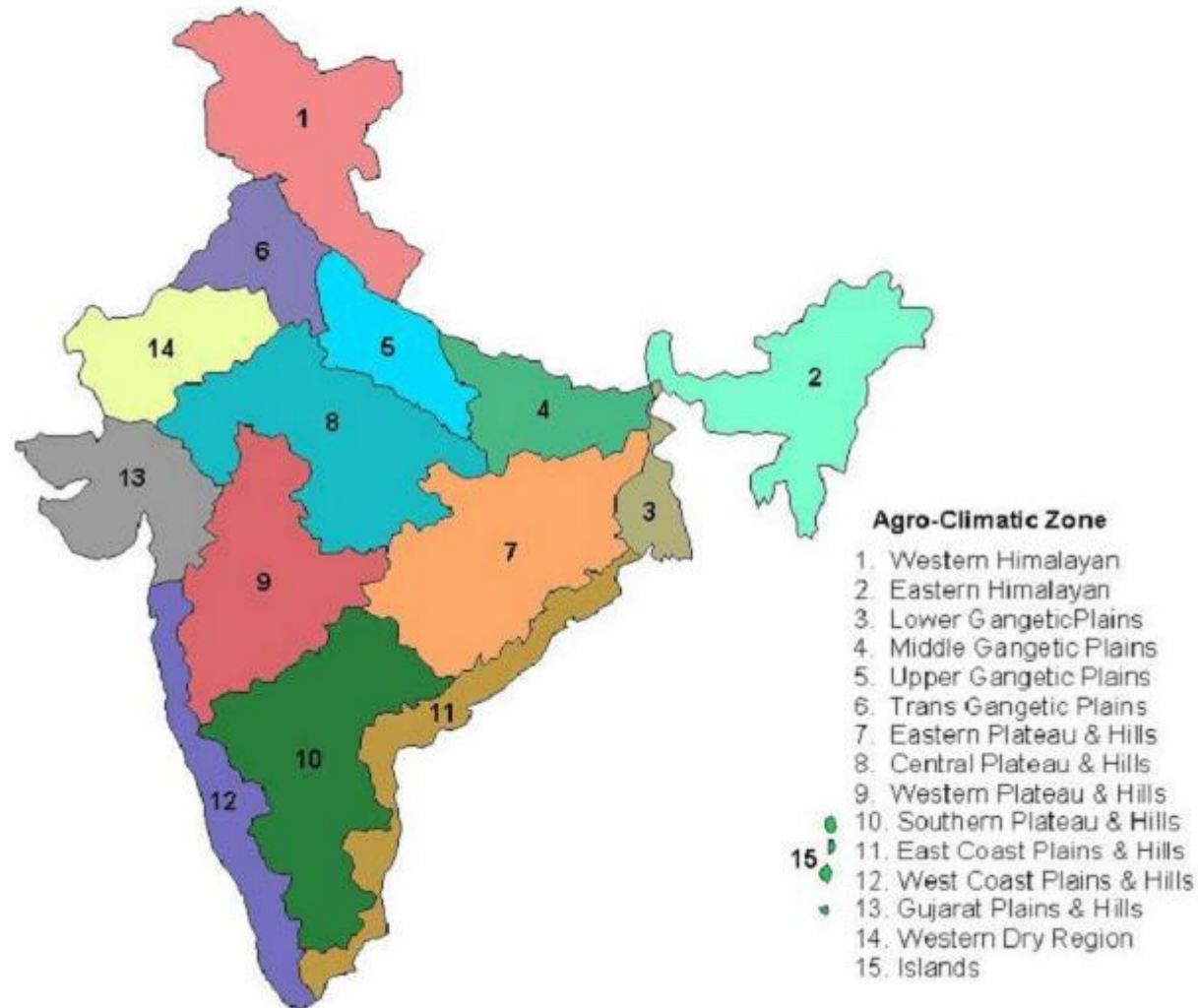
- **Sowing Season:** February to March.
- **Harvesting Season:** April-May.
- **Important Crops:** Watermelon, Cucumber & other vegetables.





