8. Cropping System

Do you know ?

Management practices are developed for individual crops and recommendations are made accordingly. The residual effects of individual crops are not considered in crop based recommendations. In this approach, resources are not utilized efficiently. System approach is applied to agriculture for efficient utilization of all resources, maintaining stability in production and obtaining higher net returns.

A system consists of several components which depend on each other. A system is defined as a set of elements or components that are inter related and interacting among themselves. Farming system consists of several enterprises with appropriate combination like cropping system, dairying, piggery, poultry, fishery, bee keeping etc. These enterprises are interrelated. The end products and wastes of one enterprise are used as inputs in others. The wastes of dairy farm like dung, urine, refuse, etc. are used for the preparation of farmyard manure which is an input in cropping systems. The straw obtained from the crops is used as fodder for cattle. Cattle are used for different field operations for growing crops. Thus different enterprises of farming systems are highly interrelated.

Think and answer

- Why is it necessary to select cropping system in agriculture business?

Let us do it

Farming system represents an appropriate combination of farm enterprises viz. cropping system, livestock, poultry, fisheries, forestry and the means available to the farmer to raise them for increasing profitability. They interact adequately with environment without dislocating the ecological and socio- economic balance on one hand and attempt to meet the national goals on the other.

Enlist the different crops cultivated in the near by fields.

List the ways adopted by farmers to manage the needs of their soil, crop, animal, poultry, etc.

8.1 Meaning

Cropping system may be defined as the order in which the crops are cultivated on a piece of land over fixed period. The cropping system is the crop production activity of the farm or holding. It comprises all cropping patterns adopted on the farm or holding and their interactions with farm resources, other household enterprises and the physical, biological, technological and socio-economic factors or environment.

Remember this

Cropping system should at least satisfy the food requirements of the farmer for his family and fodder for his cattle.

Remember this

Cropping system is a land use unit comprising soils, crop, weed, pathogen and insect subsystems that transform solar energy, water, nutrients, labour and other inputs into food, feed, fuel and fibre.

Cropping system is an important component of a farming system. It represents cropping patterns used on a farm and their interaction with farm resources.

Can you recall?

The way in which the cropping system in a particular field or farm or operational holding or locality is practiced in an agricultural crop year (July-June) is said to be the cropping pattern at that site. Cropping pattern means the proportion of area under various crops at the yearly sequence and spatial arrangement of crops on a given land area. The system of utilizing the land resources by the cropping pattern is said to be the system cropping.

Do you think

Efficient cropping system for a particular farm depends on farm resources, farm enterprises and farm technology. The farm resources include land, labour, water, capital and infrastructure. When land is limited, intensive cropping is adopted so as to fully utilize available water and labour. When sufficient and cheap labour is available, vegetable crops are also included. Crops like sugarcane, banana, etc. should be included in the cropping system when capital is not a constraint.

Do you observe

In low rainfall regions monocropping is followed and when rainfall is more than 750 mm, intercropping is practiced. Farm enterprises like dairying, poultry, etc. also influence the type of cropping system. If the enterprise is dairying then fodder crops should be included in cropping system. Change in cropping system takes place with the development of technology. The cropping system should provide enough food for the family, fodder for cattle and generate sufficient cash income, for domestic and cultivation expenses.

Internet my friend

Collect the pictures and information on various cropping system.

8.2 Study of different cropping systems

Depending on the resources and technology available, different types of cropping systems are adopted on farms.

1. Monoculture
2. Multiple cropping
3. Intercopping
4. Mixed cropping
5. Strip cropping
6. Sequence cropping
7. Relay cropping
8. Multistoried cropping
9. Catch cropping

- Why some fields have single crops while other have mixture of crops.

8.2.1 Monoculture

Monoculture or mono cropping refers to growing of only one crop on the same piece of land year after year.

It may be due to climatological and socioeconomic conditions or due to specialization of a farmer. Under rainfed conditions, crops like paddy, groundnut or cotton or sorghum are grown year after year due to limitations of rainfall. Monoculture of bajra is practiced in certain district of Rajasthan because the rainfall is uncertain and no irrigation water is available.

