

Chapter - 9 Strategies for Enhancement in food production.

Animal husbandry:

- Agricultural practice of breeding and raising livestock.
- deals with care and breeding of livestock like buffaloes, cows, pigs, horses, cattle, sheep, camels, goats etc. that are useful in Human.
- It includes poultry, farming and fisheries.
- Fisheries include rearing, catching, selling
- Animal like bees, silkworm, prawns, crabs, fishes, birds, pigs, cattle, sheep and camel have been used by humans for products like milk, eggs, meat, wool, silk, honey etc.
- more than 40% of world livestock population is in India & China. but contribution to world farm produce is 25%. Productivity per unit is very low.

Management of farm and farm animals.

➤ Dairy farm management -

- management of animals for milk and its product for human consumption.
- deals with processes and systems that increases yield and improvement in quality of milk.
- good breed - high yielding potential of milk
- care to be taken - clean animal house, adequate and potable water, maintained disease, stringent cleanliness, hygiene.
- it is important while milking, storage and transport of milk.
- regular inspection and proper record keeping is important.
- regular visit by a veterinary doctor would be mandatory.

2) Poultry farm management-

- It is a class of domesticated fowl (birds) used for food or for their eggs.
- include chicken and ducks, turkey, geese.
- selection of disease free, suitable breed, proper and safe farm condition, proper feed and water, hygiene & health care are important components for poultry farm management.

Animal breeding:

• Aims in increasing the yield of animals and improving the desirable qualities of the produce

- breed - A group of animal related by descent and similar in most characters. like general appearance, features, size etc.

breeding $\left\{ \begin{array}{l} \text{Inbreeding - Breeding between animals of same breed} \\ \text{outbreeding - cross between different breeds.} \end{array} \right.$

Inbreeding -

- refers to the mating of more closely related individuals within the same breed for 4-6 generations.
- Strategy: Superior males and superior females of the same breed are identified and mated in pairs.
- Inbreeding increases Homozygosity. hence necessary if we want to evolve a pureline in any animals.
- Exposes harmful recessive genes that are eliminated by natural selection, helps in accumulation of superior genes and elimination of less desirable one.
- Continue inbreeding or close inbreeding reduces fertility, even productivity. this is called inbreeding depression.
- to restore fertility - animal of the breeding population should be mated with unrelated superior animals of the same breed.

outbreeding -

breeding on unrelated animals (individuals of the same breed but having no common ancestor on either side of their for 4-6 generations (outcrossing)) or between different breeds (cross breeding), or different species (interspecific hybridisation)

outcrossing -

mating of animal within the same breed but having no common ancestor for 4-6 generations. helps to overcome inbreeding depression, milk production loss, low growth rate in beef cattle.

cross breeding -

Superior male of one breed are mated with superior female of another breed. develop new stable and superior breed

eg: Bikaneri ewes X Marino rams \rightarrow Hisardale (sheep breed new)

Interspecific hybridisation:

male and female of two different related species are combined,

eg: mule.

Artificial insemination -

The semen is collected from the male that is chosen as a parent and injected into the reproductive tract of the selected female by the breeder.

Multiple ovulation Embryo transfer technology programme for herd improvement.

Cow is administered FSH hormone which induce follicular maturation and super ovulation. it produce 6-8 eggs. then fertilisation is done. The fertilised egg at 8-32 cell stage are recovered non specifically surgically and transferred to surrogate mother. used to increase herd size in short time.

Bee keeping / Apiculture :

- maintenance of hives of honeybees for the production of Honey
- Honey - high nutritive value + medicinal purpose.
- Honeybees also produce beeswax (used in cosmetics, polishes)
- Most common species - *Apis indica*.

following points are important for successful bee keeping.

- i) knowledge of nature and habits of bee.
 - ii) Selection of suitable location, catching, hiving of bee group
 - iii) Handling and collection of Honey and of beeswax.
- Honeybees are best pollinators of crops.

Fisheries:

- catching, processing or selling of fish, shellfish or other aquatic animals.
- large population depend on fish, prawns, crab, lobsters, edible oyster.
- freshwater fish - catla, Rohu & common carp.
- marine fish - Hilsa, Mackerel, pomfrets.
- Aquaculture, pisciculture - Increase production of aquatic plants and animals which is a food source for aquatic life.

plant breeding:

- manipulation of plant species in order to create desired plant type that are better suited for cultivation, give better yield and are disease resistant.
- main aim - increased crop yield, and improved quality, increased tolerance to environmental stress (salinity, extreme temperature, drought), resistance to pathogens (viruses, fungi, bacteria) & increased tolerance to insect pests.