# Agro - Climatic Zone

## Agro-climatic zones of India



**Table 3. Region Specific Factors for deceleration in Productivity**

Agro-Climatic Region	States / Parts of States	Region Specific Constraints
Western Himalayan Region-I	J & K, H.P., Uttarakhal	Severe soil erosion, degradation due to heavy rainfall/floods and deforestation, low SRRs, poor road, poor input delivery and inadequate communication infrastructure and marketing
Eastern Himalayan Region-II	Assam, N.E. States, Sikkim	Al. toxicity and soil acidity, Soil erosion and floods, shifting cultivation, low SRRs, non availability of electricity, poor road, poor input delivery system and communication infrastructure.
Lower and Middle Gangetic Plains Regions-III & IV	West Bengal, Bihar, Eastern UP	Flood/ water logging, improper drainage, Salinity/alkalinity, Arsenic contamination, low SRRs, non availability of electricity, high population growth, poor road and communication infrastructure.
Upper and Trans-gangetic Plains Region-V & VI	Western U.P., Punjab, Haryana	Groundwater depletion, decreasing total factor productivity, micronutrient deficiency, non-availability of electricity and high population density.
Eastern Plateau & Hills Region-VII	Orissa, Jharkhand, Chattisgarh	Moisture stress, drought and Soil acidity, Iron toxicity, low SRRs, non availability of electricity, high population growth, poor road, poor Input delivery and communication infrastructure.
Central, Western and Southern Plateau and Hills Regions-VIII, IX & X.	Bundelkhand (in U.P & MP), parts of Rajasthan, Maharastra, AP, Karnataka & Tamil Nadu	Drought, moisture stress, Soil crusting & cracking, soil salinity / alkalinity, low SRRs
East & West Coast Plains & Ghats Region-XI & XII.	Pondicherry, Coastal area of Orissa, AP, TN and Kerala, Goa, parts of Karnataka & Maharastra	Poor water management, Poor nutritional status of soil, saline lands
Gujarat Plains & Hills & Western Dry Region Regions-XIII & XIV.	Gujarat, D&N Haveli, Daman & Diu, North Western Rajasthan	Aridity, Frequent drought, moisture stress poor soil, habitation of desert
The Islands Region-XV	Andaman & Nicobar, Lakshdweep	Soil salinity & acidity, frequent cyclones, low SRRs, poor road and communication infrastructure.

# Agro - Climatic Zone XIII

## XIII. Gujarat Plains & Hill Region-XIII.

Gujarat, Daman & Diu and Dadra & Nagar Haveli.

### (1) Typology:

- Semi-arid to arid conditions;
- Large rainfed areas with frequent weather perturbations;
- Water logging in canal areas;
- Depletion of groundwater in northern and western parts at alarming rate; and
- Low forest cover.

### (2) Potential crops, fruit crops & Livestock:

**(2.1) Agriculture crops:** Maize, *Bajra*, durum wheat, green gram, groundnut, castor, sugarcane & cotton.

**(2.2) Horticulture crops:** Onion, cumin, fennel, fenugreek, garlic, flowers (Aster, spider lilly, marigold & chrysanthemum) aromatic plants & medicinal plants (*Isabgol*, *Guggal* & aloe) and *Jatropha*,

**(2.3) Fruit crops:** Sapota, banana, guava, dates, mango, grapes.

**(2.3) Plantation crops:** Coconut.

**(2.4) Livestock & others:** Cattle, buffalo, goats, sheep, rabbit, poultry and bee-keeping.

### (3) Farming systems:

- Coarse cereals based cropping systems;
- Cattle rearing;
- Goat rearing; and
- Poultry.

## 4) Cropping sequences:

### Rainfed Areas :

- *Bajra* + Black gram – Mustard;
- Maize + Soybean – Durum wheat; and
- Groundnut – Durum wheat – Summer *Bajra*.

