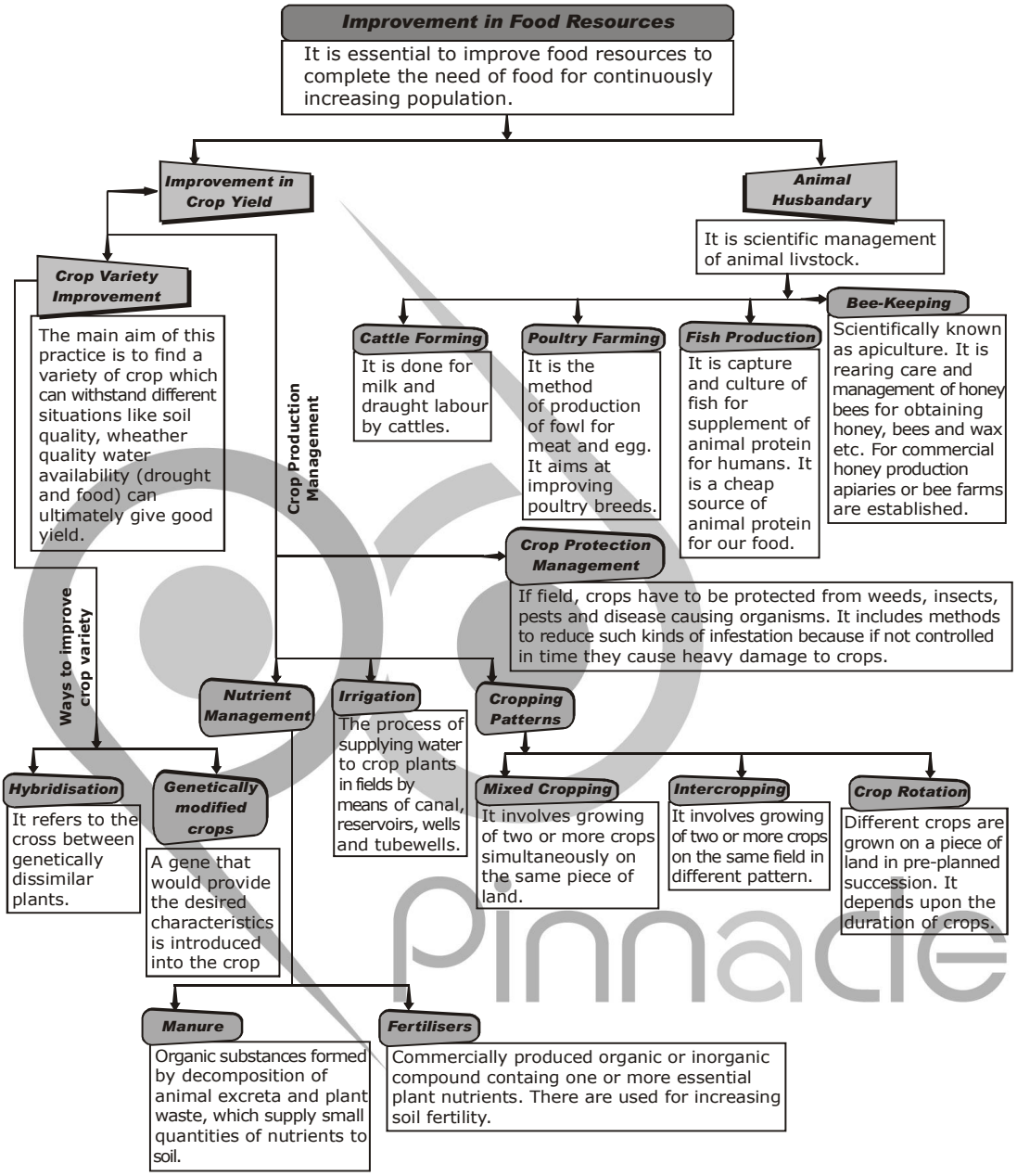
# IMPROVEMENT IN FOOD RESOURCES




**INTRODUCTION**

Food is the combination of various organic and inorganic substances which is capable of providing

(i) Energy for the various metabolic activities.

(ii) Materials for repair / replacement of worn-out tissues in the body.

(iii) Materials for growth & reproduction.

(iv) Regulatory substances, body secretions and metabolic activities etc. 70% of India's economy is based on agriculture and 40% of G.N.P (Gross National Product) comes from agriculture.

**(a)** **Agriculture:** (Ager means field; culture means cultivation). It is the applied biological science which deals with the production of plants and raising of animals useful to man, involving soil cultivation, breeding and management of crops and livestock.

**(b)** **Horticulture:** (Hortus-garden; culture-cultivation). It is the branch of agriculture and the science of growing vegetables, fruits and ornamental plants.

**(c)** **Silviculture:** (Sylvan- wood and trees) Cultivation of wood and trees e.g.-pine, teakwood, sesamum etc.

**(d)** **Sources of food:** Plants provide us with foods like cereals, pulses, oil seeds, fruits and vegetables, on this basis plants are classified as follows:

**TABLE: CLASSIFICATION OF CROP PLANTS**

| Type of crop plant | Examples | Importance |
|---|---|---|
| **1.** Cereals | Wheat, Rice, Maize, Minor energy millets, Sorghum requirements. | Rich in carbohydrates and provide energy. |
| 2. Pulses | Gram (Ghana), Pea (Matar) builders. Black gram (Moong), Pigeon pea (Arhar), Lentil (Masoor) etc. | Rich in proteins that are body building. |
| 3. Oil seed crops | Soyabean, Groundnut Sunflower, Niger, Sesame, Castor, Mustard, Linseed. | Rich in oils and fatty acid |
| 4. Root crops | Turnip, Carrot, Turmeric, medicines Sweet potato & Ginger | It is utilized as the vegetables & |
| 5. Sugar crops | Sugarcane and Beet | Important for wine industry. |
| 6. Fibre crops | Jute & Cotton industry | Important for jute & cotton |
| 7. Plantation crops | Tea, Coffee, Coconut and Rubber called cash crops. | Increases cash as are also |
| 8. Fodder crops | Berseem, Maize, Sorghum and Elephant grass. | Provides fodder for animals |
| 9. Horticulture crops | Apple, Banana, Guava, along (Fruits and vegetables) with small three quantities of Coriander, Jeera, Carrot, Raddish, Cabbage, Cauliflower, Spinach, Cucurbit. | Provides vitamins, minerals Pomegranate, Pears, Chillies, carbohydrates, proteins and oils. |

**(e)** **Crop Seasons:** Different types of crops require different climatic conditions like:

(i) Temperature

(ii) Photoperiod (duration of light**)**

(iii) Completion of life cycle

**Depending upon the growing season, there are two groups of crops:**

| | **Kharif crop/ Rainy season crop** | | **Rabi crop/ Winter season crop** |
|---|---|---|---|
| **(a)** | Grown during monsoon/rainy season | **(a)** | Grown during winter season |
| **(b)** | They require warm and wet weather | **(b)** | They require cold and dry weather |
| **(c)** | They are sown in June-July and harvested September/October | **(c)** | They are sown in October/November &harvested in harvested in March-April |
| **(d)** | Examples- Rice, Jowar, Bajra, Cotton, Urad, Moong etc. | **(d)** | Examples- Wheat, Barley, Gram, Peas, Groundnut, Mustard, Potato etc. |

## IMPROVEMENT IN CROP YIELD

To obtain the high yields from our farms the following three scientific approaches are adopted.