The main step in breeding a new genetic variety of a crop are:

i) collection of variability -

In many crops pre-existing genetic variability is available from wild relatives of the crop. The entire collection having all the diverse alleles for all genes in a given crop is called germplasm collection.

ii) Evaluation and selection of parents:

The selected plants are multiplied and used in the process of hybridisation.

iii) cross hybridisation among the selected parents:

desired characters combined from two different plants

e.g: high protein quality of one parent \times disease resistant quality from another plant.

iv) Selection and testing of superior recombinants:

v) Testing, release and commercialisation of new cultivars.

- Agriculture accounts for approximately 33% of India's GDP and employs nearly 62% of population.

some Indian hybrid crop yield varieties:

1) Wheat and rice -

During the period 1960 to 2000 wheat production increased from 11 million tonnes to 75 million tonnes while rice production went up from 35 million tonnes to 89.5 million tonnes.

- In 1963, several varieties such as sonalika and balyan sona which are high yielding and disease resistant - wheat variety.

- Jaya & Ratna - rice varieties developed in India.

2) Sugarcane -

Saccharum barberi - poor sugar content and yield (in north India)
Saccharum officinarum - thicker stem & higher sugar content, but did not grow well in north India.

These two species successfully crossed to get variety & desirable quality of high yield, thick stem, high sugar & ability to grow in sugarcane areas of north.

3) Millets - Hybridized maize, jawar, bajra successfully developed in india.

Plant breeding and disease resistance:

- Wide range of fungal, bacterial and viral pathogens affect the yield of cultivated crop species.
- Breeding and development of cultivars resistant to disease enhance food production.

methods of breeding for disease resistance-

- Conventional method for disease resistance is that of hybridisation and selection.
- Steps: screening germplasm for resistance sources, hybridisation of selected parents, selection and evaluation of the hybrids & testing and release of new varieties.

Table: Crop variety bred by hybridisation & selection, Resistance to diseases.

crop	Variety	Resistance to disease.
Wheat	Himgiri	Leaf and stem rust, hill bunt.
Brassica	Pusa Swarnim (Karan Rai)	White rust.
Cauliflower	Pusa Shubhra Pusa Snowball K1	Black rot and curl blight black rot.
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilli mosaic virus, Tobacco mosaic virus & leaf curl.

Mutation - process by which genetic variations are created through changes in the base sequence with genes. result in creation of new character.

- mutation induced by radiations
- Resistance to yellow mosaic virus in bhindi was transferred from a wild species and resulted in a new variety of bhindi (*Abelmoschus esculentus*) called parbhani kranti

Plant breeding for developing Resistance to insect pests:

- Hairy leaves in several plants are associated with resistance to insect pests. e.g: resistance to jassids in cotton and cereal leaf beetle in wheat. nectarless cotton varieties do not attract bollworms.
- High aspartic acid, low nitrogen and sugar content in maize leads to resistance to maize stem borers.
- some released crop varieties bred by hybridisation and selection for insect pest resistance are given below:

Crop	Variety	Insect pests.
Brassica (rapeseed mustard)	pusa Gaurav	Aphids
Flat bean	pusa sem-2 pusa sem-3	Jassids, aphids & fruit borer.
okra (bhindi)	pusa Sawani pusa A-4	Shoot and fruit borer.

Plant Breeding for improved food quality -

- around 3 billion people - suffer from micronutrient - protein, vitamin deficiency. Iron, vitamin A, iodine and zinc - increase the risk of disease, reduce lifespan & reduce mental abilities.

Biofortification:

- Breeding crop with higher level of vitamins and minerals or higher protein and healthier fats.
- objective of improving -
 - i) protein content and quality
 - ii) oil content, vitamin content, micronutrient & mineral content.
- Wheat variety - Atlas 66 - high protein content.
- In india - vitamin A enriched - carrots, spinach, pumpkin, vitamin C enriched bitter melon, bathua, mustard, tomato
Iron and calcium enriched spinach and bathua.
protein enriched beans - broad, lablab, french, garden peas.
- Iron fortified - rice.

Single cell protein -

- Alternate source of protein for animal and human nutrition is single cell protein.
- microbes are grown on industrial scale - good source of protein.
- e.g: Blue-green Algae like spirulina serve as a food rich in protein, minerals, fats, carbohydrates & vitamins.
- Methylophilus methylotrophus - produce 25 tonnes of protein.
- edible mushrooms culture is growing industry.

Tissue culture :-

- Explant - any part of a plant taken out and grown in a test tube under sterile conditions in special nutrient media.
- totipotency - capacity of explant to generate a whole plant
- micropropagation - This method of producing thousands of plants through tissue culture.
- somaclones - Each of these plants will be genetically identical to the original plant from which they were grown.

- meristem is free of virus. Hence one can remove the meristem and grow it in vitro to obtain virus free plants.
- protoplast - cell without cell wall
- somatic hybrid - fusion of two protoplast which are having desirable characters and further grown to form new plant.
e.g: tomato + potato → pomato
- In tissue culture nutrient medium must be provided a carbon source such as sucrose, inorganic salts, vitamins, amino acids, growth regulator auxin & cytokinin.