### Irrigated Areas:

- Rice – Rabi maize/Groundnut-Summer Moong;
- Cotton – Durum wheat – Summer Moong; and
- Groundnut – Potato – Summer *Bajra*.

### (5) Sub-region specific development related priorities ( all the 7 sub-regions):

- Promotion of integrated water management in dry areas with greater emphasis on rain water harvesting;
- *In-situ* water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton uplands and flat sowing & ridging later in light soil;
- Restriction on overdrawl of groundwater in semi-arid and arid region through regulatory measures;
- Reclamation of salinity through application of Gypsum;
- Conjunctive use of canal and groundwater to control rise in water table;
- Adoption of inter-cropping in groundnut and cotton to improve productivity per unit area;
- Promotion of hybrid rice in conjunction with SRI method of cultivation;
- Promotion of fodder development programme to support livestock population;
- Development of inland and brackish water fisheries through adoption of intensive fisheries production technology.

### (6) Research priorities :

- Development of salt tolerant cultivars of rice;
- Delineation & mapping of multi-nutrient deficiency;
- Development of extra early maturing hybrids of *Bajra* for arid region;
- Integrated Water Management ;
- Integrated farming system .

# Agro - Climatic Zone XIII

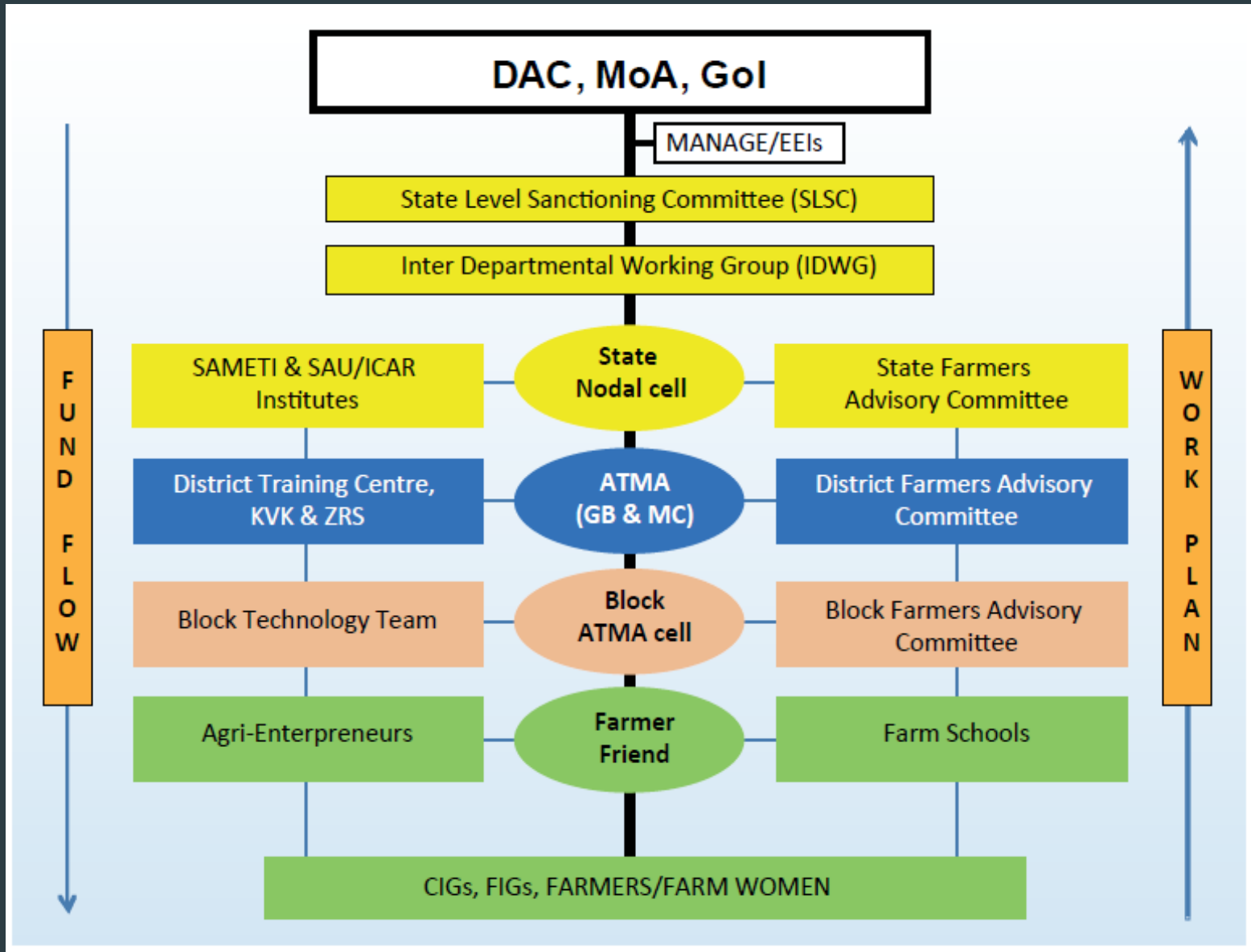
XIII Sub Region Data

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
1	South Gujarat (heavy rainfall )	1793	Semi-arid to dry sub-humid	Deep black, coastal alluvium	Rice, <i>Ragi</i> , sugarcane, <i>Jowar</i>
2	South Gujarat	974	Semi-arid to dry sub-humid	Deep black, coastal alluvium	<i>Jowar</i> , <i>Arhar</i> , cotton, wheat
3	Middle Gujarat	904	Semi-arid	Medium black	Rice, maize, <i>Bajra</i> , cotton
4	North Gujarat	735	Arid to semi-arid	Grey brown, Coastal alluvium	<i>Bajra</i> , cotton, <i>Jowar</i> , wheat
5	North-West arid	340	Arid to semi-arid	Grey brown, deltaic alluvium	<i>Bajra</i> , groundnut, <i>Jowar</i> , cotton
