CHAPTER 1

Agriculture—Food and Much More

Primitive man was a food gatherer and hunter. He moved from place to place hunting animals, collecting seeds, fruits and other edible materials. Later he learnt how to plant and grow the seeds he gathered. From being a wandering nomad, he turned into a farmer. He also started domesticating animals to provide him with a variety of products—milk, meat, hides and skins. This was the beginning of agriculture. Even today many of our festivals are connected with the planting of crops or their harvesting. Most Indian states celebrate harvest festivals like *Baisakhi*, *Pongal* and *Bihu*.

India has a large population. To provide food for such a large number of people, regular production, proper management, and distribution of food is necessary. Cultivated plants that provide useful products are called **crops**. Crops may give us edible products like rice or other cereals, pulses or lentils, spices, sugar, fruits, vegetables, oils and beverages like tea or coffee. Some crops provide us with other useful products like cotton and jute. The science of raising crops and animals is called **agriculture**.

The plot of land where a crop is cultivated is called a **field**. Farmers need to prepare the soil, sow the seeds and apply adequate quantities of manure and fertilisers to help the plants grow well. Irrigation of the field provides water for the crop; weeding removes unwanted plants that deprive the crop plants of essential minerals. After the crops mature, they are harvested and stored. All these activities are generally called **agricultural practices**. Farmers need to use various tools or **agricultural implements** for these practices.

Types of Crops

The farmers of today grow a wide variety of crops. These can be classified on the basis of the products they yield. Some common crops are:

- **Cereals:** wheat, rice, maize, barley, oats, *jowar* and *bajra* (millets)
- **Pulses:** gram, cow pea (*arhar*), green gram (*moong*), black gram (*urad*)
- **Oil-seeds:** mustard, groundnut, coconut, sunflower, sesame (*til*), cotton
- **Vegetables:** onion, potato, cauliflower, carrot, cabbage, spinach, tomato
- **Sugar crops:** sugarcane, sugar beet
- **Spices:** pepper, chillies, ginger, garlic, cumin (*jeera*), coriander (*dhania*), turmeric (*haldi*), clove, cardamom (*elaichi*)
- **Fruit crops:** mango, apple, orange, pear, guava, papaya, banana, *musambi*, grapes
- **Beverage crops:** coffee, tea, cocoa
- **Fibre crops:** cotton, jute, hemp, coconut (coir)

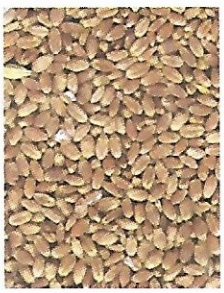
Crops are also classified according to the season in which they are grown. ***Rabi* crops are grown in winter.** Examples of *rabi* crops are wheat, mustard, pulses and many vegetables. ***Kharif* crops are grown during monsoons.** These include maize, gram, cotton, rice and *bajra*.

The growing of flowers on a large-scale for local sale and export is called **floriculture.** It is very popular nowadays.

Exercise 1

Can you identify the different food crops shown in these pictures?

i.



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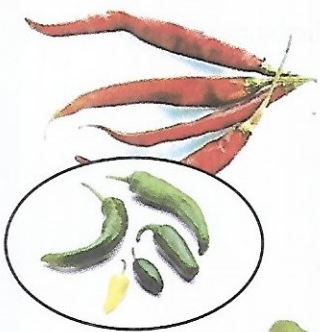

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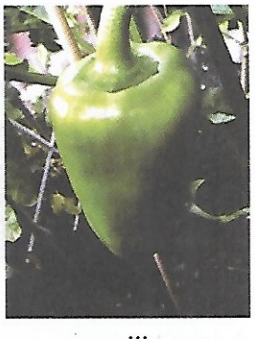

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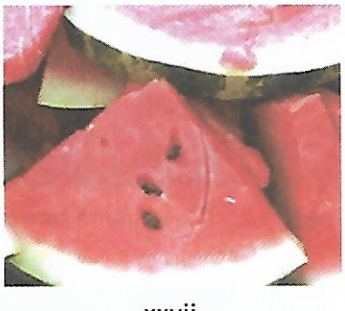

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Agricultural Practices and Implements

Several steps have to be taken before planting and during the growing of crops. These include:

A. preparing the soil
B. sowing the seeds
C. irrigation
D. using manure and fertilisers
E. weeding
F. protecting the crop against pests and diseases
G. harvesting and storing

A. Preparing the Soil

▲ plough

The farmer needs to prepare the soil before sowing seeds. Preparation of the soil requires loosening and turning it. This process is called **tillage** or **ploughing**. A simple wooden or iron **plough** pulled by bullocks or buffaloes is commonly used. Today, farmers who have large areas of land use tractors to plough their land. Ploughing allows air to enter the soil. This, in turn, helps the roots of the crop plants to breathe. Air is also needed by the microorganisms, present in soil, that bring about decomposition of organic matter. Turning the soil exposes pests, which may be killed by the heat of the sun or eaten by predators. Unwanted plants or weeds get uprooted from the soil and dry up.

▲ leveller

After ploughing, the soil is left in large pieces called **crumbs**. These are first broken down into smaller pieces using a **soil plank**. The land is then pressed down and levelled with the help of a **leveller**. If the ploughed soil consists of fine particles, these can be washed away by water or blown away by wind. Levelling the soil prevents erosion by water and wind. It also helps the soil retain its moisture.

B. Sowing the Seeds

The soil is now ready for **sowing**. Sowing seeds of good quality is very important. Poor quality seeds will not germinate or will yield much less crop. Farmers may raise their own seeds or buy good quality seeds from State Agricultural Departments or the Seed Corporation.

Activity 1 Finding Seeds of Good Quality

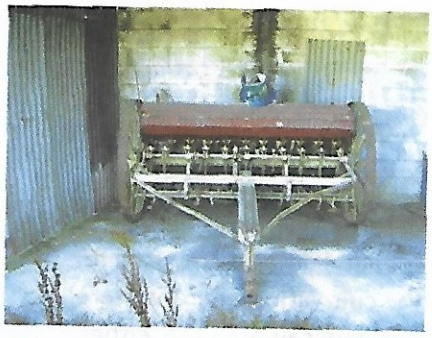
Take some wheat or bean seeds. Put them in a beaker of water. Some seeds will sink and some seeds will float on water. The ones that float are not fit for sowing. The ones that sink are fit for sowing.

Often, seeds that have been stored for a long time are eaten by insects. You may see tiny holes in them. These seeds are also unfit for sowing. Visit the store where your mother buys rice, pulses and spices every month. With permission from the storekeeper, collect about one teaspoon each of various items and observe them at home.

Which do you think a farmer sows: whole green *moong* or the yellow *moong dal*?

There are two ways in which the seeds are sown.

Broadcasting is a method of sowing seeds by scattering them by hand. This results in an unequal distribution of seeds. For proper spacing of the seeds, a **seed drill** attached to the plough is used. It consists of a funnel at the top with a tube below which releases seeds into the **furrows** or ditches created as the plough is pulled over the soil. The seeds of wheat, maize, *bajra* and mustard are sown by this method.



▲ seed drill

The seeds of rice and some vegetables are first raised in small separate plots of land called **nurseries** or **seed beds**. They are allowed to grow till they attain a certain height. The healthy seedlings are selected and transferred to another field. This process is called **transplanting**. During transplantation, plants are placed with proper space between them.

▲ transplanting rice in S-E Asia

C. Irrigation

Like all plants, crops require water. The watering of fields is called **irrigation**. Water for irrigation is drawn from wells, rivers, canals, tube wells and ponds. The requirement of water varies with the crop and the season. For instance, rice crops need to be flooded with water. This type of irrigation is called **basin irrigation**. In some crops, too much irrigation will result in **waterlogging**. The extra water does not percolate down through the soil. When the soil is waterlogged, the roots of the plants in the field cannot breathe and the plants die.

▲ furrowed fields

Irrigation water in fields of wheat, vegetables and some other crops is channelled into furrows. This is called **furrow irrigation**.

In areas where there is very low rainfall, the modern method of **drip irrigation** is being used. Underground pipes, having small holes in them at regular intervals, carry water directly to the roots of the plants, where it is needed the most. This method prevents loss of water through evaporation or flooding. Additionally, in farms in desert-like areas, the plants may be covered with plastic sheets. This prevents loss of water through transpiration. Water vapour condenses inside the sheet and falls back on the ground, where the plants can use it. Holes in the sheets ensure that plants get enough air and also that it does not get too hot inside the plastic cover.

