STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

The world population is increasing at a rapid rate and thus, the increase in demand for food. Therefore, it is necessary to increase food production from animal and plant sources to meet the increasing demand. The various biological principles like animal husbandry, plant breeding, etc., are applied on animals and plants to increase food production.

1. Animal Husbandry

The rearing of economically important livestock, feeding them, providing them shelter, working for their disease control and breeding is called animal husbandry. It includes dairy, industry, poultry, fish rearing, etc.

A. **Dairy Farm Management** It is the management of animals for milk and its products for human consumption. It mainly deals with the processes and systems to improve quality and quantity of milk. Milk yield mainly depends on the quality of breeds. The management of dairy farm includes selection of good breed, keeping animals in disease-free conditions, regular inspection by a veterinary doctor, feeding good quality and quantity of fodder, stringent cleanliness and hygiene of cattle and their handler.

B. **Poultry Farm Management** It is the management of birds like chicken, ducks, turkey, pigeons in which they are reared for their meat and eggs, prevented from diseases and are looked after. The poultry farm management must include selection of disease-free breeds, proper food and water, maintenance of health and hygiene of birds.

C. **Animal Breeding** It is an important aspect of animal husbandry, which aims to increase the yield of animals and improve the desirable qualities of the produce.

Breed is a group of animals related by descent and similar in most characters like general appearance, features, size, configuration, etc. To obtain the desired characters in livestock, following breeding methods can be used

(i) **Inbreeding**It refers to mating of closely related individuals for 4-6 generations. It increases homozygosity, which degrades the reproductivity and productivity. This condition is called inbreeding depression. It is done to develop homozygous purelines.

(ii) **Outbreeding**It is the breeding of unrelated animals. The offspring (result of such mating) is known as outcross. The single outcross may help to overcome inbreeding depression. It can be further classified as

- Outcrossing The practice of mating of animals, within the same breed but not having common ancestors on either side of their pedigree up to 4-6 generations is called outcrossing.
- Cross-breeding The mating of superior male of one breed with the superior female of another breed is called cross-breeding. This is done to combine the desirable qualities of two breeds into a single individual.
- Interspecific Hybridisation The mating between male and female animals of two different species is called interspecific hybridisation, e.g. interspecific hybridisation between female horse and male donkey species results in the formation of a 'mule'.

D. **Controlled Breeding Techniques** The breeding of animals using controlled techniques is another major approach to animal breeding. It includes

(i) **Artificial Insemination** (AI) It is a method in which the semen collected from a superior male parent is injected into the reproductive tract of the selected female parent by the breeder. It helps to overcome several problems of natural mating and cows at distant places can also be fertilised.

(ii) **Multiple Ovulation Embryo Transfer** (MOET) Technique It is the technique through which more number of offspring are produced from the milk producing cattle (cow and buffalo). In this technique, hormones having FSH-like activity are injected in milk producing animals so that they produce more than one egg.

Thereafter, these eggs are fertilised by the sperms carrying desirable genes from an elite bull. When the artificial fertilisation is done successfully, the fertilised eggs at 8-32 celled stage is inserted/ implanted into the uterus of a surrogate mother.

E. **Bee-keeping** (Apiculture or Beeculture) It includes the maintenance of hives of honeybees for the production of honey and beeswax. It has been an old age cottage industry. Large places called apiaries or beehives are used for bee culture.

The most common species reared by bee-keepers are Apis indica and Apis dorsata in India.

F. **Fisheries**It is the rearing of fishes, molluscs (shell-fish), crustaceans (crabs, prawns, etc.) to meet the increasing demand of fish products. For this different techniques like aquaculture and pisciculture are used. These techniques help to increase the production of aquatic plants and animals in both fresh and marine water.

The common Indian freshwater fishes are catla, rohu and common carp. The marine fishes include hilsa, sardines, mackerel and pomfret. The fishes are used as natural source of vitamin-A and a good source of protein and iodine.

Note • Blue Revolution It is related to increased fish rearing.