(a) Varietal improvement of crop through genetic manipulation. (Crop Variety Improvement)

(b) Crop Production Management.

(c) Crop protection management

**I. Improvement in Crop Yield**: In India, there has been four times increase in the production of food grains from 1960 to 2004. However, cultivable land area has increased by only 24 per cent. The yield of a crop can be increased by adopting number of improved agricultural practices, from sowing to harvesting. The various practices that are followed at various stages of production are. as follows:

**(i)** Preparation of soil **(ii)** Sowing

**(iii)** Application of manures and fertilizers **(iv)** Irrigation

**(v)** Weed control **(vi)** Crop protection

**(vii)** Harvesting, threshing and winnowing **(viii)** Storage

**(ix)** Crop improvement

**(x)** Rotation of crops, mixed and multiple cropping.

**(a) Varietal Improvement of crops through genetic manipulation:** The principal aim of varietal improvement is to get as many of the desirable & economic characters as possible in one variety.

**1. Aims of crop improvement are:**

(i) Increased yield-Developing high yielding varieties

(ii) Improved quality

(iii) Early and uniform maturity

(iv) Insensitivity to light and temperature

(v) Wider adaptability

(vi) Lodging-resistant varieties

(vii) Desirable agronomic characters

**2. Plant Breeding:** The technique of producing improved varieties of crop plants by the introduction of-several desired characters into them is called as plant breeding. Scientists concerned with the improvement of crop varieties are called as plant breeders.

**3. Aims of plant breeding**: New varieties of crop plants have:

(i) Higher yield.

(ii) Resistance to heat, frost, drought

(iii) Pest resistance

(iv) Early maturing varieties

**4. Methods for the genetic improvement of crop plants:**

**(i)** Introduction

**(ii)** Selection

(iii) Hybridization

**(i) Introduction:** *It refers to the taking of superior varieties of crop plants from the place of their natural cultivation to the place where they were never grown earlier.*

**(ii) Selection:** It is the process in which economic plants having best desired characters are picked up from the given population and seeds of such plants are used for future cultivation. For e.g. Maize & Cabbage are represented by their cultivated varieties only.

**Selection can be** { ***Natural*** - Survival of the fittest

***Artificial*** - Based on the human needs and interests

**(iii) Hybridization:** It means the process of crossbreeding of two genetically dissimilar varieties of crop plants (each having a specific and better characteristics) to obtain a new crop plant having both the desired characteristics is called as hybridization. Crop plants produced in this way are called as hybrid varieties or high yielding varieties.

| | | |
|---|---|---|
| **Parent 1** | × | **Parent 2** |
| (with a desired character, like high-yield) | | ↓ (with a desired character, like disease -resistance) |

## Hybrid variety

(High-yielding and disease-resistant)

**Hybridization may be** { ***Inter varletal*** - Between two different varieties
***Inter specific*** - Between two species of same genus
***Inter generic*** - Between plants belonging to different genera.

**II.** **Green Revolution** was a process by which India's production of wheat, rice, maize and several other food grains was tremendously increased in the late 1960s and early 1970s. India, which was earlier said to carry a 'begging bowl' to the West for food grain, claimed self-sufficiency, This revolution was due to the new agricultural technologies whereby high - yielding hybrid varieties of wheat and rice were grown in India. Fertilizers and pesticides were used. Irrigation facilities were improved. Dr. M.S. Swaminathan played a key role in bringing about the 'green revolution'.

**III.** **Dr. M.S. Swaminathan** Padam Vibhushan Professor M.S. Swaminathan, FRS, is the Father of 'green revolution 'in India. He stressed the need for the reorientation of the breeding programme and his work led to the era of dwarf varieties in India. In 1967, he developed a high-yield dwarf variety of wheat, **Sharbati Sonara.** Being a plant geneticist, he has contributed to the development or agriculture in India. He has held various important positions in India and abroad.

**(b)** **Crop Production Management**: In order to improve and manage our crop production system, we have to focus on cheaper and farmer friendly approaches. As there is direct co-relationship between the higher yields and input applications.

**(i)** **Successful crop production depends upon:**

(a) Understanding how crops develop and grow.
(b) How various factors affect the growth and development of crops and
(c) How each factor can be modified and managed.

**(ii)** **Approaches for crop production includes:**

**(a)** Nutrient management **(b)** Irrigation **(c)** Mixed cropping
**(d)** Inter cropping **(e)** Crop rotation

**1.** **Nutrient management**: Plant nutrients are the mineral elements needed by the plants for their growth, development and maintenance. Plants absorb a large number of elements from soil, besides water and air, only (16) elements are essential nutrients for plants, out of (40) elements present in plant ash. They are-

**(i)** Carbon **(ii)** lron **(iii)** Hydrogen **(iv)** Manganese **(v)** Oxygen
**(vi)** Boron **(vii)** Nitrogen **(viii)**Zinc **(ix)** Phosphorus **(x)** Copper
**(xi)** Potassium **(xii)** Molybdenum **(xiii)** Magnesium **(xiv)** Chlorine **(xv)** Sulphur
**(xvi)** Calcium

- **Sources of Plant nutrient**: The plants obtain their nutrients mainly from the soil. Out of the total 16 nutrients, as many as 13 are absorbed from the soil.

## SOURCES OF PLANT NUTRIENTS

**Soil-** Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Iron, Manganese, Boron, Zinc, Copper, Molybdenum Chlorine

**Air-** Carbon, Oxygen

**Water** -Hydrogen

**I. Characteristics of an essential plant nutrient:**

**(i)** In the absence of such element, the plant is not able to complete its life cycle.

**(ii)** Such element must have a direct influence on the plant nutrition and metabolism.

**(iii)** The requirement of such element must be specific and cannot be replaced by another element

**(iv)** Deficiency of such element can be corrected or prevented only by supplying that nutrient.

**II. Classification of plant nutrients:** On the basis of quantities required, mineral nutrients needed for plant growth have been grouped into two categories.

(i) Macronutrients (ii) Micronutrients

**Macronutrients-** Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur.

**Micronutrients-** Iron, Manganese, Copper, Zinc, Boron, Molybdenum, Chlorine.

Of the sixteen essential nutrients, some are required by plants in relatively large amounts than the others. The nutrients required in relatively large quantities are called macronutrients or major elements, while the ones required in very small quantities or traces are called micronutrients or minor elements.

Deficiency of the nutrients affects physiological processes in plants as well as their reproduction, growth. and susceptibility to diseases. To overcome the deficiency of nutrients, the soil can be enriched by adding manures and fertilizers.

## MANURES AND FERTILIZERS

**Manures:**

- Manure is organic substances obtained from the decomposition of animal wastes, like cow dung and vegetable wastes by the action of microbes.

**Types of Manures:**

**(i) Farmyard Manure (FYM) -**

- It is formed by the decomposition of a mixture of farm waste e.g. cattle excreta (dung), urine of cattle, litter and roughage.
- By the action of micro-organisms all these materials decompose and are used as farmyard manure (FYM).

**(ii) Compost:**

It is formed by decomposition of plant and animal waste in pits through action of microorganisms. If it is carried out with help of earthworms, then it is called vermicomposting.

**(iii) Green Manuring:**

- The practice of green manuring includes growing turning or ploughing and mixing of green crops with soil to improve physical structure and soil fertility e.g. sun hemp
- Green manures may include both leguminous and non-leguminous plants.