In southern states and Konkan region of Maharashtra, rice is widely cultivated under the monoculture system because

1. Rice forms the main commodity of their daily diet.
2. Most of the area is low lying and high rainfall with some amount of waterlogging, which makes the land unfit for other crops.
3. The land holdings are smaller and scattered which do not allow to grow more crops.

It is noticed that under rice monoculture system, there is a rapid deterioration of organic matter and soil structure. Flooding and draining increases the decomposition process in the soil.

8.2.2 Multiple cropping

It is the practice of growing two or more crops on the same piece of land one after another in one calendar year.
e.g. Udid (K)-Wheat (R), Rice-Potato-Green Gram, Jute-Rice-Potato, Rice-Mustard-Maize.

Requirements for multiple cropping

- Fields should be levelled with high productive soil with suitable climate.
- Adequate and assured irrigation facilities should be avaible.
- Availability of inputs such as seed, implement, fertilizer, etc.
- Facility to remove crop residue from the field immediately after harvest.

Advantages

- More assurance of food and feed supply throughout the year.
- Increase in productivity per unit area, time, input, etc.
- Better distribution of income throughout the year.
- Increase in total employment and distribution of labour and capital use throughout the year.
- Minimum scope for soil erosion and degradation.
- Maximum utilization of land, residual effects, manures, fertilizers, moisture and management practices.

Disadvantages

- Little time is available for land preparation.
- It requires more intercultivation to compensate inadequate prepatory tillage.
- Cleaning of field from stubbles and stumps is a great problem.
- Previous crops with residual toxicity (Alleopathic effect) may affect next crops in quick succession.
- It increases weeds, pest and disease hazard if not managed properly.
- Long durational crops can not be taken.
- Weather and physical conditions may hinder quick succession.

Assessment of land use

The main object of cropping system is to use available resources efficiently. There are several indices to compare the efficiency of different cropping systems in terms of land use.
Multiple Cropping Index (MCI) or Cropping Intensity Index (CII): MCI is the sum of area planted under different crops and harvested in a single year divided by the total cultivated area expressed as percentage.

$$MCI = \Sigma_{i=1}^{n} ai \times \frac{100}{A}$$

$$MCI = \frac{\text{gross cropped area}}{\text{Net area}} \times 100$$

Where n is 1^{th} total number of crops, a.i. area under 1^{th} crop planted and harvested within one year, and
A is total land area available for cultivation. It is also referred as cropping intensity.

Example - A cultivar has 10 ha of land. He has grown okra over 6 ha of land and bottle gourd over 3 ha of land during kharif, chilli over 5 ha of land and cauliflower over 5 ha of land during rabbi and cucumber over 4 ha of land and muskmelon over 5 ha of land in summer. Calculate CII for the given farm.

Cropping intensity index calculated based on the gross cropped area and the net area of the farm. In this context, gross cropped area is :

During kharif = 6 ha + 3 ha = 9 ha

Rabi = 5 ha + 5 ha = 10 ha

Summer = 4 ha + 5 ha = 9 ha

Total = 28

$$= \frac{28}{10} \times 100$$

= 280 %

Here, cropping intensity index 280% , implies that land is put in use, almost three times (100% = 1 time) to its original extent.

8.2.3 Intercropping

Intercropping is growing two or more crops simultaneously on the same piece of land with a definite row pattern. For example, growing soybean + redgram in 5:1 or 6:2 proportion or cotton + tur. Intercropping was originally practiced as an insurance against total crop failure under rainfed conditions. At present, the main objective of intercropping is higher productivity per unit area in addition to stability in production. Intercropping system utilizes resources efficiently there by productivity is increased. Either of the individual crop in intercropping is known as component crop.

Fig 8.1 Intercropping system

What do you think about successful intercropping ?

- The time of peak nutrient demands of component crops should not overlap.
- Competition for light should be minimum among the component crops.
- Component crops should be complimentary to each other.
- The differences in maturity of component crops should be at least one month.
- Cereals should be selected as main crop e.g. Jowar, wheat maize, etc. and among cash crops sugarcane, cotton, tobacco etc.
- The pulses and oil seeds should be selected as intercrops. The pulse crop fixes atmospheric 'N' and makes it available to main crop, improves fertility of soil, utilizes available soil moisture properly even under adverse conditions because of different root system.
- Time required for growth of main crop and intercrop should be different and sufficient.
- The water requirement of component crops should be different.
- Component crops should have different root systems i.e. shallow and deep root systems.

