

# STRATEGIES OF FOOD PRODUCTION

## Animal Husbandry

Agricultural practice of breeding and raising livestock.

→ Deals with care, breeding livestock like buffaloes, cows, pigs, horses, cattle, sheep, camels, goats etc.

→ poultry farming and fisheries.

→ Fisheries include rearing, catching, selling... fish, molluscs (shell-fish) and crustaceans (prawns, crabs etc.).

→ Bees, silk-worm, prawns, birds, pigs...  
↳ milk, eggs, meat, wool, silk, honey...

→ >70% of World livestock population is in India and China. (★)

→ Contribution - 25% productivity per unit is very low.

## Management of Farms and Farm animals →

### ① Dairy Farm Management → Milk and milk products.

→ Deals with: processes and system that ↑ yield, and improve quality.

→ Milk yield → Quality of breeds.

→ Selection of good breeds having high yielding potential, disease resistant.

→ Rearing of cattle, Routine food, Habit, processing, Transport.

→ Hygiene. Veterinary Doctor. (Jersey, Leghorn)

### ② Poultry Farm Management →

Domesticated fowl (birds) used for food/eggs.

→ Chicken, ducks, turkey, Geese.

↳ Poultry → Meat of these and other birds.

→ Imp. Components → Selection of disease free, suitable breeds, proper and safe farm conditions, proper food and water, hygiene, health care.

→ 'Bird flu Virus' → affected egg and Chicken Consumption.

## Animal Breeding →

Imp aspect of animal husbandry.

→ Aims at ↑ yield of animals and

improving desired qualities.

Breed → Group of animals related by descent and similar in most characters like general appearance, features, size, configuration etc...

## Inbreeding →

Mating of close related individuals within same breed for 4-6 generations.

Strategy → Superior males and females of same breed are mated in pairs. progeny from these matings are evaluated and superior among them are identified for further mating.

→ Sup. ♀ → ↑↑ milk per lactation

→ Sup. ♂ → Give rise to superior progeny (Bull)

Inbreeding ↑ uses homozygosity.

→ ∴ Inbreeding necessary to evolve pure line.

→ Exposes harmful recessive genes that are eliminated by selection.

→ ↑ productivity of inbred population.

→ Reduces fertility, productivity.

Inbreeding depression → to Overcome this → Cross-breeding.

## Outbreeding →

Same breed, unrelated ancestors for 4-6 generations.

① Out crossing. (Average marriage same breed)

Same breed, no common ancestors.

Offspring → Out cross

Best breeding method, for animals below average in milk product, beef cattle --

Single Outcross, helps to overcome inbreeding depression.

② Cross Breeding. (Love marriage diff breed)  
Crossing of superior male and female of different breeds.

→ Desirable Qualities.

→ Commercial production.

→ Hissardale → Sheep → Punjab

↳ Bikaneri ewes and Marino rams

③ Interspecific Hybridisation  
Male and female of 2 diff. related species are mated.



→ Desirable features, economic value.

♂ Lion + ♀ Tiger → Liger (male)  
♀ Lion + ♂ Tiger → Tigon

♂ Horse + ♀ Donkey → Hinney  
♀ Horse + ♂ Donkey → Mule } Sterile.

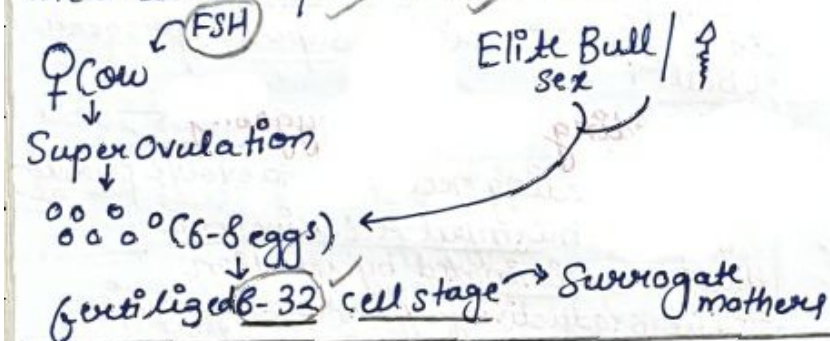
Controlled Breeding experiments →  
artificial Insemination

→ success rate ↓↓

↓ for improvement in Hybridiza.