## ❖ Advantages of Manures:

Manures affect the soil in following three ways:

- The manures enrich the soil with nutrients. They replenish the general deficiency of nutrients in the soil. Since manures contain nutrients in small quantities, they are needed to be applied in large quantities.
- The manures add organic matter (called humus) to the soil which restores the soil texture for better retention of water and for aeration of soil. For example, organic matter present in the manures increases the water holding capacity in sandy soils and drainage in clayey soil
- The organic matter of manures provide food for the soil organisms (decomposers such as bacteria, fungi, etc.) which help in making nutrients available to plants.
- Thus, organ is manures help to improve the physical properties of soil, reduce soil erosion, increase the moisture holding capacity of soil and above all these advantages, they are low cost nutrient carriers.

## ❖ Fertilizers:

- Fertilizers are the sources of plant nutrients manufactured commercially from chemicals. They are inorganic or organic compounds containing necessary plant nutrients such as nitrogen, phosphorus and potassium.
- The chemical substance which can be used as a fertilizer must have the following characteristics:
- It must be soluble in water.
- It should be easily assimilated by plants.
- It should be stable.
- It should not be injurious to plants.
- It should not disturb pH of the soil.
- It should be cheap.
- Fertilizers are classified according to the element (N, P or K) which they supply to the soil.

(i) Nitrogenous fertilizers

(ii) Phosphatic fertilizers

(iii) Potash fertilizers

(iv) NPK fertilizers

**(i) Nitrogenous Fertilizers:**

- The important nitrogenous compounds used as fertilizers are:

  Ammonium sulphate, $(NH_4)_2SO_4$

  Calcium cyanamide, $CaCN_2$

  Calcium ammonium nitrate, $Ca(NO_3)_2$, $NH_4NO_3$

  Basic calcium nitrate, $Ca(NO_3)_2$, $CaO$

  Urea, $(NH_2 – CO – NH_2)$

**(ii) Phosphatic Fertilizers:**

- The minerals of phosphorus such as phosphorite, [Ca3(PO4)2] and apatire, [3Ca3(PO4)2·CaF2] are sparingly soluble in water and thus do not serve as source of phosphorus for plants. These are, therefore, converted into soluble materials which can act as good fertilizers. The important phosphatic fertilizers are:

  Calcium superphosphate

  Nitrophosphate

  Triple phosphate

  Phosphatic slag

**(iii) Potash Fertilizers:**

- Potassium nitrate, potassium chloride and potassium sulphate are used as fertilizers.

**(iv) NPK Fertilizers:**

- Fertilizers containing N, P and K in suitable adjusted proportions are known as NPK fertilizers. These are obtained by mixing nitrogenous, phosphatic and potash fertilizers in suitable proportions.

## Irrigation

- Irrigation is the process of providing water to the soil for the purpose of supplying moisture essential for plant growth.

❖ **Irrigation method:**

- Wells: There are two types of wells, namely dug wells and tube wells. In a dug well, water is collected from water bearing strata. Tube wells can tap water from the deeper strata. From these wells, water is lifted by pumps for irrigation.

- Canals: This is usually an elaborate and extensive irrigation system. In this system canals receive water from one or more reservoirs or from rivers. The main canal is divided into branch canals having further distributaries to irrigate fields.
- River Lift Systems: In areas where canal flow is insufficient or irregular due to inadequate reservoir release, the lift system is more rational. Water is directly drawn from the rivers for supplementing irrigation in areas close to river.
- Tanks: These are small storage reservoirs, which intercept and store the run-off of smaller catchment areas.

## Cropping pattern

### ❖ Mixed Cropping:

- The process of mixing seeds of two or more different crops and then sowing then in the same field is called mixed cropping.
- Example of mixed cropping -
  (a) Wheat + mustard
  (b) Maize + urad
  (c) Arhar + mung
  (d) Ground nut + sunflower

### ❖ Advantages of Mixed Cropping:

- There is lesser risk of total crop failure because if one crop fails, then the other crop helps the farmers to overcome his loss.
- Farmers get a variety of products for their family by growing crops under the mixed cropping system, e.g. cereals, pulses, fodder and vegetables may be grown simultaneously.

### ❖ Intercropping:

- Intercropping is a special type of mixed cropping in which two or more crops are grown simultaneously in the same field following a definite row pattern.

## Differences between mixed cropping and intercropping:

| | Mixed cropping | Intercropping |
|---|---|---|
| 1 | Marketing of only mixed produce is possible | Produce of each crop can be marketed sepa- rately |
| 2 | It is difficult to apply pesticides to individ-ual crop | Pesticides can be app- lied easily to the indiv- idual crop |
| 3 | Prior to sowing, the seeds of two crops are mixed | Seeds of two crops are not mixed before sow- ing |
| 4 | There is no set pattern of rows | A pattern of rows is observed |

**CROP ROTATION**

The growing of different crops on a piece of land in a pre-planned succession is called crop rotation.

Depending upon the duration, crop rotation may be of following three types:

(a) One-year rotation
   1. Maize – Mustard
   2. Rice - Wheat

(b) Two years rotation
   1. Maize - Mustard-Sugarcane - Fenugreek
   2. Maize - Potato- Sugarcane - Peas

(c) Three years rotation
   1. Rice - Wheat - Mung - Mustard
   2. Sugarcane - Berseem
   3. Cotton - Oat - Sugarcane - Peas - Maize – Wheat

❖ **Selection of Crops for Rotation:** Crops should be chosen such that they have different nutrient requirements so that soil doesn't get depleted of same nutrients. Non – leguminous crops should be grown alternately with leguminous crops

❖ **Advantages of Crop Rotation:**

- Crop rotation helps in replenishment of soil fertility.
- It prevents depletion of selective nutrients.
- It prevents building up of diseases and pests of particular crop.
- It enhances the production by increasing the soil fertility.

❖ **Organic Farming:**

- It involves no chemicals or minimal use of chemicals. We can employ biopesticides, biofertilizers etc.
- Manures are natural fertilizers. They are bulky sources of organic matter which supply nutrients in small quantities but organic matter in large quantities. Manures include farmyard manure (FYM). Compost, green manures, vermicompost, etc.

**CROP PROTECTION MANAGEMENT**

❖ **Crop protection management:**

- Field crops are affected by a large number of weeds, pests which cause damage to the crops & reduce their productivity.

❖ **Weeds:**

- Weeds are unwanted plants which complete with main crop for nutrition & reduce the growth of crop.

**Examples of weeds: -**

* Wild sorghum
* Chaulai
* Bathua
* Parthenium

❖ **Methods of weed control:**

- Mechanical methods
- Chemical or use of weedicides
- Biological

❖ **Pests:**

- Harmful creatures for our crop plants are small insects which attack the plants in three ways:

❖ **Insect Pest Control**

- Insect pests are small insects that harm the crop plants and make them unfit for consumption.
- Based on the mode of attack, the insect pests are of following three types:

❖ **Chewing Insects:**

- They cut and chew root, stem and leaves of the plants with the help of their chewing type of mouth parts. e.g., grasshoppers, locusts, caterpillars, grubs etc.

❖ **Sucking Insects:**

- They suck the cell sap from different parts of the plants with the help of piercing and sucking mouth parts. eg. Aphids, leaf hoppers, plant bugs, etc.

❖ **Borer Insects:**

- They bore and enter different plant parts, and feed on the plant tissues eg. Sugarcane borer, pod borers, cotton ball weevil, grain weevils, etc.