2. Plant Breeding

It is a technique of manipulation of plant species, in order to create desired plant types that are better suited for cultivation, give better yields and are disease-resistant. The following characters or traits are incorporated into crop plants

■ Increased tolerance to environmental stresses, such as salinity, extreme temperature, drought, etc.

■ Resistance to pathogens like viruses, fungi, bacteria and increased tolerance to insect pests.

■High yielding and improved quality of crop plants like grain size, colour, shape, flavours, protein content, etc.

A. **Steps of Plant Breeding** These include collection of variability, evaluation and selection of parents, cross hybridisation among the selected parents, selection and testing of superior recombinants and their testing, release and commercialisation of new cultivars. By using this method, scientists brought about green revolution specially by enhancing the yield of cereal produce.

Dr. Norman E Borlaug is regarded as Father of Green Revolution worldwide for obtaining wheat variety possessing Norin-10 dwarfing gene.

Dr. MS Swaminathan is regarded as the Father of Indian **Green Revolution**.

Indian hybrid crops of high yielding varieties produced during green revolution are wheat (Sonalika, Kalyan Sona), rice (Jaya, Ratna, IR-8), sugarcane (a hybrid of Saccharum barberi and Saccharum officinarum), etc.

B. **Plant Breeding for Disease Resistance** Resistance of the host plant is the ability to prevent the pathogen from causing disease and is determined by the genetic

constitution of the host plant. It is carried out by either of the following two breeding methods

(i) **Conventional Breeding**It is the traditional technique used to produce hybrid varieties. Some important varieties developed by conventional breeding are Himgiri (wheat), Pusa Swarnim (mustard), Pusa Shubhra (cauliflower), Pusa Komal (Cowpea) and Pusa Sadabahar (chilli).

(ii) **Mutation Breeding** Mutation is a process by which genetic variation is achieved through the changes in base sequences within genes. The mutation process is also used for the improvement of crops by changing their genotype through induced mutation. Certain examples of mutation breeding are mung bean (resistance to yellow mosaic virus and powdery mildew).

C. **Plant Breeding for Developing Resistance to Insect Pests** The insect resistance in host crop plants may be due to the morphological, biochemical or physiological characteristics. Some crop varieties developed by hybridisation and selection for insect pest resistance like for aphids include Pusa Gaurav (rapeseed mustard), Pusa Sem 2 (flat bean), etc.

D. **Plant Breeding for Improved Food Quality** Breeding of crops for improvement in quality of the food produced is an important aspect due to the following reasons

(i) Lack of adequate food with nutritional requirements.

(ii) People suffer from hidden hunger.

(iii) Absence of essential micronutrients in diet. Due to the above reasons, the following two different methods are used for meeting the requirement of food.

(a) **Biofortification** It is the process of breeding of crops containing high levels of vitamins, fibre, protein and carbohydrates, etc.

(b) **Single Cell Protein** (SCP) It refers to edible unicellular microorganisms. The biomass or protein extract from pure or mixed cultures of algae, yeasts, fungi or bacteria may be used as an ingredient or as a substitute for protein-rich foods. It is suitable for human consumption or also as animal foods, e.g. Spirulina, Chlorella, etc.

3. **Some Other Techniques** Other techniques like tissue culture (other than plant breeding) and somatic hybridisation are used for food production.

(i) **Tissue Culture** It is a technique which produces the whole plant from a plant tissue (i.e. explant) by growing it in an artificial culture medium. This ability of a plant cell to produce a whole plant is called totipotency.

Micropropagation is the application of tissue culture for growing new large number of plantlets. It is a fast method to multiply plants vegetatively.

(ii) **Somatic Hybridisation** The process of fusion [with the help of Polyethylene Glycol (PEG)] of protoplast of somatic cells obtained from different varieties or species of a plant on a suitable nutrient medium in vitro to develop a hybrid is known as somatic **hybridisation**. The hybrids so, produced are called **somatic hybrids**

Pomato is a somatic hybrid produced by the fusion of tomato and potato protoplasts. Unfortunately, this plant does not have all the desired characteristics for its commercial utilisation.