Multiple Ovulation Embryo Transfer Technology (MOET)

→ Cattle, Sheep, rabbits, buffaloes, mares...  
→ ↑↑ milk yielding breeds, ↑↑ Quality lean meat with ↓ lipid, ↑↑ herd size.



Beekeeping / Apiculture →

Maintenance of hives  
→ produc. of Honey (high nutritive value)  
→ age-old cottage industry.  
→ Bee wax → cosmetics, polishes...  
→ Income generating industry.  
→ Need: Wild shrubs, fruit orchards etc..  
→ Apis Indica (★) ✓

Imp. for successful bee-keeping →

- ① Knowledge about bees.
- ② Selection of location of beehives.
- ③ Catching and hiving of swarms (group of bees).
- ④ Management of beehive during diff. seasons.
- ⑤ Handling and collection of honey, bee wax  
→ Good pollinators.

Fisheries →

Catching, processing, selling of fish, shellfish...

→ Food: fish, fish products, prawns, crab, lobster, edible oyster.  
→ Fresh water fishes → Catla, Rohu, Common carp (★) (★)  
→ Marine Water → Hilsa, Sardines, Mackerel, Pomfrets (★)

Aquaculture - Culture and rearing of fish and other aquatic organisms (prawn, oyster...)

Pisciculture - Only culture and rearing of fish.

→ Blue Revolution (★)

Plant Breeding →

① Father - MS Swaminathan (★)

↑↑ Yield to very large extent.

Green Revolution was dependent to large extent on plant breeding techniques for development of high yielding and disease resistant varieties in wheat, rice, maize.

What is plant Breeding?  
purposeful manipulation of plant species in order to create desired plant types

→ Better Cultivation, Yield, disease resistant.

→ 9,000-11,000 years old

→ ↑↑ crop Yield, ↑↑ Quality, ↑↑ tolerance to env. stress (salinity, extreme temp., drought), Resistance to pathogens (viruses, fungi and bacteria), ↑↑ tolerance to insect pest.

Main steps in Breeding →

① Collection of Variability →

→ entire collection (of plants/seeds) having all diverse alleles for all genes in given crop is called gene pool

Collection

② Evaluation and selection of parents

→ pure lines created, wherever desirable and possible

③ Cross hybridisation among selected parents →

e.g. → ↑↑ Protein X disease resistant

→ Time consuming, tedious process

→ ↓↓ Success Rate

④ Selection and testing of superior recombinants →

→ Superior parents self pollinated  
→ homozygosity

⑤ Testing, release and commercialisation of new cultivars →  
quality, disease resistance.



India → agricultural Country.

Agriculture → 33% GDP ✓  
62% employment ✓

↑↑ Yielding  
Variety of Wheat and rice,  
in mid 1960s → plant breeding techniques

Green Revolution food production

Indian hybrid crops of high yielding  
Varieties → Maize, Wheat-Sonalika,  
Garden peas - P1542

Wheat and Rice → ⊛ VIMP

1960-2000 → Wheat production ↑↑ed,  
from 11 million tonnes → 75 million tons  
Rice → 35 million tons → 89.5 million tons

due to semi-dwarf variety of wheat  
and rice.

Nobel laureate Norman E. Borlaug  
→ International Centre of wheat and

maize in Mexico → Semi-dwarf variety

1963 → Sonalika, Kalyan Sona, ↑↑ yielding,  
disease resistant → Wheat

Semi-dwarf Rice Varieties → IR-8  
(developed at IRRI (Philippines) and  
Taichung Native-1 (from Taiwan)).

Later, better yielding  
Semi-dwarf varieties  
Jaya, Ratna → India (1986)

Sugar Cane → Saccharum barberi →  
North India (↓ Sugar, Yield)

Saccharum officinarum → South India  
(thick stem, ↑↑ sugar, did not grow well  
in North India).

→ Cross → ↑↑ yield, thick stem, ↑↑  
sugar, grow in North India

Millet → Hybrid Maize, Jowar,  
Bajra.

→ Hybrid breeding  
→ ↑↑ yield, water stress resistant

Plant Breeding for Disease

Crop losses → 20-30% → fungal,  
bacterial, viral pathogens.

