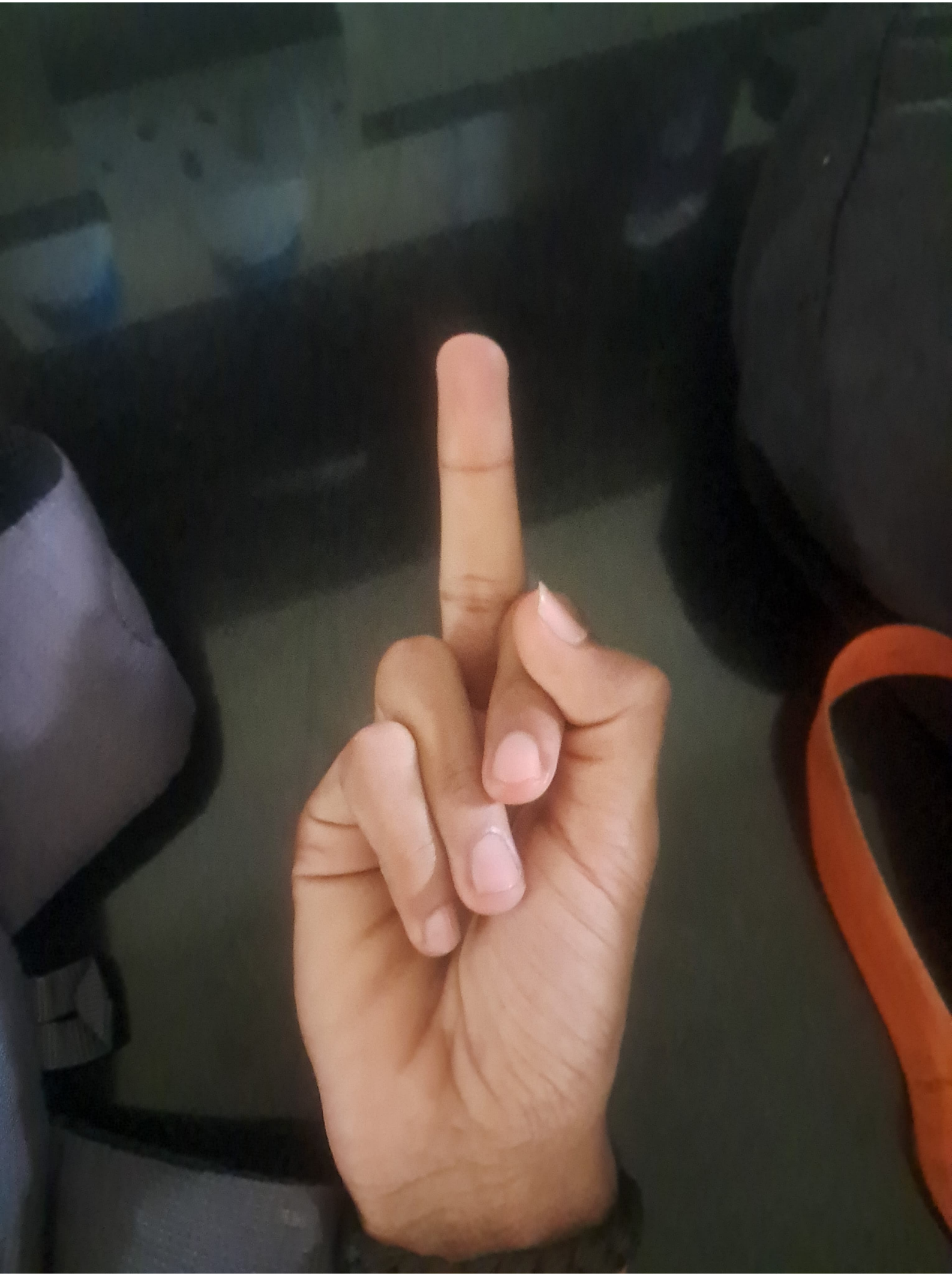


जय माँ अम्बे

my self

Name : आशीष सिंह शेखावत ☺

Class: BVSc and A.H. 2nd year

School / College: PGIVER, Jaipur

Email:

Index

Date	Page No.	Subject:	Sign	Remark

☆ ☆ आशीष सिंह शेखावत

Class → Mammalia

Subclass I → Eutheria

Order I → Ungulata (hoofed mammals)

Sub order :-

☆ (i) Artiodactyles (Even toed hoofed)

A. Suina : Families → Hippopotamidae
→ Suidae : Genus : Sus (non ruminant)
- Sus Scorfa (wild boar)
- Sus. domestica (domestic swin

B. Tylopoda : Family = Camenelidae (ruminant)
↳ Genus : Camelus
- C. bacterianus (Asian 2 humpe
- C. dramedrius (Arabian one humped)

C. Pecora : Families
- Cervidae (Deer)
- Girraffidae (Giraffes)
- Bovidae (hollow horned)

Sub family : bovinae

Genus : 1. Ovis (sheep) 2. Bovis (Bos) 3. Capra (Goat)

Species : O. aries (domestic sheep)

B. taurus (Humpless Cattle)

B. indicus (Humped cattle)

B. frontalis (mithun)

B. grannies (Yak)

B. bubalis (Indian water buffaloes)

☆ (ii) Suborder Perissodactyles (Even toed)
↓
2 families

a. Rhinocerotidae

b. Equidae (non-ruminant)
↓
Genus : Equus
- E. Caballus (Horse)
- E. asinus (Ass)

Animal Breeding

By Ashish Singh Shekhawat

Page No.
Date 13/05/25

Domestication :- Man's activity of taming the wild animals and to control the breeding, feeding and care of animals.

Domestications result in some biological changes in animal which may be morphological, physiologi or behavioural. It differs from taming which is defined as the elimination of tendencies to flee from the man.