Objectives of intercropping

- Insurance against total crop failure under aberrant weather conditions or pest epidemics.
- Increase in total productivity per unit land area.
- Utilization of resources such as land, labour and inputs.

Practices of intercropping

Paired row system : In this system the distance between two crop lines of main crop is reduced and space for intercrop is created e.g. Jowar+Mung/Udid/Tur or Bajra + Tur

Skipped row system : In this system the distance between two crop lines is kept as it is but after two rows, one row is kept for intercrop. The plant population of main crop can be kept constant as in normal sowing by reducing plant to plant distance in the row. e.g. in jowar, plant to plant distance is kept 10 cm instead of 15 cm.

Advantages

- It provides yield advantages as compared to sole cropping.
- It gives profitable use of space and time by cultivating two or more crops.
- Greater assurance and stability of higher yield.
- It reduces the cost of cultivation of main crop.
- Improves soil fertility by use of legumes as intercrop.
- Efficient use of soil, nutrients, moisture, air, etc.
- It helps to control weeds upto some extent.
- It covers the more ground area continuously and helps to control soil erosion.
- It provides more employment and better distribution of labour.
- It provides income in installments and reduces marketing risks.

Disadvantages

- Difficulties may arise in the practical management of intercrops under high degree of mechanization and different requirements of component crops.
- Harvesting is difficult as each intercrop has its own harvesting time.
- It may reduces qualitative and quantative yield of crops
- It requires sowing skills.

Assessing yield advantages

Since several crops are involved in inter cropping system, it is not logical to compare total yield of different crops in one system with the other. Several indices are developed to evaluate cropping systems.

Crop equivalent yields

The yield of different intercrops are converted into equivalent yield of any one crop based on price of the produce. The crop equivalent yield (CEY) is calculated as follows.

$$CEY = \sum_{i=1}^{n} (Yi\ ei)$$

Where Yi is yield of i^{th} component and ei equivalent factor of i^{th} component or price of i^{th} crop.

Example : Let the yields of groundnut and redgram in a hectare of intercropping be 1000 and 600 kg, respectively. The total yield of intercropping system can be expressed as groundnut equivalent yields by knowing the price of each produce. If the prices of groundnut and redgram are Rs. 20 and Rs. 25 per Kg, respectively.

Equivalent yield (EY) of groundnut

$$= \frac{1000 \times 20}{20} = 1000 \text{ Kg}$$

$$\text{EY of redgram} = \frac{600 \times 25}{20} = 750 \text{ Kg}$$

EY of system = 1000 + 750 = 1750 Kg of groundnut

Land equivalent ratio

Land Equivalent Ratio (LER) is the relative land area under sole crops that is required to produce the yields achieved in intercropping. LER can be mathematically represented as follows

$$LER = \sum \frac{Yi}{Yij}$$

Where Yi is the yield of i^{th}component from a unit area grown as intercrop and Yij is the yield of i^{th} component grown as sole crop over the same area. In brief, LER is the summation of ratio of yields of intercrop to the yield of sole crop.

Example : Let the yields of groundnut and redgram grown as pure crops be 1200 and 1000 Kg /ha, respectively. Let the yields of these crops when grown as intercrops be 1000 and 600 kg / ha, respectively.

The land equivalent ratio of groundnut + redgram intercropping system is a follows:

$$\text{LER of groundnut} = \frac{\text{yield of intercrop}}{\text{yield of sole crop}}$$

$$= \frac{1000}{1200}$$

$$\text{LER of system} = \frac{1000}{1200} + \frac{600}{1000} = 1.43$$

LER of 1.43 indicates that 43% yield advantage is obtained when grown as intercrops compared to growing as sole crops. In other words, the sole crops have to be grown in 1.43 ha to get the same yield level that obtained from 1.00 ha of intercropping.