Disease caused by →

① Fungi → Rusts (brown rust of wheat,  
red rot of sugarcane, late blight of  
potato).

② Bacteria → Black rot of crucifers.

Virus → Tobacco mosaic, turnip mosaic..

Methods of breeding for disease resistance

Breeding techniques / Mutation Breeding.

Conventional Method → Hybridisation and  
Selection.

Steps → ① Screening germplasm for resistance  
sources.

② Hybridization, ③ Selection and evaluation

④ Testing and release of new varieties.

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Leaf and stripe rust, hill bunt.
Brassica	Pusa Swarnim (Karan Rai)	White rust (fungal)
Cauliflower	Pusa Shubra, Pusa Snowball K-1	Black rot and curl blight black rot.
Cowpea	Pusa Komal	Bacterial blight.
Chilli	Pusa sadabahar	Chilli mosaic virus, Tobacco mosaic virus, and leaf curl.

→ Conventional breeding is constrained by,  
availability of limited no. of disease  
resistance genes.

Mutation → genetic variations through  
(changes in base sequence within genes).

Result → Creation of new character/trait,  
not found in parents.

Mutation Breeding → Inducing mutation  
artificially through chemical/gamma radiat-  
ions and selecting and using plants that  
have desirable character as source in breeding.

Mung bean, resistance to Yellow mosaic  
virus and powdery mildew were induced  
by Variation/mutation

Resistance to Yellow mosaic virus in Bhindi  
(Abelmoschus esculentus) was transferred  
from wild species and resulted in new  
variety of A. esculentus called Parbhani  
Kranti. ⊛ ⊛

Plant Breeding for Developing  
Resistance to Insect Pests →

→ due to Morphological, biochemical,  
physiological characters.

Hairy leaves → resistance to insect pests.

Eg → Resistance to Jassids in Cotton and oral  
leaf beetle in wheat. ⊛



Wheat → Solid stem lead to non-preference by stem sawfly and → smooth leaved and nectar-less cotton varieties do not attract bollworms.  
 ↑↑ aspartic acid, ↓↓ nitrogen, sugar content in maize lead to resistance to stem borers.

Crop	Variety	Insect pests
Brassica (rape seed 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 →

- > 840 million → Khane ke liye nahi hai (World)
- 3 Billion - Hidden Hunger (micronutrient, protein, Vitamin deficiency)
- Diet lack → Iron, Vitamin A, Iodine, Zinc
- Disease, ↓ life span, mental abilities.
- Biofortification → Crops with ↑↑ Vitamin, minerals, proteins, healthy fats.
- protein content, quality.
- Oil content, quality.
- Vitamin, micronutrient, mineral content.
- 2000, Maize Hybrids → X2X amino acid, lysine, tryptophan.
- Wheat Variety, Atlas 66 → ↑↑ protein content.
- Iron-fortified rice Variety → X5 iron.

### Indian Agriculture Research Institute - Delhi.

- Crops → ↑↑ Vit. and minerals
- Vit A ↑↑ → Carrot, spinach, pumpkin
- Vit C ↑↑ → bitter gourd, bathua, mustard, tomato.
- Iron, Calcium → Spinach and bathua.
- protein ↑↑ → beans - broad, lablab, french and garden peas.

### Single Cell Protein - SCP

- Animal farming → 1 Kg meat → 3-10 Kg grain.
- > 25% people → hunger, malnutrition.

Alternate Source → protein and nutrition - SCP.

Microbes - Good protein

Blue Green algae (Spirulina) → grow in waste water, potato processing plants (starch), straw, molasses, animal manure, sewage → ↑↑ protein, mineral, fat, carbohydrate, Vitamins food.

Bacteria → Methylophilus methylotrophus ↑↑ rate of biomass growth → 25 tonnes of protein.

Microscope fungi → food.

### Tissue Culture →

1950's → Explant → Whole plant.

Totipotency → capacity to generate whole plant from any cell.

Micropropagation (tomato, banana, apple...)

nutrient medium

Carbon source (Sucrose, inorganic salts, Vitamins, amino acids, auxin, cytokinins)

propagation of 1000's of plants.

Somacomes (genetically same)

# Virus plant → Meristem Culture

e.g - banana, sugarcane, potato

Virus free plant

# Somatic Hybridisation →

tomato X potato → pomato.