❖ **Methods of Insect Pest Control:**

- The root cutting type of insects can be controlled by mixing insecticide in the soil.
- The stem and leaf cutting, and boring type of insects can be controlled by dusting or spraying the contact insecticides. e.g., malathion, lindane.

- The sap sucking insects can be controlled by spraying systemic insecticides.

**DISEASE CONTROL**

- A wide variety of plant pathogens such as bacteria, viruses and fungi, exist in our environment.
- Pest infect and cause serious diseases in our crops.
- The diseases caused by these pathogens include blast in paddy (rice), rust in wheat, red rot in sugarcane.
- Based on the mode of transmission, plant diseases are of following four types –

## Seed Borne Diseases:

- The diseases which spread through seeds are called seed borne diseases, e.g., loose smut of wheat, leaf spot of rice.

**Soil Borne Diseases:**

- The soil borne diseases mostly affect roots and stems of crop plants, e.g., smut of bajra, tikka disease of groundnut.

**Air Borne Diseases:**

- The air diseases attack all aerial parts of the plants like leaves, flowers and fruits. e.g., rust of wheat, blast of rice.

❖ **Water Borne Diseases:**

- The diseases which are transmitted through water are termed as water borne diseases. e.g., bacterial blight of rice.

**Storage of grains**

- Proper and safe storage of food grains is necessary to ensure their availability throughout the year.
- The various factors that contributes to this loss can be placed into two categories –

**Biotic Factor:**

- Such as insects, rodents (e.g., squirrel, rat), birds (e.g., sparrow, crow, pigeon), fungi, mites and bacteria.

**Abiotic Factor:**

- Such as moisture content and temperature.
- Higher temperature (i.e., 30 – 32$^0$C) of stored grains make them liable to decay.
- The various types of damages caused by the above factors include

(a) Infestation in insects,
(b) Degradation in quality,
(c) Loss in weight,
(d) Poor germinability,
(e) Discoloration of produce
(f) Poor marketability

## ANIMAL HUSBANDRY

Science which deals with the scientific management of farm animals including their feeding. breeding. weeding and heeding (disease control) is called as Animal husbandry.

There are four main practices involved in keeping of animals or animal husbandry.

- **Breeding:** It is done to obtain animals with desired characters. Through breeding, we can develop high milk - yielding and high meat-yielding cattle.
- **Feeding:** It deals with the study of proper food (called feed), mode and timeor feeding of different animals.
- **Weeding:** This concerns with the elimination of uneconomical animals.
- **Heeding:** It means the proper care and management of animals.

❖ Animal food mainly comes from:

**(i)** **Milk:** From cattle such as cow, buffaloes, goat, camel.

**(ii)** **Egg:** From birds (poultry).

**(iii)** **Meat:** Animals like pigs, fishes, poultry etc.

**(iv)** **Honey:** From honeybees.

**Table: Nutritional values of Animal Products**

| Animal Product | Nutrients (%) | | | | |
|---|---|---|---|---|---|
| | Protein | Fat | Carbo | Minerals | Water |
| Cow Milk | 4.0 | 3.6 | 3.5 | 0.7 | 87.2 |
| Egg | 13.0 | 12.0 | Traces | 1.0 | 74.0 |
| Meat | 21.1 | 3.6 | Traces | 1.1 | 74.2 |
| Fish | 19.0 | 2.5 | Traces | 1.3 | 77.2 |

**Various types of animal farming are:**

**(i)** **Cattle farming -** (Milk producing or milch animals)

**(ii)** **Poultry farming -** (Egg yielding animals)

**(iii) Fish farming -** (meat providing fishes)

**(iv) Bee keeping -** (Honey providing bees)

**CATTLE FARMING**

Farming of cattle for milk and labour is called cattle farming.

| AVERAGE MILK PRODUCTION BY COW BREEDS | | |
|---|---|---|
| Dairy breeds of cows | Average milk production (litres) | Lactation periods (days) |
| Sahiwal | 2800 | 300 |
| Holstein Friesian | 16000 | 365 |
| Frieswal | 5000 | 326 |

**(A) Milk producing breeds:** Milk providing animals are - cows, buffaloes, goats, camels.

**Breeds of Cow:** Cows are a good source of milk for food of human beings and bullocks help in farming and transport purposes. Based upon the milk production and other utility, various breeds of cow are categorized in three types i.e.

(i) Milch breeds or dairy breeds
(ii) Draught breeds
(iii) Dual purpose or general utility breeds.

**(I) Milch or Dairy breeds:** Milch or dairy breed cows are of three types in India I.e.

(a) Indigenous breeds
(b) Exotic breeds and
(c) Cross breeds.

**(a) Indigenous breeds:** These are the Indian breeds of milch or dairy cows. These are
(i) Red Sindhi (ii) Sahiwal (iii) Gir

**(b) Exotic breeds:** These are foreign breeds of cows which have been introduced in our country. The selected breeds of cows that have been successfully used for cross breeding in our country are:

(i) Jersey: England
(ii) Holstein Friesian: Holland
(iii) Brown Swiss: A dual purpose breed of cow from Switzerland

**(c) Cross breeds or improved breeds of cows:** Cross or improved breeds of dairy cows have been developed in India at National Dairy Research Institute (NDRI) Kamal (Haryana).The successful Cross breeds of cow in our country are:

**(i) Karan Swiss:** This is the cross breed of Brown Swiss and Sahiwal.

**(ii) Karan Fries:** This is the cross breed of Holstein-Friesian from Holland and Tharparkar of India. The yield of milk from new cross breed cows has increased two to three times more than our indigenous cows.

**(II) Draught breeds:** Cattle of this breed are strong and sturdy. They are the "beasts of burden: I.e. are used for drawing bullocks' carts, ploughing land of crop fields are transporting materials from one place to another. The cows of these breeds produce less milk. Some of the common examples of these breeds are Malvi, Nageri etc.

**(III) Dual Purpose or General utility breeds:** In these breeds, the cows are good milk yielders and bullocks are good for draught work. Some of the breeds of this category are Haryana, , Ongole, Kankrej etc.

| TYPES OF BREEDS OF CATTLE | |
|---|---|
| Draught breeds | Strong & sturdy chiefly for labour |
| Dairy or milk breeds | Specialized in milk production |
| Dual purpose | Both for milk production & labour |

- **Breeds of** Buffalo: Buffaloes are major source of milk in our country. These are domesticated in great number. The important breeds of buffaloes with high yield of milk are:
  (a) Mehsana (b) Surti (c) Murrah
- Most notable effort for dairy development & milk production in India is being carried out by NODS (National Dairy Development Board) and is called "operation flood" to increase milk production.
- It has resulted in White revolution in India.

| WHITE REVOLUTION |
|---|
| Just like the green revolution in case of crop plants, the increase in milk production has been possible due to the launching of countrywide programme called' operation flood' which resulted in the white revolution in India. This operation involved use of new improved high milk-yielding crossbreeds of milch animals and following the practices of animal husbandry providing them with proper feed and health care. Dr. V. Kurien is credited with the designing and implementation of the largest dairy development programme - the operation flood, and sharing in of the white revolution in India. He is known as the father of white revolution and is the founder chairman of the National Dairy, Development Board (NDDB). |

**FEEDING CATTLE**

- Cattle food is of two types:
- **Roughage:** Rich in fiber content. It includes green fodder, silage, hay.
- **Concentrate:** Rich in all types of nutrients, lacks fiber. It includes maize, oat, barley, jowar etc.

| KNOWLEDGE BOOSTER |
|---|
| Use of antibiotics in the feed of cattle is not permitted in Europe. |

❖ Diseases of Cattle A healthy animal is recognized by:

(a) Its regular feeding,

(b) Normal posture,

(c) A definite body temperature

(d) Normal pulse and respiration rates.