Taxonomy of domestic animals

All the farm animals except poultry → Class = Mammalia
Poultry → Class = Aries

In mammalia class -

Orders

(1) Ungulata → Hoved animals
↳ 2 Suborders

(a) Axtiodactiles
(even toed hooves)

Super
3 suborder

(i) Suina → 2 family (Hippopotamidae & Suidae) ⇒ monogastric
(ii) Tylopoda → Camilidae family (Pseudoruminant)
(iii) Picora → 3 families (Cervidie, Giraffide, Bovide)
↳ Hollow Horned Ruminants

Bovidie → 3 Genus
- Ovis aries (sheep)
- Capra hicus (Goat)
- Bovis
  ↳ Bos torus → Humpless cattle
  Bos indicus → Humped Cattle

Bos frontalis (mithun)
Bos grunniens (Yak)
Bubbalus bubalis (water buffalo)

(b) Perissodactyles

Dog → Canis
Cat → Felis

2 families
(i) Rhinocerotidae
(ii) Equidae
Equs Cabalus (Horse)
Equs asinus (Donkey)

Important

Breed :- A group of animals of same species which are related by descendants and breeding true for certain characterstics like general appearance, body colour, size, features etc., K/a breed.

Classification

Strain :- A group of individuals of same breed which are kept in isolation for specific purpose

Variety :- A group of same breed having particular comb type, plumage colour and general appearance.
It is specifically used in poultry.

begets (Produces)

Page No.
Date

→ Robert Bakewell is father of animal breeding.
He developed 2 theory
(i) Like begets like
(ii) Breed the best to the best.

→ He used inbreeding and pedigree in his exp.

→ He developed ~~Sire~~ Shire horse, long horned Cattle, Leicester sheep

→ Collings developed short horned cattle.

★ Buffon (French naturalist) → Systematic cross breeding.

J.L. Lush → Used statics in breeding
Father (Modern animal breeding)
Book → "Animal breeding plans"

R.A. Fischer → 'Anova'

1. Cattle Breeds (India)

Highest milk prod^n] → Sahiwal (Pak.)
" lactose %
" Fat % → Red Sindhi

Rathi → Spotted
Red Sindhi → Dark Red-brown coat color, droopy ears, tail touching to the ground

Best dual purpose breed of india → Kankrej.
'Sawai Chal' → Kankrej
Leaf like ear → Gir, indigenous cattle
most exported breed → Gir

most common in bikaner ← Rathi = Red Sindhi + Sahiwal + Tharparkar + Dhani

Navel flap ⊖nt in Hariana breed.

Tallest cattle breed → Ongol (Nellore, Andhra pradesh)

Kankrej → Heaviest
Sawai chaal
Dual purpose

Page No.
Date

- Miniature cattle → Panzanoore (Motli Cow) breed
- Dwarf cattle → Vechur breed

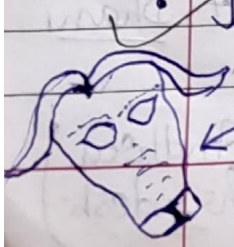
→ 54 registered cattle breed in India (Game)
→ "Pullikulum" breed of cattle is used in Zallikattu.

→ Beautiful cattle breed (world) → Ayrshire
→ Best beef breed → Short horned, Beef master, Angus, Hereford

Friesian
→ Highest milk producing cattle breed (world) → Holestein Fr. (Netherland) (HF)
→ Heaviest cattle breed → Kankrej
Brown Swiss → Heat tolerant exotic cattle breed
Jersey (England) → Fawn coloured small cattle breed, (4.5%) fat

② Buffalo

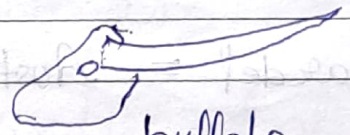
- Best (world) → Murrah (Rohtak, Jhajjhar) (HR) → Coiled hair, white switch horn
- Neeli Ravi (Panchkalyani) → 5 white markings presenton: forehead, Face, Muzzle, Legs, Tail
- Surti (Baroda) → Sickle-shaped horn, 2 white collars at neck, Pinkish legs
- Jafrawadi → Heaviest buffalo breed (Bulging forehead)



unprocessed wool → fleece

Page No.
Date

Bhadawari → 13% fat, Copper colour (Highest fat %) → थोड़ी² लाल

Nagpuri → Sword like horns ⇒ 

Imp. "Pundapuri" → Door to door milking ~~Cattle~~ buffalo breed.

Leut → Assam

③ Sheep

Finest wool (India) → Chokhla (Sikar, Nagaur)
Finest wool (in southern india) → Neelgiri
Best Carpet wool breed in RJ → Magra (Ring around the eyes) — चश्मे जैसे
Best mutton breed → Malpura, Sonadi
Highest prolifecacy breed → Garole
(No. of offsprings in single parturation)

Mutton breed → Mandya (Karnatka)
(कलमुही) Black faced → Marwari
→ Marwari → Black face breed
→ All the sheep breeds in RJ are hornless.

→ Marino (finest wool producing in world) (Spain)
Switch

→ Rambouillet (French breed of sheep, used in india for cross breeding programme.)
→ Jaisalmeri → Highest wool production per clip.

Mandga (Goat like sheep)

Page No.
Date

Hampshire, Cheviot, Ponydel → medium wool producing

→ Hisardel = Australian Marino X Magra (Bikaneri Aves)

→ Avishan = Garole (WB) + Patanwadi (GJ) + Malpura

→ Fur sheep breed → Karakul

→ Exotic Mutton breed → Dorset

④ Goat

(RJ) → Sirohi (Curved back), Marwari (Black, 3 purpose goat breed, high hair growth)
Jhakrana (Alwar, Black body with white ear, best milk production)

Pashmina → Chegu, Chanthangi (sheep like goat)

→ Barberi → most beautiful, urban goat

→ Zalawdi (GJ) or Jhalawari

→ Most prolific goat breed → Black Bengal ☆

→ Exotic → Swiss baby foster mother (Sanen)
Alpine, Anglo

Roman nose → Jummapari

Sojat breed → Pinkish ear

Page No.
Date

Togenburg (Switzerland)
Boer (Mathura) → Meat purpose

- Angora (Turkey) → Mohair (undercoat of angora)
- Orenburg (~~Afganistan~~ Kazakhstan) → Best Pashmina