▲ drip irrigation

D. Using Manure and Fertilisers

Crops, like all plants, get their nutrients from the soil. Repeated cultivation of a crop in the same field makes the soil deficient in minerals. Crops planted in such fields grow weak and their yield is also poor. Farmers add manure and fertilisers to the soil to ensure that the correct amount of nutrients becomes available to the crop. **Manure**, and organic fertilisers are made from cattle dung, leaves, farmyard waste and other biodegradable domestic waste material. Farmyard waste consists of a mixture of cattle dung, urine and crop waste. This is mixed and allowed to dry in the sun. It is then used directly as farmyard manure.

Compost is a brown manure obtained by decomposition of dead plant and animal matter. Biodegradable waste is also put in the compost pit and turned into manure. **Vermicompost** is another form of compost that is used by farmers. In vermicomposting, organic waste in decomposed faster with the help of earthworms. It takes 2–4 weeks to turn the biodegradable waste into compost by earthworms. Decomposition by bacteria takes about 3–4 months. This forms an excellent organic fertiliser.

Exercise 2

Which animals are used for making vermicompost? What is the advantage of vermicompost over compost?

The semi-solid material left after the production of biogas and *gobar* gas is a **biofertiliser** rich in nutrients.

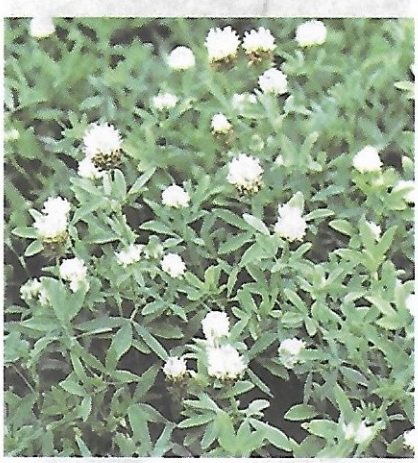
Green manure consists of leguminous plants or all types of pulses and beans that have high nitrogen content. These are grown in a field and ploughed back into the soil after their pods are harvested. These plants enrich the soil with nitrogen. They are generally grown alternately with cereal crops.

Crops grown to feed cattle are called **fodder crops**. These are also ploughed back into the soil after harvesting. *Burseem* is one such crop, widely grown in North India. Alfalfa is another fodder crop.

Fertilisers are chemical compounds made in factories. Unlike manure, fertilisers are usually applied in small quantities. As a result, they may also be bought in small quantities which are

Did you know?

Organic farming is a system of farming where environment-friendly methods are used for the cultivation of crops. Here, no chemicals are used, either as fertilisers or as pesticides. The crops are cultivated using organic manures. Natural pesticides like *neem* oil are used instead of chemical pesticides. Plants like marigold, *tulsi*, garlic and *neem* growing in a field repel insect pests. Organic foods are generally more expensive than food grown using fertilisers and pesticides. Find out more about organic foods and where they are available in your city.



▲ *Burseem*

easier to transport and store. Fertilisers are used to supply specific nutrients that are required for the growth of healthy plants. Among these are nitrogen, phosphorus, potassium and calcium. Commonly used fertilisers are nitrogenous compounds like urea, $(NH_2)_2CO$, ammonium nitrate, NH_4NO_3, and sodium nitrate, $NaNO_3$. All three of them supply nitrogen. Super phosphate and ammonium phosphate, $(NH_4)_3PO_4$, supply phosphorus. Potassium nitrate, KNO_3, and potassium sulphate, K_2SO_4, supply potassium. Commercial fertilisers are sometimes named according to the elements or nutrients they supply. For example, **CAN** supplies calcium, ammonium and nitrogen. Similarly, **NPK** supplies nitrogen, phosphorus and potassium. CAN and NPK are also called **mixed fertilisers** as they supply more than one major element.

▲ trowel

Fertilisers need to be selected and used carefully, according to the crop and soil type. The use of excess fertilisers changes the nature of the soil. They can make the soil either too acidic or too alkaline. Fertilisers percolate through the soil with rain or irrigation water and reach the underground aquifers. If excess chemicals are present in this water, it becomes unfit for human consumption. Fertilisers, therefore, should be used judiciously.