- A sick animal shows following symptoms.

(a) The animal stops eating and becomes lethargic, looks tired and remains isolated.

(b) The animal shivers with high body temperature.

(c) The animal shows excessive formation of saliva which sometimes hangs from the mouth,

(d) Blisters appear on skin surface, eyes turn red, and the animal may have a running nose,

(e) The animal passes loose dung and colored urine.

(f) The lips and ears of the animal droop.

(g) Milk yield, egg-laying capacity or working capacity of the animal is reduced.

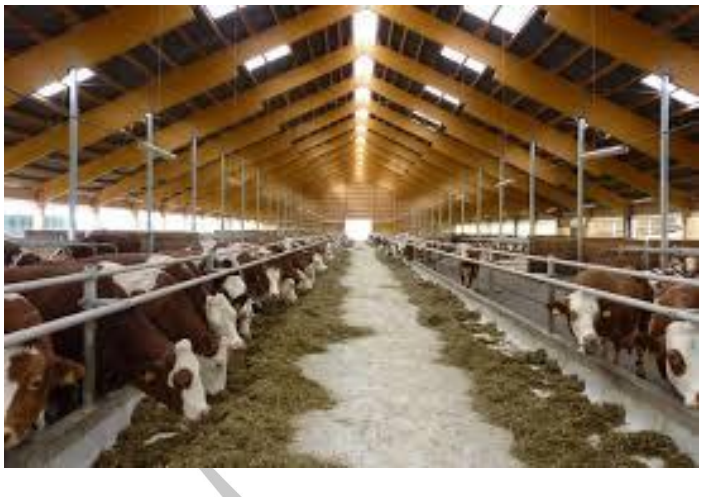
❖ **Diseases:** Diseases caused are broadly of three types:

- Parasitic
- Infectious
- Non – infectious

| TABLE: DISEASES OF DAIRY ANIMALS & THEIR CAUSAL RGANISM. | | |
|---|---|---|
| **S.NO.** | **CAUSAL** | **DISEASE** |
| 1 | Virus | Foot and mouth disease, Pox |
| 2 | Bacteria | Anthrax |
| 3 | Fungi | Ringworm, Dermatitis |

❖ **Prevention and Control:**

- Providing proper shelter.
- Ensuring animal hygiene (frequent bathing and grooming) and proper disposal of dead animals and animal wastes.
- Periodic screening of animals for diseases and immediate isolation of diseased animals.
- Providing proper diet and suitable medicines under the advice of a veterinary doctor.
- Hygienic handling of all animal products and by products,
- Compulsory vaccinations



**POULTRY FARMING**

**Poultry:** Poultry is the collective term for domestic birds such as chicken, ducks, pheasants, geese etc. raised for their egg and meat. Rearing, breeding and caring of fowls and related birds for eggs and meat is called Poultry farming. An egg laying poultry bird is called egger or layer and the poultry birds reared for obtaining meat are called chicken (broilers).

**(A) Indigenous (desi) breeds of hen**

- Aseel (Indian game)
- Ghagus (kadaknath)
- Basara (Burrsa)
- Chittagong (Chhattisgarh)
- Brahma
- Cochin

**(B) Exotic breeds used in India**

- White Leghorn
- Rhode Island Red
- Black Minorcha
- Plymouth
- Light Sussex

❖ **Silver Revolution:** Increase in egg production on large scale.

**(C) Improvement of poultry breeds:** It involves:

- Developing of new varieties. They have following advantages.
- Number & quality of chicks are increased.
- Summer adaptation capacity.
- Low maintenance requirements.
- Dwarf broilers present for commercial chick production.

**(D) Poultry diseases:** These birds suffer from many diseases caused by bacteria, fungi, viruses and parasites along with nutritional deficiencies.

❖ **Diseases of poultry birds:**

| S.No. | Name of disease | Causative organism | Symptoms |
|---|---|---|---|
| 1 | Dermatitis | Virus | Irritation, blisters and erruptions on the skin surface. |
| 2 | Fowl pox | Virus | Wart like pox lesions on comb, wattles, lesions in mouth, difficulty in breathing, yellow cheese like discharges from eyes and nose. |
| 3 | Rinderpest | Virus | Constipation followed by severe diarrhoea, discharge from eyes and nostrils, loss of appetite. |
| 4 | Fowl cholera | Bacteria | Loose motions and dehydration. |
| 5 | Aspergillosis | Fungus | Patches on the skin due to growth of moulds. |

❖ These can be prevented by proper cleaning sanitation and spraying of disinfectants.

❖ Poultry farming offers other advantages like:

(a) Investment involved is small.

(b) Area required is small.

(c) Maintenance is easy, and

(d) Returns are quick.

**PISCICULTURE**

❖ **Fish Farming:** Fishes have been used as protein rich diet for human beings since pre-historic period. Fishes are aquatic animals and their production is called fish farming or water agriculture.

**KNOWLEDGE BOOSTER**

- Term fisheries is used to include all animal resources from water (both marine and fresh water) which include fishes, crustaceans (Prawns, crabs and lobsters) and molluscs.
- Production of useful aquatic plants and animals, like fishes, prawns, crabs, lobsters, molluscs etc. by the use of various types of water sources is called **aquaculture.**
- Rearing, breeding and management of fishes on large scale under controlled condition is called. **pisciculture.**

❖ **Various ways to obtain fishes:-**

❖ **Capture fishing -** From natural resources.

❖ **Culture fishing -** Fish farming in land water fishes, ponds, lakes, marine fishes.

- Our fresh water edible fish include cat fishes such as Wallago etc.

- Indian major carps such as Catla, Rohu, Mrigal (Cirrhina).
- Exotic varieties such as Silver carp and Grass carp.
- Catla is the fastest growing carp of great economic significance.
- **Marine fisheries:** India's marine fishery resources include 7500 km of coastline and the deep seas beyond it.
- Popular marine fish varieties are pomphret, mackerel, tuna. sardines and Bomby duck.
- Yield are increased by locating large schools of fish in the open sea using satellites and echo-sounders
- Some marine fish of high economic value are also farmed in seawater.
- This includes finned fishes like mullets. bhetki , and pearl spots, shellfish such as prawns mussels and oysters as well as seaweed .
- Marine fish culture is called mariculture.
- **Inland fisheries:** Fresh water resources include canals, ponds, reservoirs and rivers.
- Catlas are surface feeders.
- Rohus feed in middle zone of the pond.
- Mrigals and common Carps feed on the weeds.

**APICULTURE**

❖ **Definition:** Apiculture is the process of rearing of honeybees in the artificial hives, called apiaries, to produce honey at commercial level.

❖ **Species of Honeybees:** Honeybees belong to phylum Arthropoda and class Insecta. There are several species of honeybees some of which are indigenous while some of them are exotic which have been introduced to increase the yield of honey.

**(a) Indigenous Species:**

**(i)** ***Apis dorsata*****:** It is commonly called rock bee or giant bee (being largest sized). Though it produces maximum amount of honey but is ferocious and migratory bee so it is difficult to domesticate this variety.

**(ii)** ***Apis indica*****:** It is commonly called Indian bee. It can be domesticated easily as it is very gentle in nature but is less producing species.

**(iii)** ***Apis florae*****:** It is commonly called little bee (being smallest sized). It is also very docile, but yield is less.