⑤ Camel

1. Bikaneri → Draught camel. Camelus bacterianus :- Asian dua humped
2. Jaisalmeri → Riding Camel C. dramedrius :- Arabian
3. Kuchhi → Swimming Camel Single humped

⑥ Mithun → Mountain Cattle or Ceremonial ox

↳ 58 chromosomes (2n)

Mithun ♂ × Cow ♀ → Jatsa ♂, Jatsamin ♀ → F_1

Jatsamin ♀ × Mithun ♂ → Napsa ♂, Napsamin ♀

Siri → Cattle breed (Sikkim)

Mithun ♂ × Siri ♀ → Jechha ♂, Jessam ♀

① American class :- Plymouth Rock, Wyandotte, Rhode Island Red (RIR), New Hampshire (NH)

② English class :- Australop, Dorking, Sussex, Cornish, Orpington, Red Cap

* Exotic Pig breed → Yorkshire, Berkshire, Duroc, Landrace

* Poultry
Chicken → Gallus domesticus.
Red Jungle fowl (Gallus gallis)
↳ Ancestor of current chicken generation

Aseel → Fighting ~~chik~~ chicken
Kadaknath → kalamasi.
Mewari → Single most chicken breed of RJ
Aravali → GJ

* Turkey → Meleagris gallopavo
* Duck → Anas platyrhynchos
* Goose → Anser anser
* Guinea fowl → Numeda meleagris
* Emu → Dromaius novaehollandiae
* Ostrich → Struthio camelus
* Japaneese quail → Coturnix coturnix.

★ Economic trait

(i) Growth trait :- Meat animals
Birth weight
eg. Body wt. at different age
wt. at sexual maturation
wt. at calving
Average daily gain.

Birth wt. of Calve → 20 – 30 kg

③ Mediterranean :- Leghorn, Minorca, Ancona, Andalusian

④ Asiatic :- Brahma, Cochin, Langshan

(2) Production trait

(3.) Reproduction trait
eg. Age at sexual maturation

A. Directly observed / Primary trait

Recorded by directly observation and measurement without any mathematical calculation.
eg. Body wt., Body colour, Height, Girth, Litter size, Iris colour, Horn pattern, Blood group, Daily milk yield, Fat %, mortality, Sex of calf, Egg wt., carcass wt., Physiological traits (body temp., pulse rate, respiration rate)

B. 2° trait

Generated from 1° traits by some mathematical calculation.

→ Most of the economic traits are 2° trait.

eg. Age (at sexual maturity, at parturation)
Average daily gain, Total milk yield, Service p. lactation period, dry period, Fertility Index = No. of Conception / No. of Insemination × 100
Herd life

→ Body wt. is more important than age in animals for breeding purpose

Herd life :- Difference in days b/w ~~days~~ date of first calving to the date of disposal (death or culling)

Longevity or Life span :- Date of birth to date of disposal.

* ~~Open~~ days open (%) = $\frac{\text{Total service period in all lactation}}{\text{Herd life}} \times 100$

* days dry (%) = Total dry days in all lactations / Herd life $\times 100$

* Involution period = Time period b/w calving and first heat.

* Lactation Length = Date of drying − date of calving

26/12/23 Calving
↓
01/03/24 First heat
↓
22/03/24 2nd heat
↓
13/04/24 Pregnant
↓
01/05/24 PD (Pregnancy diagnosis)

Next Calving 03/02/25

Date of drying → 01/11/24

5 Colestrum

10 months 300 days

→ Successfully Conceive 305 days

* Service Period = Time period b/w calving to next successful conception. (26/12/23 to 22/03/24) (60 − 90 days)
→ Most variable period (Gestation period is least variable)
→ Exclusively depends upon management.

Dry period = Date of next Calving − Date of drying

→ Service period and dry period must be limited but not very less or zero.

→ Service period and dry period are economically important trait.

→ Tharparkar cattle breed has minimum dry period.

* Calving Intermediate / Intercalving Interval period :- It is time period b/w 2 successful calving.

Fleece :- Shearing product of sheep. (Unprocessed & dirty)

Wool :- Processed fleece.

Page No.
Date

* Service Period + Gestation Length = Lactation Length + Dry Period - Calving Interval

* Breeding efficiency $= \frac{n\,365 + 1020}{AFC + CI} \times 100$

n = number of caling interval

CI = Caling interval in days

AFC = Age at first caling in days

For buffalo → B.E. $= \frac{n\,365 + 1040}{AFC + CI} \times 100$

दो दाँत की बकरी → First 2 Incisors are permanent (1 year age)

चार दाँत की बकरी → 4 Incisors are permanent (2 year age)

Full mouth goat → Complete dentition (3 year age)

अट्ठन्ती बकरी → Below 1 year age

Weaning Period

* Greesy fleece yield

Wool traits :- Staple length, Medulation, Fibre diameter

Staple length ↑ → wool quality good

Hair :- Medulation (Air space) ↑, Straigh

Wool :- Medulation ↓, Crimpness present

54
×2
3/108(36
-9
18

24-26 hr में 1 Egg → By 1 Hen

Page No.
Date

→ Wt. of day old chicken → $\frac{2}{3}$rd of egg wt.
↳ (36 gm)

→ Wt. of egg → 54 gm.

* Layer :- Egg purpose

Broiler :- Meat purpose, Chick of any sex attaining 1 kg body wt. in 4 weeks consuming 2 kg feed.

FCR = 1:2

→ Age of sexual maturity in chicken = 6 months

Clutch :- Number of egg production continuously without any break.

Pause :- Time interval b/w 2 sucessive clutch.