▲ harrow

E. Weeding

Often many other unwanted plants or **weeds** start growing with the crops. The seeds of these plants may have been already present in the soil or may have been brought from other areas. In your school or home garden, you would have seen the gardener removing them by hand with the help of a **trowel** (*khurpa*). In big fields, a tractor-driven **harrow** is used. In rice fields, which are usually flooded with water, a special **Japanese weeder** is used to remove weeds.

▲ Japanese weeder

Weeds can also be removed by using chemicals called **weedicides**. These kill the weeds, but do not harm the crop.

Exercise 3

Why do you think weeds should be removed?

Exerise 4

Match the following:

Column I	Column II
i. tillage	**a.** large mud pieces
ii. broadcasting	**b.** rice
iii. crumbs	**c.** unwanted plants
iv. transplanting	**d.** wheat
v. weeds	**e.** plough
vi. *rabi* crop	**f.** scattering of seeds

F. Protecting the Crop

Crops need to be protected from **pests** like rats, mice, insects and birds. Bacteria, fungi and viruses can also cause diseases in crops. Birds may be scared away by beating drums or using scarecrows. The use of **pesticides** or chemicals to control pests is very common. **DDT, BHC** and **Malathion** are commonly used pesticides. Chemicals that kill only specific organisms can also be used. These chemicals are usually sprayed in liquid form on the plants.

▲ aphids

Scientists are looking for ways to control pests without using chemicals. If organisms that are natural enemies of a pest are put in the field, they will only destroy the pests and not harm the crop. The use of living organisms to control pests is called **biological pest control**. Scientists have found that by using chemical substances called **pheromones,** they can lure adult male insects into special traps and prevent them from breeding. Some insect pests called aphids are eaten by ladybirds, which do not harm the plants in any way. Farmers and gardeners, therefore release ladybirds in gardens, so that they can eat up the aphids and thus protect the plants.

▲ ladybirds

G. Harvesting and Storing Crops

When the seeds ripen on the plants, they are ready for harvesting. Removal and gathering of a mature crop is called **harvesting**. After harvesting, the grains are separated from their stalks by **threshing**. This is done by beating the cut stalks against a hard floor or by using

▲ thresher

a **mechanical thresher**. The straw is used as food for cattle. Pieces of straw and the husk of the grains left behind after threshing are called **chaff**.

Chaff is separated from the whole grain by **winnowing**. The grain, along with the husk, is allowed to fall from a height. The chaff being lighter is blown away by the wind and the heavy grains fall straight down.

▲ winnowing

In small patches of land, crops are usually cut down using a hand-held tool called a **sickle**. In big farms, a large vehicle called a **harvester combine** is used. This performs two functions at the same time. It can harvest the grain as well as separate it from the unwanted chaff.

▲ sickle

The grains are dried in the sun before being stored. Drying the grain in the sun reduces its moisture content and helps in storing it for a long time. Usually grains are stored in gunny bags in well-ventilated **godowns**. They are kept on raised, dry platforms. Sometimes, the bags are sprayed with pesticides to keep insects away. For large-scale storage, very tall **cement tanks** called **silos** are used. In shops and homes, grains may be stored in **metal bins** or **terracotta** storage pots.

▲ harvester combine

Crops like cotton, vegetables, fruits and flowers are handpicked. Fresh fruits and vegetables have very high moisture content. Therefore they are stored in refrigerated godowns or in **cold storage**.

Exercise 5

Grains of wheat are usually washed and spread out in the sun to dry before being ground into flour (*atta*). Why is this done?

Exercise 6

Arrange the following agricultural practices in the order in which they are carried out.

irrigation, levelling, ploughing, weeding, adding fertilisers, harvesting, sowing, storing seeds, crop protection

Improving Crops

Farmers constantly look for new methods to grow better crops. They try to select seeds of the best quality and use new techniques of farming to get a better yield. Agricultural scientists, through

constant research, try to improve the different varieties of seeds so that the crops will mature earlier, yield more, and remain resistant to diseases and pests. They also advise farmers on the effective use of fertilisers and pesticides.

Exercise 7

How do you think a crop that matures early is beneficial to the farmer?

Scientists may **cross** two varieties of a crop with different characteristics. The new seeds are carefully selected and grown. This process continues till a set of desired characteristics are obtained in the plant. This process is known as **crossbreeding** or **hybridisation**. Crop improvement programmes also include use of natural methods to restore nutrients lost from the soil.