**(b) Exotic Species:**

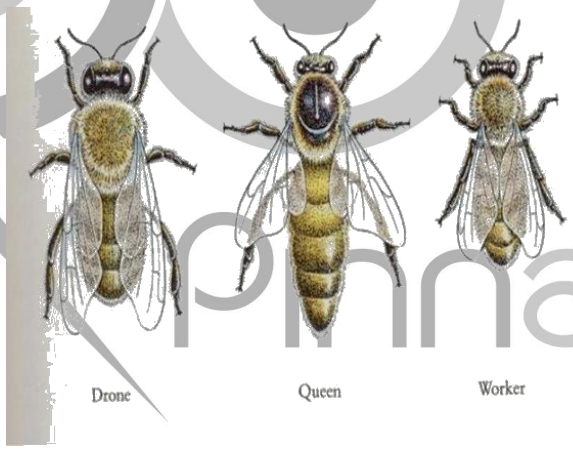
- ***Apis mellifera:*** It is commonly called Italian bee. It is preferred over the indigenous species for the commercial production of honey because of its docile nature, high yield of honey, prolific egg production, less swarming and with good defense mechanism.

- **HoneyBee Colony and Social Organization:** Honeybees are social and polymorphic insects. These live in large colonies, called hives or combs, of about 40,000 to 100,000 individuals. In a colony, there are three castes of bees which are structurally and functionally different from one another so polymorphism is associated with division of labour. These three castes are:

**(i)** **Queen:** Every healthy colony has only one fertile female called queen. It is the mother of the colony and has well developed ovaries. It has long tapering abdomen, short legs and wings. Its sole function is to lay the eggs at the rate of 1500 to 2000 in a day, while during its life span of about 3 years, a queen lays about 1.5 to 2.0 million eggs. A queen lays two types of eggs: fertilized and unfertilized eggs. Queen and workers develop from fertilized eggs while drones develop from unfertilized eggs.

**(ii)** **Workers:** These are largest in number (about 50,000 to 60,000) but smallest sized members. These are most active and perform variety of jobs like: attend the queen and nursery. clean the hives. form a new hive and produce wax. repair the comb, keep the comb cool, defend the members etc. So the workers have strong wings, long mouth parts. wax glands on abdomen, pollen collecting apparatus on the legs and a sting at the end of abdomen.

**(iii)** **Drones:** These are male members of the colony and are of intermediate size. These have reduced mouth parts and are sluggish Their sole function is to copulate with the queen.




❖ **Importance of Apiculture:**

- **Products of honeybees** include honey, bees wax, bee venom and royal jelly.

**(i)** **Honey:** It is produced by the workers from the collected nectar and cane sugar. It is formed of levulose, dextrose (23%), maltose (40%), enzymes and pigment (25%), minerals, vitamins and water.

**(ii)** **Bees wax:** It is used in cosmetics, paints. ointments, polishes etc.

**(iii)** **Bee venom:** It is used to cure certain diseases like gout and arthritis.

**(iv)** **Royal jelly:** It is used as tonic to heart patients and growing children.

Honey bees are chief cross-pollinating agents. Apiculture provides additional income generating activity to the farmers

**MANAGEMENT FOR HIGH YIELDS OF HONEY**

❖ **Management:** Involves all those steps which are required to be undertaken to obtain good quality and higher yield of honey from the honeybees. It involves following considerations:

**(a) Bee Forage or Pasturage:** It includes all those flowering plants which provide pollens and nectar to the honeybees e.g. Mango, coconut, almond, tamarind, berseem, litchi, cotton, apple, mahua, coriander, cashew, coffee. rubber plant, guava, sunflower, etc. Their pollens form the protein-rich food for honeybees while their nectar acts as raw material of honey. The pasturage is different from region to region and depends upon the geographical location. The quality and taste of honey depend, upon the nature of flora from which the nectar is collected. For increased yield. the pasturage should be easily available near the apiary.

**(b) Apiary or Beehive:** An artificial and movable bee hive, commonly called apiary, is about 46 x 23 cm in size and is a wooden box formed of following parts:

**(i) Stand:** It is the base on which the whole hive is placed.

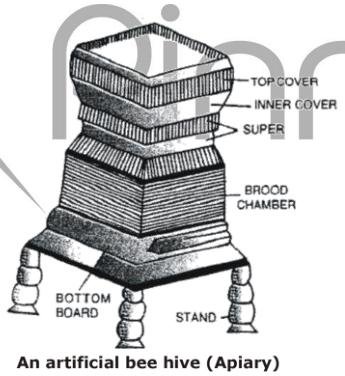
**(ii) Bottom Board:** It forms the base of the hive and has two apertures which act as entrance and exit for the workers and drones.

**(iii) Brood chamber:** It contains 5 to 10 wooden frames, each of which has a wax-sheet of the hexagonal frames, called comb foundation, on which the honey forms the combs,

**(iv) Super:** It provides extra space for the expansion of the hive.

**(v) Inner cover:** It is a hole-bearing wooden cover.

**(vi) Top cover:** It is a plain zinc sheet for the protection of hive.



An artificial bee hive (Apiary)

**(c) Location of Apiary:** To get maximum yield of honey, a number of beehives should be placed in that area where abundance of bee-flora is available within 1 or 2 kms radius for honey collection.

**(d) Honey Flow Season:** The yield of honey upon the total period for which large number of nectar and pollen-yielding plants are available in the vicinity of the apiary is called honey flow period. So honey yield will be more if the bee hives are established in an area having abundance of bee flora for longer period. While the period when no nectar and pollen is available is called dearth period.

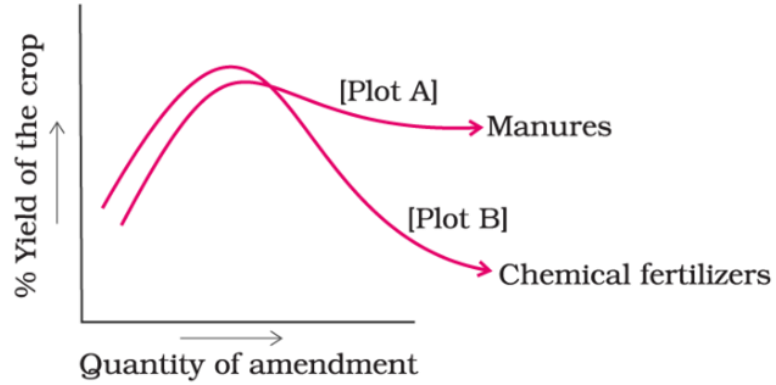
**(e)** **Swarming:** It is the process of leaving off the colony by the old queen with some workers and drones to establish a new colony at a new place and to provide the existing hive for the progeny. It normally occurs by the end of spring or early summer. But the frequent swarming decreases the yield of honey and increases the maintenance cost of the beehives. So to get higher yield of honey, less swarming variety of honey bees (e.g. *Apis mellifera*) should be reared.