→ 52 weeks तक मुर्गी अंडे देती है

→ Culling age → 72 weeks

* Pullet :- Young ♀ chicken
Cockrel :- Young ♂ chicken

Page No.
Date

Hatch % = $\frac{\text{No. of chick produced}}{\text{total no. of egg set}}$

Selection

There are 2 ways in which selection of the breeders can change the genetic properties of population.

1. By choice of individuals to be used as parent which constitute selection.

2. Control of the way in which the parents are mated which embraces inbreeding and crossbreeding (accept)

→ Selection means breeding from best individual whatever best may be.

→ Important: Selection is a process of giving preference to a certain individual in a population to reproduce than other individuals which are denied for opportunity to produce next generation.

→ In genetic terms the selection is a non-random process of differential reproduction and survival of genotypes.

→ Selection without creating any new genes, changes the genetic str. of population by changing the frequency of genotypes and genes.

→ Frequency of desired genes is ↑sed in population through selection at a expense of freq. of undesirable or less desirable genes, this is the genetic effect of selection.

Page No.
Date

- Types (On the basis of Operator)

1. Natural Selection :- The Selection operating through differences in natural forces (fertility and Viability).

- It follows Survival of the fittest principle.

2. Artificial :- The Selection operated by human being.

A/c to Lush ; Artificial Selection is causing or permitting some kinds of individuals to produce, more offspring than other kinds do.

Note : Culling :- Removal of underisable or unproductive individuals from population.

Selection differential (S) :- The superiority of the selected parents over the population mean is k/a selection differential. It is aka reach.

→ It is a difference b/w the mean of selected individuals and population mean before selection.

$$\boxed{S = \bar{P}_S - \bar{P}}$$

$\bar{P}_S$ = Mean of selected individual.

$\bar{P}$ = Population mean before selection

$(P = G + E)$

Page No.
Date

(R)

Response to selection

It is difference b/w the mean phenotypic value of progeny of selected individuals and the population mean before selection (R)

S = • It is aka genetic gain.

$P_s - P$

$$R = \bar{P}_0 - \bar{P}$$

$\bar{P}_0$ = Mean of offsprings of selected parent.

$\bar{P}$ = Population mean before selection.

The phenotypic superiority of selected parents has 2 component part

1.) Genetic superiority
2.) Environmental superiority

It is the genetic superiority which is transferred further, it is only additive genetic variability which is inherited.

In this way the additive genetic variability of the total phenotypic variability is only responsible to selection and it is expressed as heritability and more commonly k/a Realized heritability.

$h^2 = \frac{R}{S}$

The proportion of the selection differential which is transmitted to progeny is k/a realized heritability.

$$h^2 = \frac{R}{S} \qquad R = h^2 S$$

$h^2 = 1$ $\quad$ $h^2 = 0$

$R = S$ $\quad$ $R = 0$

Page No.
Date

- If value of heritability is 1, then respose of to selection (R) ~~whi~~ will be equal to Selection differential (S).
- If value of h^2 is 0, there will be no response to the selection, i.e. the selection is ~~useless~~ useless.

Poultry

① Hen day egg production (HDEP)

$$\text{HDEP/day} = \frac{\text{No. of eggs produced}}{\text{Total no. of live hens on that day}} \times 100$$

② Hen housed egg production (HHEP)

$$\text{HHEP/day} = \frac{\text{No. of eggs produced on a given day}}{\text{Total no. of hens housed at beginning}} \times 100$$

③ Yolk Index $= \dfrac{\text{Average height of yolk (mm)}}{\text{Average width of yolk (mm)}} \times 100$

(Range = 0.39 to 0.45)

④ Haugh Unit $= 100 \log \left[H - \dfrac{\sqrt{(30 W^{0.37} - 100)}}{100} + 1.9 \right]$

H = albumin height (mm), G = 32.2, W = weight of egg (g)

(08)

$$H.U. = 100 \log\left[H + 7.57 - 1.7W^{0.37}\right]$$

In chicken the H.U. of good quality of egg is 72.

(5) Egg production = $\frac{\text{No. of egg laid on that day}}{\text{No. of birds at start}} \times 100$

(6) Fertilization rate (%) = $\frac{\text{Number of fertilized eggs}}{\text{Total number of eggs in a batch}} \times 100$

(7) Hatching rate (%) = $\frac{\text{Number of hatched eggs}}{\text{Total number of fertilized eggs in a batch}} \times 100$

(8) Survival rate (%) = $\frac{\text{Total number of survival larvae untill day } 7^{th}}{\text{Total number of larvae counted at day } 01^{st}} \times 100$

Page No.
Date

2 Tools for genetic improvement

Breeding plan

- Selection
  - Natural
  - Artificial
- Mating system
  - Random
  - Non-Random
    - Based on Phenotypic resemblance
      - (+) Assortative mating
      - (−) Assortative mating
    - Based on Genetic resemblance
      - Inbreeding
      - Out breeding

Diff. b/w Artificial and natural selection

☆ Cattle breed

1. Milch breeds :- Sahiwal (MP, WB), Red Sindhi (Pb, UP, HR), Gir (HR, TN), Tharparkar (GJ), AJ, JD
2. Dual purpose :- Rathi, Hariana, Mewati, Kankrej, Deoni, Ongole, Krishna valley.

Hint: MK देव राइ पर krishna valley में Ongole जगाइ रहा

3. Draught purpose :- Nagori, Malvi, Bachur, Hallikar, Amritmahal

4. Crossbreed

Jersind = Jersey x Red Sindhi
Sunandini = Brown Swiss x non-descript Cattle breed
Frieswal = Friesian x Sahiwal
Karan Fries = Friesian x Tharparkar → (NDRI, Karnal)
Karan Swiss = Brown Swiss x (Sahiwal & Red Sindhi) at (NDRI, Karnal)

2 Tools

Page No.
Date

- Complications of selection, responsible for failure of selection effect

A Genetic complications
(i) Heredity and environment
(ii) Genotype and phenotype
(iii) Heritability
(iv) Type of gene action
(v) Regression to mean (Galton's law of filial regression)

B Operational
(i) Number of traits
(ii) Foundation stock
(iii) level of performance
(iv) Time length
(v) Animal numbers

Selection diff. can be predicted in advance provided that 2 cond.n hold the phenotypic values of characters being selected are normally distributed and selection are truncation.