Exercise 8

What will happen if the same crop is grown again and again on the same land?

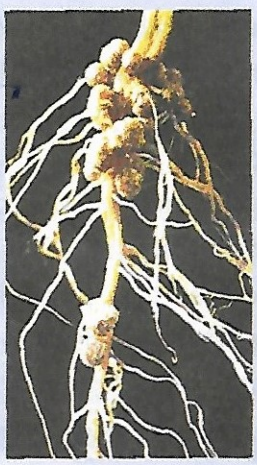
One way of improving the crop is by following the process of **crop rotation**. In this method, different crop plants are grown alternately. Crop rotation avoids depletion of nutrients caused by the repeated planting of the same crop. Leguminous crops can utilise the nitrogen present in the atmosphere. After the pods are harvested, the plants are ploughed back into the soil giving it additional nitrogen. Thus, farmers grow leguminous crops alternately with cereals to restore the used nitrogen.

Nitrogen Cycle

Nitrogen is part of many organic compounds like proteins. Plants get their supply of nitrogen from nitrates or ammonium salts present in the soil. Nitrogen is also found in a variety of other chemical compounds essential for life. The atmosphere has a large quantity of nitrogen gas present in it. However, this cannot be directly used by the majority of living organisms.

Activity 2 Looking at the Roots of Leguminous Plants

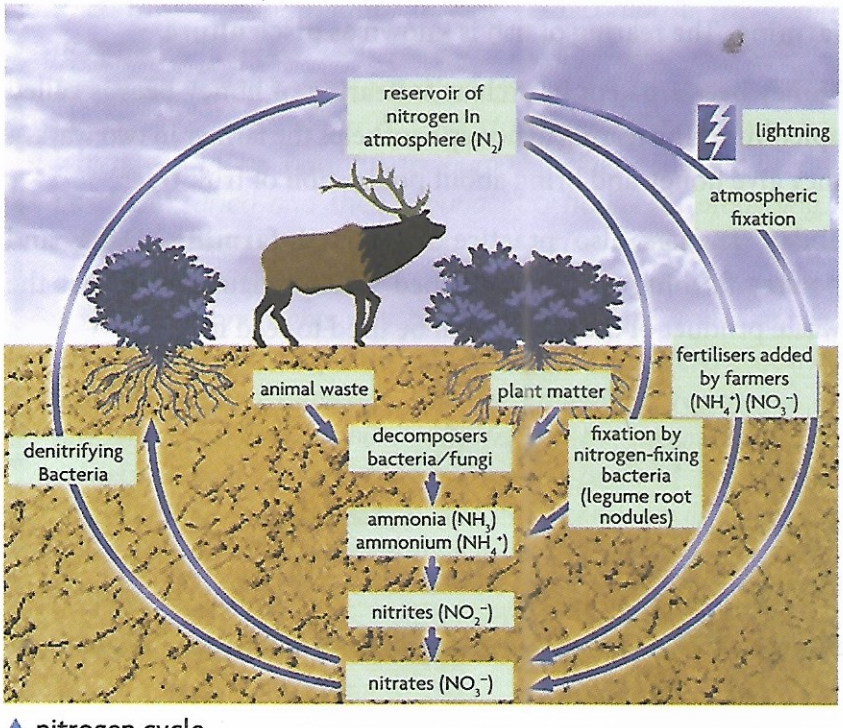
Take a trowel and carefully dig up a pea plant or any leguminous weed from the garden. Wash off the mud and observe the roots. The bead-like structures on the root are called **nodules**. The nodules contain a bacterium called *Rhizobium*. These bacteria live in a symbiotic relationship with the plant. They take up nitrogen from the atmosphere and convert it into forms which can be used by the plant. This process is known as **fixation of atmospheric nitrogen**. In return, the bacteria get ready-made food from the plant. The nitrogen, after being used by the plants, goes back into the atmosphere. In other words, it goes through a **cycle**.