# EXERCISE - 1

1. What do we get from cereals, pulses, fruits and vegetables?
2. How do biotic and abiotic factors affect crop production?
3. What are the desirable agronomic characteristics for crop improvement?
4. What are macro-nutrients and why are they called macronutrients?
5. How do plants get nutrients?
6. Compare the use of manure and fertilizers in maintaining soil fertility.
7. Which of the following conditions will give the most benefits? Why?
   (a) Farmers use high-quality seeds, do not adopt irrigation or use fertilizers.
   (b) Farmers use ordinary seeds, adopt irrigation and use fertilizer.
   (c) Farmers use quality seeds, adopt irrigation, use fertilizer and use crop protection measures.
8. Why should preventive measures and biological control methods be preferred for protecting crops?
9. What factors may be responsible for losses of grains during storage?
10. Which method is commonly used for improving cattle breeds and why?
11. What management practices are common in dairy and poultry farming?
12. What are the differences between broilers and layers and in their management?
13. Discuss the implications of the following statement: "It is interesting to note that poultry is India's most efficient converter of low fiber food stuff (which is unfit for human consumption) into highly nutritious animal protein food."
14. How are fish obtained?
15. What are the advantages of composite fish culture?
16. What are the desirable characters of bee varieties suitable for honey production?
17. What is pasturage and how is it related to honey production?
18. Explain any one method of crop production which ensures high yield.
19. Why are manure and fertilizers used in fields?
20. What are the advantages of inter-cropping and crop rotation?
21. What is genetic manipulation? How is it useful in agricultural practices?
22. How do storage grain losses occur?
23. How do good animal husbandry practices benefit farmers?
24. What are the benefits of cattle farming?
25. For increasing production, what is common in poultry, fisheries and bee-keeping?
26. How do you differentiate between capture fishing, mariculture and aquaculture?
27. Arrange these statements in correct sequence of preparation of green manure.
   (a) Green plants are decomposed in soil.
   (b) Green plants are cultivated for preparing manure or crop plant parts are used.
   (c) Plants are ploughed and mixed into the soil.

(d) After decomposition it becomes green manure.

28. An Italian bee variety A. mellifera has been introduced in India for honey production. Write about its merits over other varieties.
29. Why bee keeping should be done in good pasturage?
30. What would happen if poultry birds are larger in size and have no summer adaptation capacity? In order to get small sized poultry birds, having summer adaptability, what method will be employed?
31. Name two types of animal feed and write their functions.
32. Figure shows the two crop fields [Plots A and B] have been treated by manures and chemical fertilizers respectively, keeping other environmental factors same. Observe the graph and answer the following questions.
    (i) Why does plot B show sudden increase and then gradual decrease in yield?
    (ii) Why is the highest peak in plot A graph slightly delayed?
    (iii) What is the reason for the different pattern of the two graphs?



# EXERCISE - 2

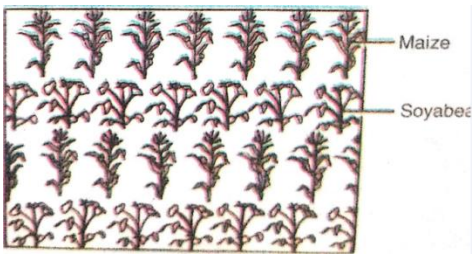
## Crop Variety Improvement

33. Write differences between Rabi and Kharif crops.
34. What does hybridization mean?
35. What will happen if there is a change in the maturity duration of a crop?
36. Explain various factors associated with variety improvement.
37. How do biotic and abiotic factors adversities affect crop production?
38. Genetic manipulation is considered as useful agricultural practice. Why?
39. Why micronutrients and macronutrients are called so? What role do they play?

## Crop Production Management

40. Write a note on essential nutrients needed by plants.
41. Write down the various abiotic sources of the plant nutrients.
42. What is manure? How is it prepared? State whether it is organic or inorganic. Elucidate the various advantages of manure.
43. What is green manure? State the various crops that are grown for the same.
44. What do you understand by compost and vermicompost?
45. List the main nutrients supplied by fertilization to the plants.
46. 'Fertilizers can cause water pollution' justify the statement.
47. What are the advantages and disadvantages of fertilizers?
48. Differentiate between manure and fertilizer.
49. List various types of cropping systems, what are their benefits.
50. List the various irrigation systems used for supplying water to crops in India.
51. Name two fertilizers supplying N, P, K to crops.
52. A farmer grows soya been in five rows and maize in another five rows and follows the same pattern throughout his one acre of land. Name the type of cropping pattern, define the term and state two advantages.
53. The use of manure is better than the use of fertilizers. Mention any two points in support of this statement.
54. Why do we select crops which have different nutrient requirement for inter – cropping? Give two reasons.
55. What type of irrigation is showed in the figure?

56. A field with maize and soyabean plants is shown here.



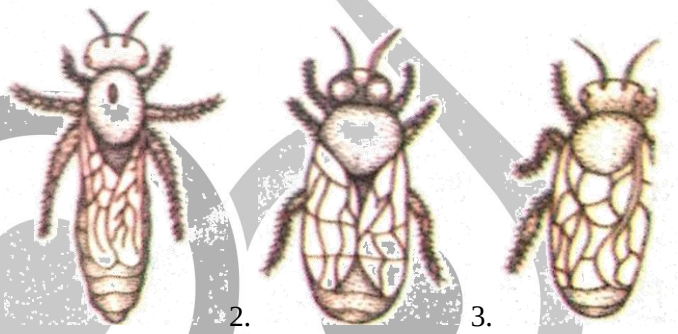
(a) What pattern of cropping does the field shows?
(b) Mention any two advantages of this type of cropping pattern.

## Crop Protection Management

57. What factor may be responsible for huge losses during storage. Give its preventive measures?
58. Why is removal of weeds essential for a good harvest? How does it affect the main crop?
59. How do insect pests affect the health of the crop and reduce its yield?
60. List different preventive measures taken for weed controlling.

## Animal Husbandry

61. What is Animal husbandry?
62. What are benefits of Cattle farming?
63. Look at figure 1, 2 and 3 given alongside and answer the following questions:



1. 2. 3.

(a) What do these figures show all together?
(b) Which one is queen bee?
(c) Which one of them is the haploid, fertile male? What is it called?

64. How are fishes obtained?
65. What are advantages of composite fish culture?
66. For increasing production, what is common in poultry, fisheries and bee-keeping?

# EXERCISE - 3

1. Which of the following is a natural insecticide?
   (a) Nicotine
   (b) Neem
   (c) Pyrethrum
   (d) All of these
2. Growing two or more crops in a definite row patterns is
   (a) Mixed farming
   (b) Mixed cropping
   (c) Intercropping
   (d) Crop rotation
3. The common biofertilizers used in organic farming are
   (a) Margosa
   (b) Pyrethrum
   (c) Green manure
   (d) Nitrogen fixing bacteria and cyan bacteria
4. Which is a micronutrient for the crop plants?
   (a) Calcium
   (b) Iron
   (c) Magnesium
   (d) Potassium
5. Pulses are rich in
   (a) Carbohydrates
   (b) Proteins
   (c) Oils
   (d) Vitamins and minerals
6. The technique used to obtain variety with high – yield and other desirable characters is
   (a) Introduction
   (b) Selection
   (c) Hybridization
   (d) Both (a) and (b)
7. Organic farming does not include
   (a) Green manure
   (b) Chemical fertilizers
   (c) Crop rotation
   (d) Compost and farmyard manure
8. Increase in milk production refers to _____ revolution.
   (a) Golden
   (b) Yellow
   (c) White
   (d) Blue
9. All animals are
   (a) Parasitic
   (b) Saprophytic
   (c) Autotrophic
   (d) Heterotrophic
10. Which is the most important source of food and fodder?
    (a) Algae
    (b) Fungi
    (c) Lichen
    (d) Cereal
11. Nodules with nitrogen – fixing bacteria are present in
    (a) Mustard
    (b) Wheat
    (c) Gram
    (d) Cotton
12. Inland fisheries is referred to
    (a) Culturing fish in freshwater
    (b) Trapping and capturing fishes from sea coast
    (c) Deep sea fisheries
    (d) Extraction of oil from fishes
13. Which of the following statement is incorrect about fertilizer?
    (a) It is nutrient specific
    (b) It is water insoluble
    (c) It is readily absorbed by the plant
    (d) It is compact and easy to transfer
14. When both crops and livestock are raised on the same farm, it is known as
    (a) Mixed farming
    (b) Mixed cropping
    (c) Intercropping
    (d) Crop rotation
15. Living organisms are used in
    (a) Organic manure
    (b) Biofertilizers
    (c) Natural insecticides
    (d) Pesticides
16. Gundhi bug is a pest of
    (a) Sugarcane
    (b) Cotton
    (c) Rice
    (d) Wheat
17. Sustainable agriculture involves
    (a) Mixed farming
    (b) Mixed cropping
    (c) Crop rotation