- Truncation selection means that individuals are choosen strictly in order of merit as just by their phenotypic values, no individual being selected that is less good than any of those rejected. Under these cond the 'S' depends only on the proportion of population included among the selected group and phenotypic standard deviation of character.

- Standard deviation which measures variability is the prop. of character and the population and it sets the unit in which the response is expressed. The 'R' may be generalised if 'S' is expressed in terms of the phenotypic standard deviation (σ_p).

σ_p

Page No.
Date

This standardized 'S' is called as intensity of selection (i).

$$S = i \cdot \sigma_p$$

$$R = h^2 \cdot S$$
$$R = h^2 \cdot i \sigma_p$$

$$i = \frac{S}{\sigma_p}$$

$$R = i \cdot \frac{\sigma_A^2}{\sigma_p^2} \cdot \sigma_p$$

$$R = i \cdot \frac{\sigma_A^2}{\sigma_p}$$

$$R = i \cdot \sigma_A \cdot h$$
$$i = \frac{R}{\sigma_A \cdot h}$$

$$i = \sigma_A \cdot h$$

'i' depends only on proportion of population inclu-de in selected group.

If p is proportion selected and z is the height of ordinate at point of truncation then

$$i = \frac{z}{p}$$

'i' depends upon only 'p'.

→ 'S' and 'i' refers to the mean superiority of all the parents used. ♂ and ♀ may differ in amount of selection that can be applied to them. Some characters can be measured only on one sex, so no selection can be applied to other sex. If selection applied to ♂ & ♀ differ the value of S & i

$S = \frac{1}{2}(S_m + S_f)$ $i = \frac{1}{2}(i_m + i_f)$ $S_m = 1 S_f$

Page No.
Date

$S_m = 0$

Unweighted

to be used are the unweighted mean for 2 sexes, that is

$$S = \frac{1}{2}(S_m + S_f)$$

$$i = \frac{1}{2}(i_m + i_f)$$

If only ♀ can be selected then $S = \frac{1}{2} S_f$ & $S_m = 0$

$$\boxed{R = \frac{1}{2} h^2 . S_f}$$

$h^2 = \frac{R}{S}$

$R = h^2 . S$ $R = h^2 . \frac{1}{2} S_f$

Improvement of Response

To improve the 'R' there are following ways

1. Reduction in environmental variation through attention of technique, rearing and management.
2. Assort at the mating
3. Adjustment of data
4. Accuracy in measurement of data
5. Multiple measurements.
6. Reduction in proportion of selected individuals

Accuracy of Selection

It indicates the extent to which phenotypic value on which the selection is based reflects its genic value.

Page No.
Date

- It is correlation b/w breeding value & phenotypic value.
- It is $\sqrt{h^2}$.

* Generation Interval

→ It is avg. age of parents (♂ & ♀) at birth of their selected offspring.

→ It is time gap b/w the same stage of life cycle in successive generation of potential parents.

→ Avg. age of parent when offsprings are born that are destined to become parents in next generation

→ To estimate the 'R' per unit of time it must be divided by generation interval

Thus $\boxed{\text{generation interval} \propto \frac{1}{\text{Genetic gain per year}}}$

→ To improve genetic gain per year, the generation interval should be minimised

Page No.
Date

Types of 'S'

1. Observed or Expected Selection differential
2. ~~Waited~~ Weighted or Effective Selection differential

1. Observed 'S'

Avg. superiority of selected parents over the mean of the population from which they come.
This works on the principle that ~~on~~ all the selected individuals contribute equal no. of progeny to next generation.

2. ~~Waited~~ Weighted 'S'

Since all the selected group of parents don't contribute equal no. of progeny to next generation due to several reasons such as fertility and other reprod^n factors. In such cases ~~waited~~ weighted 'S' is estimated where each parent value is crossed by no. of progeny it produces.

Basis of Selection / Aids of Selection / Criteria of Selectio

The sources of info. ~~based~~ on which the breeding value of individuals is estimated are called basis of selection.
The breeding value so obtained is k/a Estimated breeding value. or probable breeding value. or predicted breeding value.

Temperament
स्वभाव

if $h^2 \uparrow \rightarrow$ Individual selection

Page No.
Date

(1) Individual Selection

In this basis of selection, the animal's ~~on~~ own a phenotypic value of a character is under consideration to estimate the breeding value of that character for that individual.

→ It is aka performance testing b/c individuals ~~on~~ own performance is taken as a measure of the breeding value.

→ Individual selection is done for highly heritable traits ($h^2 \uparrow$) eg. Growth traits, Body conformation traits.

→ ~~Individual~~ Mass selection is done for microbes, plants

Limitation

→ Individual selection is not done for sex limited traits and for carcass traits, and late expressed traits or traits which express (4) after sexual maturity / after death of individuals, and for traits have low heritability.

→ This method is mainly used in animal fairs for trading of animals ~~and~~ when other info. about pedigree are not available, hence it is a k/a Show ring test.

→ When individual's recording is not visible and individuals are kept in mass, then the whole ~~fa~~ colony or group is selected as a unit then it is a k/a mass selection.

The individuals can be selected either on basis of single records or on the basis of mean measurement of several records.

$h^2 \rightarrow$ Heritability

r_{AP} $\sqrt{\frac{nh^2}{1+(n-1)r}}$

Not more imp.

Accordingly of 2 procedures of Individual Selection are discussed separately.

1. Individual Selection based on single record :- The accuracy of this type of Individual Selection is the correlation b/w the individual's breeding value (A) and its phenotypic value (P) which is (h).