8.2.4 Mixed cropping

It is cultivation of two or more crops simultaneously in the same field without keeping their identity with respect to field area. e.g. Maize + Cowpea, Jowar + Tur, Wheat + Mustard.

Mixed cropping is grown for two or more crops simultaneously intermingled without any row pattern.

When two or more crops are sown together on the same land, it is known as mixed cropping. In mixed cropping, there is always one main crop and one or two subsidiary crops. It is a common practice in most of dryland tracts of India. Seeds of different crops are mixed in certain proportion and are sown. The proportion of the mixtures of different crops depend upon the local soil and climatic conditions. The object of mixed cropping is to meet the family requirement of cereals, pulses and vegetables. It is subsistence farming.

Fig 8.2 Mixed cropping system

Principles of mixed cropping

- Cereals should be sown mixed with legumes e.g. Jowar + Tur, Wheat+Gram.
- Tall growing crops should be sown with dwarf growing crops. e.g. Maize + Mung/ Udid.
- Tap rooted crops should be sown mixed with adventitious rooted crops. e.g. Kidney bean + Bajra
- Bushy crops should be sown with erect growing crops.
- The crops should not be grown together having similar insect pest and diseases.
- Long and short durational crops should be grown mixed together.

Advantages of mixed cropping

- Less risk of failure of crops and total loss in income due to insect pest, diseases and adverse climatic conditions. e.g. Wheat + Gram cropping. If there is epidemic rust disease, wheat crop may failure but farmer will get returns from gram crop.
- Mixed cropping helps for maintaining the fertility of soil by including legumes as a mixture.
- The farmer gets assured food from his land, by taking cereals, pulses and oilseeds.
- Problem of cattle feed is solved and the nutritious feed is obtained.
- Gets quick and periodic cash returns especially in irrigated crops.
- Achieves better utilization of land and labour throughout the year.
- Utilizes available space and nutrients to the maximum extent.
- Better use of soil moisture by the crops due to difference in root system.
- Helps to reduce the soil erosion and to control the weeds to some extent.

Disadvantages

- Usually it spreads pest and diseases e.g. Groundnut + Castor mixed cropping, castor spreads the pest castor semilooper.
- Difficulties in management, if the crops have different requirements.
- Labour saving implements and machinery can not be used e.g. Harvesting.
- Field can not be ploughed immediately after harvest of crop.
- Yield of main crop is always less than compared to grown as sole crop.
- Reduces the acreage of main crop and also may reduces the quality of produce.

Characteristics of good subsidiary crop in mixed cropping

- It should preferably be a legume crop.
- It should mature earlier or later than the main crop.
- It should have different growth habit and nutrient requirement.
- It should not be very similar in climatic requirement.
- It should have different rooting depths.

8.2.5 Strip Cropping

Strip cropping consists of growing erosion permitting crops and erosion resisting crops in alternate strips across the slope of land. In this system, the crops like Jowar, Bajra etc. are grown as erosion permitting crops which allow the runoff water to flow freely within the rows. The erosion resisting crops are mostly legumes like groundnut, kidney bean, soyabean, horsegram, etc. spread and cover the soil and do not allow runoff water to carry much soil. The soil which flows from the strips of erosion permitting crops is caught by the alternating strips of legume crops reduces transporting and eroding power of water by obstructing runoff, filter the soil and retain in the field.

Strip cropping of bajra and groundnut, if followed will save erosion and also give more gross return than bajra grown alone.

8.2.6 Sequence cropping

Sequence cropping is growing two or more crops in sequence on the same piece of land. In general the sequence of crops is maintained season after season for one or more years.

Sequential cropping depends on several factors. The most important are the availability of water, the agro-climatic situation of the locality, the farmer's preference and requirements for the family and the price of the produce as well as the suitability of raising crops one after another even in turn around periods. Economic return per unit area, utilization of land and other resources, should also be considered.

Interactions in sequence cropping

Competition for light, water and nutrients as in mixed crop communities does not occur when sole crops are grown in sequence. It occurs only in relay cropping. The important purpose in sequential cropping is to increase the use of solar radiation. It is achieved by longer field duration and rapid ground coverage. Crops are raised in sequence one another, to keep the land occupied by the crop for longer period. If the crop development is slow, much of the solar radiation reaches the ground, favouring weed growth and increasing evaporation losses from the soil surface, which is checked in this cropping.