(d) All of the above

18. Poultry farming is undertaken to raise following
(i) Egg production
(ii) Feather production
(iii) Chicken meat
(iv) Milk production
(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (iii) and (iv)

19. Which one of the following fishes is a surface feeder?
(a) Rohus
(b) Mrigals
(c) Common carps
(d) Catlas

20. Preventive and control measures adopted for storage of grains include
(a) Strict cleaning
(b) Proper disjoining
(c) Fumigation
(d) All the above

21. DDT is:-
(a) A non-degradable pollutant
(b) A biodegradable pollutant
(c) An antibiotic
(d) Not a pollutant

22. The pesticides need to be replaced because these:-
(a) Are very costly
(b) Cannot be stored for a long time
(c) Are mostly toxic and non-biodegradable
(d) Cause abnormalities in the target population

23. Fumigants are used for:-
(a) Preserving food materials
(b) Killing insects harming food grains
(c) Increasing nutrients of plants
(d) Preserving dairy products

24. Materials of biological origin which are commonly used to maintain and improve soil fertility are:-
(a) Green manures
(b) Biofertilizers
(c) Bioinsecticides
(d) Both (a) and (b)

25. Heterotrophs are organisms which:-
(a) Make their own food
(b) Derive food from animals
(c) Derive food from plants
(d) Derive food from the biomass of other organisms

26. Autotrophs are organisms which-
(a) Make their own food
(b) Derive food from animals
(c) Derive food from plants
(d) Derive food from the biomass of other organisms

27. The increase in food grain production after the introduction of improved varieties of crops is often referred as:-
(a) White Revolution
(b) Green Revolution
(c) Yellow Revolution
(d) Blue Revolution

28. The minerals required by a plant in very small quantities are called: -
(a) Macronutrients
(b) Micronutrients
(c) Manures
(d) Fertilizers

29. The process of preparing manure with the help of earthworms and kitchen wastes is called: -
(a) Green manuring
(b) Manuring
(c) Vermicomposting
(d) Farming

30. Growing two or more crops at the same time in a field is called: -
(a) Mixed farming
(b) Mixed cropping
(c) Farming
(d) Intercropping

31. The practice of growing two or more crops simultaneously in definite rows in the same field is called: -
(a) Mixed cropping
(b) Mixed farming
(c) Intercropping
(d) Farming

32. Increase in oil production is:-
(a) Golden revolution
(b) Yellow revolution
(c) White revolution
(d) Blue revolution

33. Pulses are rich in:-
    (a) Proteins
    (b) Carbohydrates
    (c) Oils
    (d) Vitamins and minerals
34. Kharif crop is:-
    (a) Summer season crop
    (b) Winter season crop
    (c) Spring season crop
    (d) Autumn season crop
35. Rabi crops are sown in
    (a) August
    (b) September
    (c) October
    (d) March
36. The method used to obtain variety with high yield and other desirable characters is :-
    (a) Introduction
    (b) Selection
    (c) Hybridization
    (d) Both a and b
37. Which one is a micronutrient: -
    (a) Iron
    (b) Calcium
    (c) Magnesium
    (d) Potassium
38. Cultivation of two or more crops together in the same field is:-
    (a) Mixed cropping
    (b) Intercropping
    (c) Crop rotation
    (d) All the above
39. Growing different crops in the same field in a preplanned succession is:-
    (a) Crop management
    (b) Crop rotation
    (c) Intercropping
    (d) Plant breeding

# EXERCISE - 4

**1.** Which is not a cropping pattern?
(a) Mixed cropping
(b) Hybridization
(c) Intercropping
(d) Crop rotation

**2.** Which is the Italian variety of bee?
(a) *Apis mellifera*
(b) *Apis dorsata*
(c) *Apis florae*
(d) *Apis cerana indica*

**3.** How many eggs can a queen lay in a day?
(a) 1500
(b) 2100
(c) 2000
(d) 3000

**4.** Which of the following secretes bee wax?
(a) Queen bee
(b) Drone bee
(c) Worker bee
(d) All of these

**5.** A food adulterant is
(a) mixed in the food deliberately
(b) Toxic
(c) Cheap and of low quality
(d) All of these

**6.** Starch molecule is made of _____ units.
(a) Fructose
(b) Triose
(c) Glucose
(d) Sucrose

**7.** Milk production from cows and buffaloes depends on
(i) lactation period
(ii) type of period
(iii) country
(iv) breed of cattle
(a) (i), (ii) and (iii)
(b) (i), (ii) and (iv)
(c) (i), (iii) and (iv)
(d) (ii), (iii) and (iv)

**8.** Bacillus thuringiensis is used to control
(a) Bacterial pathogens
(b) Fungal pathogens
(c) Nematodes
(d) Insect pests

**9.** Which amongst the following is a fungicide?-
(a) 2-4 D
(b) DDT
(c) Bordeaux mixture
(d) BHC

**10.** Malathion is used as:-
(a) Fungicide
(b) Insecticide
(c) Weedicide
(d) Biocide

**11.** Storage grains produce aflatoxin due to growth of:-
(a) Yeast
(b) Mold
(c) Aspergillus
(d) Virus

**12.** A pulse crop is grown in the time interval between two cereal crops to compensate for the :-
(a) Loss of phosphate
(b) Loss of water
(c) Loss of Sulphur
(d) Loss of nitrogen

**13.** The science of improving crop varieties is called: -
(a) Hybridization
(b) Selection
(c) Plant breeding
(d) Introduction

**14.** Plant breeding aims to produce:-
(a) disease-free varieties
(b) high-yielding varieties
(c) early-maturing varieties
(d) All the above

**15.** Pusa lerma is an improved variety of:-
(a) Rice
(b) Maize
(c) Soya bean
(d) Wheat

# ANSWER KEY

## EXERCISE – 3

| Ques. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| Ans. | b | c | d | b | b | c | b | c | d | d |
| Ques. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| Ans. | c | a | b | a | b | c | d | b | d | d |
| Ques. | 21. | 22. | 23. | 24. | 25. | 26. | 27. | 28. | 29. | 30. |
| Ans. | a | c | b | d | d | a | b | b | c | b |
| Ques. | 31. | 32. | 33. | 34. | 35. | 36. | 37. | 38. | 39. | 40. |
| Ans. | c | b | a | a | c | c | a | a | b | |

## EXERCISE –4

| Ques. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| Ans. | b | a | c | c | d | c | b | d | c | b |
| Ques. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| Ans. | c | d | c | d | d | | | | | |