$\rightarrow$ Repeatability

$$h = r_{AP}$$

$\hookrightarrow$ Square root of heritability

Hence, The selection on basis of individuality is more imp. while the heritability of trait is high. When heritability is low many mistakes will be made by this selection.

2. Individual Selection based on mean of several records :- When more than one observation of character is available for each individual, it is advantageous to base selection on the avg. of these repeated observation rather than a single observation. Accuracy of this method of selection is -

$$r_{A\bar{P}} = \sqrt{\frac{nh^2}{1+(n-1)r}}$$

$\bar{P}$ = avg. measurements of n observations

r = repeatability

h^2 = heritability of character.

The efficiency of this type of individual compared to that based on single record is therefore equal to

$$\sqrt{\frac{n}{1+(n-1)r}}$$

$\sqrt{\frac{n}{1+(n-1)r}}$

Page No.
Date

Thus for any given value of n, the efficiency ↑ses with the ↓se of the value of r
Therefore as r ↑ses use of more than one record in selection is not advantageous. As such if the repeatability is high there is no use waiting even for the 2nd record.

The efficiency of selection ↑ses with no. of observation for fixed value of r
∴ More the number of repeated records are used greater will be repeatability ~~the~~ terms of gain per generation.

This method based on n records has also some disadvantages –

(i) Results in ↑sed cost b/c the animal has to be kept till more than one record is available

(ii) ↑ses generation interval and will ↓se the genetic gain per unit of time

The ~~measure~~ major usefulness of repeated observation is for those characters which are strongly influenced by temporary environment effect and cancelled by ~~take~~ taking and which can be observed without much extra cost on diff. ~~occ~~ occassion and without much ↑se in generation interval.

$$\bar{H} + \frac{n\gamma}{1+(n-1)\gamma} \cdot (\bar{P}_i - \bar{H})$$

S.N.

Page No.
Date

Full form in fill in the blank

Most Probable Producing Ability (MPPA)

→ Given by J.L. Lush (1945).

→ It estimates the producing probabality of a female to rank them in a herd when there is difference in no. of records.

$$\boxed{MPPA = \bar{H} + \frac{n\gamma}{1+(n-1)\gamma} \cdot (\bar{P}_i - \bar{H})}$$

$\bar{H}$ = Herd average
n = No. of observations
γ = Repeatability
$\bar{P}_i$ = Avg. of all observations for a particular animal

Imp

(2) Pedigree Selection

Difinition = It is a record of an individual's ancestors that are related through their parents & selection based on such records is k/a Pedigree Selection.

The selection can be based on either info. of one parent or on the basis of mean performance of the two parent or on the mean performance of parents and grandparent or on mean performance of number of generations of ancestors.

* This is most commonly used for early age selection.

High heritability of trait → I.S.

Page No.
Date

- Pedigree selection is beneficial when more closely related ancestors are given more importance and heritability of characters should be high and sufficient, ~~and~~ valid info. about ancestors are given.

Merits

(i) Allows the selection at younger age and provides first hand info.

(ii) Usefull for sex limited traits, Carcass traits, later expressed traits.

(iii) Helpful, when 2 individuals have similar performance but one belongs to a better category.

(a) Selection based on mean record of one parent

Selection based on performance of one parent is half effective as that based on individual's own performance.

50%

(b) Selection based on mean record of 2 parents

This efficiency of this type of selection related to individual selection is close to 70%

70%

(c) Selection based on mean performance of parents and grandparents

71%

In this cond.^n the accuracy ↑ses with the ↑se in the value of heritability and no. of observations but never exceeds 0.71.

71%

Page No.
Date

Limitation

(i) It provides no basis of selection among individuals which are decendents of the same ancestor.
वंशज

(ii) Proper records of all the ancestors have to be maintained; which are not available usually.

(iii) Some Pedigree gal gets undue emphasis and favoured environment which cause biasness in selection.

(d) Selection on the basis of Collateral relatives

Collateral relatives are those that are not related directly to an individual either as ancestor or as their progeny, thus they are individuals
सगे भाई-बहन ← fullsibs, halfsibs, first cousin, double first cousin
↳ (सौतेले) (मैं और विकास) (मैं और टोनी)

The more closely they are related to the indiv. the more valuable is the info. they might supply for selection purposes.

The collateral relatives can be grouped into families which may be of full sib or half sib or more remote relationship
Since the later families are of little practical significance therefore confined our attention only to full and half sib families.

आशीष सिंह शेखावत

Page No.
Date

The info about family mean can be used as a basis for identifying superior genotype.

The family mean can either be computed by including or excluding the individual own performance. When selection is based on family mean in ~~determining~~ which the individual's ~~on~~ own recorded is included, the selection is k/a family selection and when individual own record is not included, the selection based on family mean, is k/a Sib-selection.

Family S :- In this, families are selected or culled on the basis of the avg. phenotypic value of family. In determining family mean, the individual's own contribution is to be included. performance.

In this, the whole family is selected or rejected as an unit. ~~The~~ For the animals which are polytocous, family selection is very much ~~loose~~ used.

This is very usefull when (i) the heritability of character is low.
(ii) Large family size
(iii) little variation due to common environment

Sib S. When the individual is selected on the basis of performance of its sibs. This becomes necessary when character under consideration

C = Common environment

Page No.
Date

either requires destroying the individual in order to measure it (Carcass traits) or it can't be measure on individual that are used to be as parents eg. milk yield in selection of dairy ~~Shise~~ Sire

Full sib S

~~This~~ is more accurate than half sib S. However, half Sib S. is more favoured for following reasons —

(i) Easily available in more numbers than full sib S
(ii) Rate of inbreeding is more in full sibs.
(iii) Full sib Correlation is more likely to be ↑sed by C effects which ↑ses the full sib S accuracy.

★ C effect :- Environment effects which are diff. for different families but same for all the members of a same family are k/a Common environmental effects.

→ Given by Lerner.

* Advantages of family S.