6	North Saurashtra	537	Dry sub-humid	Medium black	<i>Bajra</i> , <i>Jowar</i> , groundnut, cotton
7	South Saurashtra	844	Dry sub-humid	Coastal alluvium, medium black	Groundnut, wheat, <i>Bajra</i> , cotton

XIII Major Crops and Livestock

Food grain crops	Bajara, , pulses
Commercial crops	tobacco, groundnut
Fruit Crops	Mango, Banana, guava, papaya
Vegetable Crops	Tomato, Chillies, Cucurbit, Potato, Onion
Flowering plant	Aster, Spider lilly marigold chrysanthemum
Spices	Garlic
Medicinal and Aromatic plants	Isabgol, Guggal, Aloe,
Plantation crops	Jatropha
Others (Mushroom & Honeybee)	Honey
Live stocks	Indigenous Cattle, Goat, Camel, Poultry

# Agriculture Extension Set-Up



- DAC - Department of Agriculture and Cooperation
- MoA - Ministry of Agriculture
- GoI - Government of India
- MANAGE - National Institute of Agricultural Extension Management
- EEI - The Extension Education Institute
- SAMETI - State Agriculture Management Training Institute
- SAU - State Agricultural Universities
- ICAR - Indian Council of Agricultural Research
- KVK - Krishi Vigyan Kendra
- ZRS - Zonal Research Station
- ATMA - Agricultural Technology Management Agency
- GB - Governing Board
- MC - Management Committee
- CIG - Commodity Interest Groups
- FIG - Farmer Interest Groups

# Climate and Agriculture

- Monsoon is a key source of water in agriculture
- Most of our rivers are seasonal fed by the monsoon; even irrigated agriculture depends on monsoon.
- Cropping pattern has evolved over years based on climate.
- Market forces influence cropping patterns in recent times.
- Rainfall drives water availability and determine sowing time (rainfed crops).
- Temperature drives crop growth, duration and influences milk production in animals.
- Temperature and relative humidity influence pest and diseases incidence on crops, livestock and poultry.
- Wet and dry spells cause significant impact on standing crops, physiology, loss of economic products (e.g. fruit drop).
- Extreme events (e.g. high rainfall, floods, heat / cold wave, cyclone, hail, frost) cause enormous losses of standing crops, livestock and fisheries.