▲ root nodules

In activity 2, you learnt how symbiotic *Rhizobium* bacteria, which live in the root nodules of leguminous plants, help in the fixation of atmospheric nitrogen. Some other kinds of bacteria living in the soil and blue-green algae found in rice fields can also fix atmospheric nitrogen. When lightning occurs, the nitrogen and oxygen in the atmosphere combine to form nitrogen dioxide, NO_2, which comes down with the rain to enrich the soil. The nitrogenous fertilisers used by farmers also add some nitrogenous compounds to the soil. Dead organisms are acted upon by some microorganisms. They convert the nitrogen present in dead organisms to ammonia, ammonium salts, nitrates and nitrites. These are some ways in which the nitrogen in the soil is constantly replenished.

How is it that the quantity of nitrogen in the atmosphere does not get depleted? **Denitrifying bacteria** act on decaying plant and animal wastes and release nitrogen gas into the air. Thus, a balance is maintained and a cycle is set up in the ecosystem, between the nitrogen present in the air and the soil. This **nitrogen cycle** is shown in the diagram below.



▲ nitrogen cycle

Did you know?

GM foods (genetically modified foods) generally refer to crop plants modified by using the latest molecular biology techniques. These plants have been modified in the laboratory to introduce desired **traits** or characteristics such as resistance to pests and improved nutritional content. Conventional plant breeding methods are time consuming and are often not very accurate. Genetic engineering, as the technique is called, on the other hand, creates plants with the exact desired traits. GM foods have the potential to solve many of the world's hunger and malnutrition problems.

They can produce massive yields without the use of pesticides. However, environmentalists and many public interest groups have raised doubts and concerns about GM foods. They feel we must proceed with caution. Adequate regulatory measures must be taken to avoid harm to human health and the environment.

Exercise 9

Can you say why denitrifying bacteria are an important part of the nitrogen cycle?

Food from Animals

Man started domesticating animals about the same time he settled down and began growing crops. Cattle dung provided him with manure for crops. Bullocks were used for ploughing. Horses, camels and bullocks were used for transportation. They are still used in some parts of the country. Animals provide us with food and other requirements, for example, wool for clothing and leather for making shoes. Animals also provide us with milk, eggs, honey and meat.

The animals that give us milk are **dairy animals**. The practice of keeping and breeding animals for milk is termed **dairy farming**. Cows and buffalos are the two main dairy animals. Like plants, animals also need looking after. They need to be protected against diseases. To keep animals healthy, they should be provided with adequate food of the right type, clean drinking water and airy sheds with ample space.

▲ apiculture

Exercise 10

Find out about the other animals which provide milk in our country.

Eggs are a rich source of protein. The practice of keeping and breeding birds that provide us with eggs and meat is called **poultry farming**. The rearing of fish is known as **pisciculture**.

Honey bees are kept in orchards. Rearing of honey bees is called **apiculture**. The rearing of honey bees helps the farmer in two ways—they give honey and bring about pollination of fruit trees.

Today, farmers also practice **integrated farming**. Dairy and poultry farming can be combined with pisciculture so that the waste product of the former can be used to feed fish.

Exercise 11

Give one or two words for each of the following:

i. an example of a chemical pesticide

ii. a vehicle used for harvesting and threshing

iii. large cement storage tanks

iv. process of crossing two varieties

v. symbiotic bacteria present in the root nodules of legumes

vi. practice of keeping and breeding birds that give us eggs and meat

vii. rearing of honey bees

viii. rearing of fishes

ix. combining together two or more types of farming

x. milk-producing animals

CHECK IT OUT

1. *i. rice; ii. wheat; iii.* arhar dal; *iv.* moong; *v.* urad dal *(black gram); vi. mustard seed; vii. sesame (*til *whole); viii. coconut; ix. cumin seeds (*jeera*); x. chillies; xi. ginger; xii. garlic; xiii. cloves (*laung*); xiv. cardamom; xv. cinnamon (*dalchini*); xvi. gourd; xvii. yam; (*zimikand*); xviii. bitter gourd (*karela*); xix. snake gourd (*chichinda*); xx. lotus stem; xxi. drumsticks; xxii. raw bananas; xxiii. capsicum; xxiv. mushroom; xxv. sugarcane; xxvi. red bananas (fruit); xxvii. watermelon* ***Activity 1:*** *Whole green* moong *is planted to get the crop. When the green skin is removed, the two yellow cotyledons of the* moong dal *are obtained.* ***2.*** *Earthworms are used for making vermicompost. This compost takes much less time to prepare than the compost made in a compost pit.* ***3.*** *Weeds use up the nutrients meant for the crops. If they are not removed from the field, the yield of crops will suffer.* ***4.*** *i–e; ii–f; iii–a ; iv–b; v–c; vi–d* ***5.*** *The stored grain may have been sprayed with pesticides, which would be harmful to human beings. The grains are washed to remove these pesticides, dried and then ground into flour.* ***6.*** *ploughing, levelling, sowing, irrigation, adding fertilisers, weeding, crop protection, harvesting, storing seeds* ***7.*** *If crops grown are of an early maturing variety, farmers can grow more crops on the same land.* ***8.*** *The same nutrients will be used repeatedly. These nutrients will get depleted in the land. If different crops are grown they use different nutrients, so the nutrients in the land do not get depleted.* ***9.*** *They release nitrogen gas into the atmosphere for the nitrogen cycle to continue.* ***10.*** *Yaks in the mountainous regions of North–West India, camels in Rajasthan and goats in some parts of the northern plains also provide milk.* ***11.*** *i. DDT/BHC/*Malathion*; ii. harvester combine; iii. silos; iv. crossbreeding/hybridisation; v.* Rhizobium*; vi. poultry farming; vii. apiculture viii. pisciculture ix. integrated farming; x. dairy animals*

BECOME A YOUNG SCIENTIST

1. Using your atlas, find out the names of the major rivers in various states of India. Many of them have large dams built on them. These help to store water, which is released into canals, to irrigate the farms in the surrounding areas. Find the location of the following dams: Bhakra, Hirakud, Rihand, Tungabhadra, Mettur.
2. Rajasthan, once a dry desert state, now has a plentiful supply of water from the Indira Gandhi Canal. Find out more about this.
3. What is the source of water shown in the picture? ▶ Collect more pictures of irrigation projects and the different crops grown in India and put them up on the bulletin board.

4. Collect crop plants and their seeds. Get them identified by a reliable source. Classify them and prepare a bulletin board display in the class using seed packets, identifying them and writing about their uses.
5. Find out about the festivals in India that are related to harvests. What are the special foods made during these festivals? Is there a special significance of these preparations?
6. Visit a nearby agricultural institute/museum in your town. A visit to a farm, a fish farm, orchard, dairy farm and poultry farm will give you first-hand knowledge of how these are run.

Can You Answer These?

Choose the correct answers in Q1 to Q12.

1. Drip irrigation is used in places where
   a. there is plenty of water available.
   b. there is little water available.
   c. the water table is very low.
   d. the water needs to be lifted up.

2. Which one of the following is **not** an example of a *kharif* crop?
   a. maize
   b. rice
   c. mustard
   d. pulses

3. Separation of grains from the chaff is called

a. winnowing. b. harvesting.
c. separation. d. threshing.

4. Before sowing, the first step in the cultivation of crops is

a. removing the weeds.
b. watering the field.
c. preparing the soil.
d. levelling the soil.

5. A crop that enriches the soil with nitrogen is

a. wheat. b. mustard.
c. carrot. d. beans.

6. Atmospheric nitrogen is fixed by _____.

a. lightning
b. blue-green algae
c. bacteria present in the root nodules of leguminous plants
d. all the above

7. Crop rotation is the method by which

A. crops are rotated to 90 degrees.
B. cereal crops are alternated with legumes.
C. crops are grown separately.
D. soil is enriched with nitrogen.

a. Only B is correct
b. B and C are correct
c. B and D are correct
d. All are correct

8. Basin irrigation is done in

a. wheat. b. rice.
c. maize. d. vegetables.

9. Furrow irrigation is **not** done in

a. vegetables. b. banana.
c. wheat. d. rice.

10. Manures are **not** made of

a. cow dung. b. farmyard waste.
c. urea. d. leaves.

11. An example of a mixed fertiliser is

a. urea. b. CAN.
c. KNO_3. d. K_2SO_4.

12. Which implement is **not** used for removing weeds?

a. tractor b. Japanese weeder
c. trowel d. harrow

13. List two differences between manure and fertilisers.

14. Give one advantage and one disadvantage of fertilisers.

15. Write short notes on the following:
hybridisation, irrigation, integrated farming, crop protection, symbiotic nitrogen fixation

16. Classify the following crops according to their use.
maize, pepper, pea, mustard, sugarcane, clove, potato, banana, coffee

17. How is tillage or ploughing helpful to crops?