(i) Can improve the characters of low heritability in species with high reproductive rate eg. Pig, fowls
(ii) F.S. doesn't allow generation interval to increase.
(iii) F.S. is a support to I.S. b/c it is better to select an individual from a Superior family

F.S. → Family Selection / I.S. → Individual Selection.

ॐ श्री

Shekhawat

Page No.
Date

Disadvantages of F.S.

(i) Costly of space, particularly when breeding space and testing facilities are limited. limited facilities ↓ses the intensity of S.

(ii) F.S. as an unit of S. results in inbreeding and thus limit the genetic diversity.

☆ Within family Selection

This is the selection criteria when individuals are selected on the basis of their performance expressed as deviation from their family mean. The individuals that exceeds their family mean by a greatest amount are selected, thus it is opposite to family S. b/c family mean is given no ~~weithage~~ weightage.

This Selection criteria is preferred when C-effects are important or when the families differ considerably in environment to which these are exposed, or when a large component of environmental variance is common to all members of family.

The within F.S. is mostly used, where breeding space is limited and rate of inbreeding is to be minimised.
eg. In lab animals & Captive wild animal

Shekhawat Shekhawat

Page No.
Date

In within f.s, each family Contribute to the parent of next generation. When Single pair mating is ~~are~~ made, 2 individuals of each family are selected as replacement of parents.

→ W.F.S. is more practical for full sib family

Combined S.

Procedure of selection, based on the information from 2 or more sources is k/a Combined/ index selection. Since in species with high profecacy such as poultry and swine, full sibs and half sibs are usually available in adequate no. It is usefull to base selection on an index in which info. from ~~there~~ various relatives is combined with indi's own merit.

Imp. This scheme of selection was considered by Osborne (1957).

only define or mcq When the breeding value of an individual is estimated from info. of about diff. relatives, then estimation is statistically the process of multiple regression, represented as

$$[I = b_1P_1 + b_2P_2 + b_3P_3 ----]$$

where b are the weighing factors whose values are to be estimated and P is phenotypic value of selection Criteria. eg. Osborne Index.

Page No.
Date

☆ Osborne Index (Given by Osborne in 1957)

Osborne index is based on combining info. of records of individuals and its family members by giving proper ~~inforo~~ weightage for improving egg production.

This indices were developed for 2 sexes separately as –

$$\begin{cases} I_F = (P-\bar{P}) + W_2(F_D-\bar{P}) + W_3(F_S-\bar{P}) \\ I_m = W_2(F_D-\bar{P}) + W_3(F_S-\bar{P}) \end{cases}$$

P = Phenotypic value of individual
$\bar{P}$ = Population mean
F_D = Dam family avg.
F_S = Shire family avg
W_2 & W_3 = weighing factor

☆ Abplanalp Index

It is also a combined index given by Abplanalp (1974) for the selection of pullets and cockrels.

Exam
Selection on the basis of combined info.

$$I_f = (P-\bar{P}) + W_2(F_D-\bar{P}) + W_3(F_S-\bar{P})$$

S. → Selection
indi → Individual

Page No.
Date

Progeny Testing

The selection criteria for evaluating an indi. based on its progeny performance is k/a progeny selection/ testing. It is most imp. basis of selection. It is aka best basis of selection. [It is said that individuality tells that what it seem to be. The pedigree tells what it ought to be but it is the progeny which tells, actually what it is.] ~~progeny test are very useful in selet selection of trait~~

Only Fillups

imp Progeny tests are very usefull in selection of traits which are expressed only in one sex.

eg. Such as milk production and egg prod^n

→ Even though the bull doesn't produce milk nor does the roaster produce egg but they carry genes for these traits and supply 1/2 of the inheritence to each of their daughter for those particular traits.

ii Progeny tests are also usefull in measuring traits which can't be measured in living individual. eg. Carcass quality in meat animals.

Genetic principle of Progeny testing

(i) It stands on the principle on like begets like.

Shire X Sire ✓

Page No.
Date

(ii) Sampling nature of inheritence

✓ Precautions in Progeny Testing

(i) Adult females should be alloted randomly to all the shires under test to avoid the effect of prod^n level of the dam level on the progeny.

(ii) Diff. shire groups should be raised and compared under similar environmental cond^n (Same nutrition level and management practices).

(iii) The progeny should be born in same season and year as well as should be recorded at same age and or lactation.

(iii) All healthy progeny should be included or excluded those which could not complete lactation either due to their ~~health~~ death or culling during lactation due to disease or abnormal calving.

X (iv) The data recorded should be adjusted or corrected for environmental effects i.e. (age, year, season, lactation length)

(v) More no. of progeny per shire should be recorded to cancel out the randomly distributed sources of error.

Shekhawat

Page No.
Date

Requirements

(i) It is always better that more than required no. of males must be kept for progeny testing so as to have an opportunity of selection among progeny test sires.

(ii) About 4 to 5 males should be progeny tested for each required progeny tested sire for future breeding.

(ii) The facilities should exists for frozen semen and to record info. on progeny.

(iii) The progeny should be tested in several herds & stations, and comparison should be made for contemporaries from other sires, this increases the accuracy.

(iv) No progeny should be culled untill the end of test.

(v) Progeny test should be completed as early as possible in life of males.

Problems

(i) Small population size

(ii) Unplanned mating

- Problem of Small population size can be solved if the sires are tested in different associated herds and the field progeny testing.

This will allow to test more no. of sires and that too in no. of sires in diff. herds with more no. of progeny, this will result in higher accuracy of selection

The unplanned mating results in wastage of breeding data & also the non orthogonality in terms of unequal no. of daughters for diff. sires. It is being found that 5 pregnencies are required to get one replacement daughter, therefore to run a progeny testing programme it is required to get 100 inseminations of 50 pregnancies from each bull to get about 10 daughters to be performance recorded.

major Q: Methodology of Progeny Testing

(i) In order to overcome the problem of pop. size, the progeny testing programme should be carried out in the associated herd or in field.