# Impacts of Climate Change in India

## Climate, cropping pattern and agricultural production issues

- Cropping patterns based on climate and land capability are sustainable but market forces and farmers' aspirations are forcing unsustainable systems.
- Farmers must innovate in producing more even from less endowed areas by adopting suitable technologies to cope with changing climate.
- Climate change will likely to cause further problems in our crop production and is likely to become the most important environmental issue in the 21st century.

## Important agricultural related factors responsible for climate change

- Deforestation and forest degradation
- Burning of fuel and farm waste
- Water logged condition
- Excessive use of external input
- Large-scale conversion of land for non-agricultural purpose

## Impact of climate change in India

- **Rainfall:** No long-term trend noted. However, regional variations seen, increased summer rainfall and less number of rainy days.
- **Temperature:** About 0.6 °C rise in surface temperature during 100 years. Projected to increase 3.5 to 5 °C by 2100.
- **Carbon dioxide:** Increasing at the rate of 1.9 ppm per year and expected to reach 550 ppm by 2050 and 700 ppm by 2100.
- **Extreme events:** Increased frequency of heat wave, cold wave, droughts and floods observed during last decade.
- **Rising sea level:** Rise of 2.5 mm/year since 1950.
- **Glaciers:** Rapid melting of the glaciers in the Himalayas.
- **Rainfall distribution:** Shift in peak rainfall distribution also noticed in some parts of country.

## Expected impact of climate change on agriculture

- Due to increase in temperature, crop may require more water.
- Yield may be reduced in cereal crops especially in Rabi; i.e. wheat.

## Change in pest and disease scenario due to climate change

- **Due to increase in rainfall:** Pests like bollworm, red hairy caterpillar and leaf spot diseases may increase. Due to increase in temperature: Sucking pests such as mites and leaf miner may increase.
- **Due to variation in rainfall and temperature:** Pest and diseases of crops to be altered because of more enhanced pathogen and vector development, rapid pathogen transmission and increased host susceptibility. Sometimes a minor pest may become a major pest.
- Agricultural biodiversity is also threatened by decreased rainfall and increased temperature, sea level rise and increased frequency and severity of drought, cyclone and flood. Quality of farm products such as fruits, vegetables, tea, coffee, aromatic and medicinal plants may be affected.

# Impacts of Climate Change in India



Impact of Drought



Heat Wave on Maize



Impact of Flood



Cold wave damage to chana harvest

# Coping options for Farmers



## Enlarging the Food Basket

- Diversifying the livelihood sources.
  - Changing cropping patterns.
  - Increased traditional coping strategies.
  - Change to a mixed cropping pattern.
- E.g: Crop Mixture- Nutri Millets, Pulses and Oilseed

## Integrated Farming System

- Increased share of non-agricultural activities
- E.g: **Type of Integrated Farming Systems**  
Agriculture +vegetable cultivation  
Agriculture + animal husbandry



## Neem, Mulberry & Cowpea

- Planting more drought tolerant crops and increased agro-forestry practices.
- Agro-forestry systems to provide more stable incomes during years of extreme weather events.

## Mango, Pumpkin, maize mixed cropping



## Mixed farming/Multi level farming



# Coping options for Farmers



Lucerne & Sunhemp for green manuring & fodder

Farm Pond



Conservation Furrow

- Improved on-farm soil & water conservation.
- Adopting scientific water management, nutrient management and cultural practices.

Vegetative Barriers



Percolation Tanks

# Coping options for Farmers



**Contour trenching for runoff collection**

## Conventional Raised Bed Planting

- 20-25% Saving in irrigation water



## Shelterbelts

- Shelterbelts reduce wind velocity.
- Moderate temperature.
- Reduce evaporative loss and conserve soil moisture.

## Straw Thatching

- Protecting young seedlings against cold by covering with straw thatching.



## Frost Protection

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Thank you!