In sequential cropping, the preceding crop has considerable influence on the succeeding crop mainly due to changes in soil conditions, presence of allelopathic effect, shift in weeds and carry over effects of fertilizers, pest and diseases. Field preparation is difficult after rice crop since soil structure is destroyed due to puddling. Crops like sorghum and sunflower leave toxic chemicals in the soil, which affects germination of succeeding crop. Phosphorus applied to the previous crop is available for the succeeding crop.

Weed number and species differ in the succeeding crop due to the effect of the previous crop. The pest and diseases in stubbles and other residues of the previous crop may infect the subsequent crop.

8.2.7 Relay Cropping

Relay cropping refers to planting of the succeeding crop before harvesting the preceding crop. Here the crop in succession is sown or planted either in the field of the standing crop which is going to be harvested soon or in nursery so that immediately after the harvest of the standing crop the subsequent crop can be transplanted in the same field without any allowance for keeping the field uncropped or fallow even for the turn around period. e.g. Jute-Rice, Mustard-Onion.

The farm resources such as land, labour, water, capital and infrastructure are efficiently utilized. When land is limited, intensive cropping is adopted to utilize the available water and labour. When sufficient and cheap labour is available, vegetable crops are also included in the cropping system, as they require more labour.

8.2.8 Multistoried cropping

When two or more crops are grown on the same piece of land according to their height is termed as multistoried cropping. It is mostly followed in Konkan region in high value plantation crops, where land holding is very small and value of land is very high e.g. Arecanut + balck pepper + banana+ pineapple. It is also termed as multitier or multilevel cropping.

In this arecanut with high sunlight demands makes first tier followed by black pepper growing with the support of trunk making second tier. In between two arecanut trees, papaya or banana is planted making third tier and pineapple or ginger makes the fourth tier with high demand of shade and humidity, just like a multistoried building.

8.2.9 Catch cropping

When a subsidiary crop is sown in between the gap of a widely spaced crop or when a subsidiary crop is sown in the gap between two major crops of different seasons or when contigent crop is sown to catch a season under the circumstances of total failure can be termed as catch cropping e.g. Cotton + green gram, Sugarcane + potato, Green gram, bajara, sesamum, sunflower as midseason correction crops when main season crop fails.

Try this

With the help of information collected from internet, prepare the slides of various cropping system for PPT presentation.

Fig 8.3 Multistoried cropping system

Exercise

Q.1 A) Fill in the blanks.

1. Growing two or more crops simultaneously on the same piece of land with a definite row pattern is known as _____
2. The number of crops to be grown increases within a definite period of time, this cropping method is termed as _____
3. Growing two or more crops simultaneously on the same piece of land with a definite row arrangement is called as _____.
4. Planting of succeeding crop before harvesting the previous crop is called as _____
5. Planting one crop year after year on the same piece of land is called _____.

B. Make the pairs.

'A' group	'B' Group
1. Mixed Cropping	a. Growing of single same crop year after year
2. Multiple Cropping	b. Growing of two or more crops together
3. Intercropping	c. Growing of more number of crops within a year
4. Monocropping	d. Growing of two or more crops with definite row arrangement
	e. Use of two to three floors in same area and same time
	f. Crops at different time

C. State true or false.

1. When a subsidiary crop is sown in between the gap of widely spaced crop is called catch cropping.
2. Cropping system will not achieve better utilization of land and labour through out the year.
3. Cropping systems should be framed as per farm budgeting and management.
4. In mixed cropping system labour saving implements and machinery can be used for harvesting.
5. Cropping intensity index is the sum of area planted to different crops and harvested in single year divided by the total cultivated area expressed as percentage.

Q. 2 Answer in brief.

1. Define intensive cropping.
2. What do you mean by multiple cropping?
3. Define the term of sequence cropping.
4. Write examples of intercropping.
5. Define catch crop.

Q. 3 Answer the following questions.

1. Write short note on strip cropping.
2. Explain the difference between relay and intercropping system.
3. Complete following chart.

Sr. No.	Multistoried tier	Name of crop for planting
1	First tier crop	
2	Second tier crop	
3	Third tier crop	
4	Fourth tier crop	

4. Calculate cropping intensity index for the given conditions. A cultivator has seven hectares of land. He has grown cotton over four hectare of land and soybean over 2 ha of land during kharif, Jowar over 2 ha of land and sunflower over 2 ha during rabi and ground nut over 1 ha of land and green gram over 1 ha of land in summer.

5. Calculate the equivalent yield of soybean. Lets the yield of soybean and red gram in a hectare of intercropping be 2000 kg and 800 kg respectively. The total yield of intercropping system can be expressed as soybean equivalent yield by knowing the price of each produce if the price of soybean and red gram are Rs. 30 and Rs. 25 per kg respectively.

Q. 4 Answer in detail

1. What is intercropping and give its advantages and disadvantages.

2 Read the following information and answer the questions.

Cropping system is an important component of farming system. From the farm organization point of view, a system consists of several components'. They are depending on each other, defined as a set of components' which are inter related and interacted among themselves. The available technology determines their makeup. Farming system consists of several enterprises with appropriate combination like cropping system, dairying, poultry, fishery, bee keeping, etc. These enterprises are interrelated. The end products and wastes of one enterprise are used as inputs in others. The wastes of dairying like dung, urine, refuse, etc. are used in preparation of farm yard manure which is an input in cropping systems. The straw obtained from the crops is used as fodder for cattle. Cattle are used in different field operations for growing crops. Thus, different enterprises in farming system are highly interrelated.

a. Which are the important components of farming system?

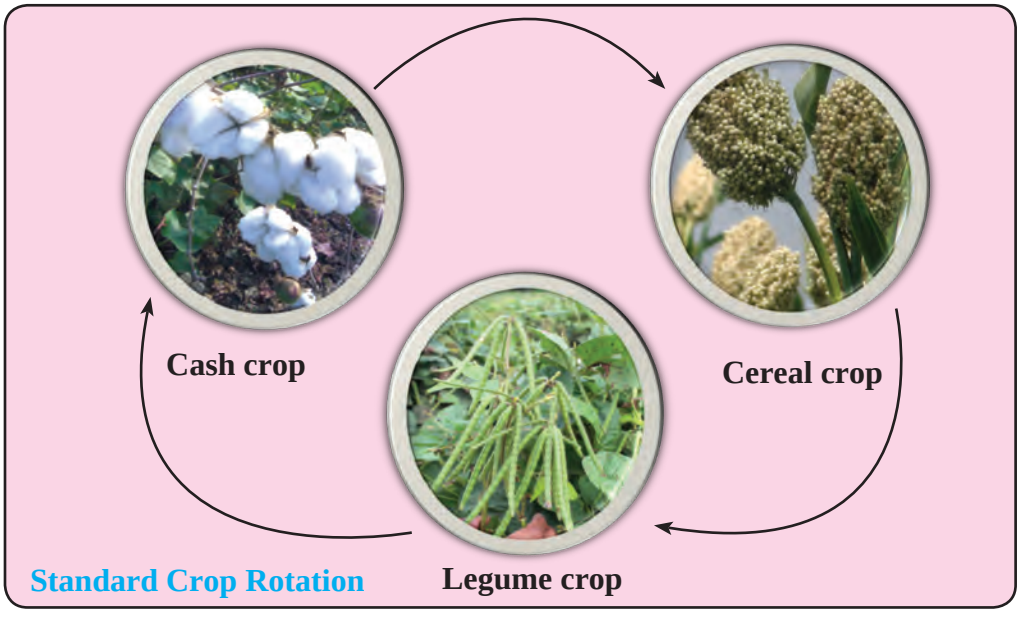
b. What are the enterprises of farming system?

c. List out the various wastes products dairying used as input for farming.

d. What are the interrelations of straw obtained from crop and cattle in farming system.

3. What is mixed cropping and give its advantages and disadvantages.

4. Describe the land equivalent ratio (LER) with suitable examples.



Standard Crop Rotation