(ii) About 4-5 males, should be kept under test for each required progeny tested bull for further breeding.

(iii) About 50% pregnancies should be settled from each bull so about 10 daughters of each bull must be performance recorded.

10 daughters → 1000 A.I. → 50 pregnencies

Page No.
Date

(iv) It is better to complete one set of bull within 2 years period.

50 pregnancies → 2 years

In (v) In Each set of bulls, about (8-10 males) should be tested, so that atleast two top ranking bulls are selected on the basis of their breeding value, estimated from their daughter's ~~fer~~ performance.

(vi) Taking a set of 10 males, 02 tested and 8 under test, it will require 500 pregnancies in 02 years.

(vii) Taking into Consideration that only 66% of breeding females will calve each year, 250 pregnancies will be settled in one year from 375 breedable females.

10 ♂ ② ⑧

(viii) Two best proven bulls should be used on about 60 best yielding Cows to get a set of young males for testing in later days and the remaining ♂s which are the son of two best proven bulls of an earlier batch should be used on the remaining cows. It should be kept in mind that no male is to be rekept from the bulls under test.

(ix) The breeding value of bull is based on progen performance is estimated by following formula

$$B.V. = \bar{P}_c + \frac{2nh^2}{4+(n-1)h^2} \cdot (\bar{P}_i - \bar{P}_c)$$

Page No.
Date

$\bar{P}_c$ = Mean of Contemporary (समकालिक) daughter
$\bar{P}_i$ = Mean of its own daughter
h^2 = heritability
n = no. of progeny

$\bar{P}_i$ $\bar{P}_c$

Accuracy of progeny testing

The accuracy of P.T. with about 5 progenies giv as high as that of individual selection for traits of moderate heritability and it is more effective if no. of progeny exceed 5 in number.
Thus P.T. gives a higher accuracy at than any other selection criteria.

Progeny test compared to individual S. is relat more accurate at lower values of heritability. In comparison to family S. the P.T. is almost twice as effective as the selection based on half sib families and about 1.4 ($\sqrt{2}$) times than that based on full sib for any value of h^2.

Fill up

Advantages of P.T.

(i) It is a better method for sex lim low heritable traits and slaughter traits in meat animals.
(ii) It is usefull to prove a sire whethe he is free from any recessive gene.

Index → Indices
Singular form plural form

Page No.
Date

(iii) Main advantage of PT is that it ↑se the selection intensity.
(iv) It is a modified form of family S.

Fill up

Limitation of PT.

(i) The time and cost required is the main
(ii) It ↑ses the generation interval; therefo the genetic gain per year is low.

Imp. Sire Indices

The results of progeny tests are expressed in the form of an index which is the index of the genetic worth of sire and such index is k/a sire index. It is a mathematical expressio of breeding worth of a sire.

Page No.
Date

Multi trait

Methods of Selection

There are 3 methods of multi trait S.

① Tendom Selection

One by One

In this, the selection is practiced for only one trait at a time till the satisfactory improvement is achieved.

After improvement in first trait upto desired level the selection is started for improvement in 2nd trait till the goal is achieved to the desired level and so on.

Adv: In this method, response is rapid as the full attention is given only on one trait

Disa: It requires more time to improvement in all the traits.
If there are negative genetive correlation b/w any 2 traits the improvement achieved in 1st trait would be neutralized by genetic progress made in the 2nd trait.

② Independent Culling level (ICL)

Full form

This method involves selection for 2 or more traits at a time. A min. standard for each trait is fixed and every animal to be selected must met with this min. level for each of trait under consideration.

Page No.
Date

An animal fails to meet the min. standard fixed for any one of the trait will be rejected irrespective of the fact that how good the animal was in other trait. thus an animal is rejected inspite of being exceptionally good in one trait but if it was little poor in another trait. The main disad. of this method is that it doesn't permit superiority in some traits to compensate for a deficiency in other and there is a possibility to cull genetically superior animals.

Apart from this it involves a tedious (थकाऊ) work to determine the optimum culling level.

Imp.

★ The intesity of S. is reduced with ↑se in no. of traits. The intensity of S. for (n) trait is equal to $\frac{1}{\sqrt{n}}$ compared to selection intensity for only one trait.

Fill up

Major Q.

★ ③ Total Score or Selection Index method

→ Selection is practiced for several traits simultaneously in this method.

Each trait is given a particular weightage according to its economic value and animal is given a total score by adding the individual score for each trait

Separation

It involves the tech. of discriminate function test developed by fischer (1936) and first used by Smith (1936) in plant breeding.

Hazel (1943) first used this tech. for anim improvement

In the selection index, multiple regression equations are used to estimate the genetic worth of individua so the aggregate genetic worth of individual is denoted by H.

$$H = a_1 G_1 + a_2 G_2 + \cdots + a_n G_n$$
$$H = \sum_{i=1}^{n} a_i G_i$$

a = relative economic value of trait
G = breeding value of trait

Economic value means, the amount by which the profit is expected to ↑se by each unit change in variable X.

As practically genotypic value can't be estimated for any trait and index value of I is calculated with a assump that it is closely related to the genetic worth of individual.

$$H = \sum a_i f_i = I > \sum b_i f_i$$

(161) 2 tools for genetic improvement of individual or population = Selection & mating System

Page No.
Date

b = regression coefficient or weighing factor for each trait

P = Phenotypic value of the trait

To estimate the partial regression coefficient matrix algebra are used.

ag = bP

$[aG = bP]$ G = Genotypic variance Co variance matrix

$b = P^{-1} aG$ or $\frac{aG}{P}$

P^{-1} = Inverse of Phenotypic Value Variance Co-variance matrix.

The no. of partial regression coefficient = No. of traits taken under consideration

$[I = b_1P_1 + b_2P_2 + b_3P_3 ----]$

I = Total score

Economic Value → Increment in profit occuring from improving the trait by one unit.

Construction of S. index

The following genetic and economic parameters of traits inc

(i) Genetic and phenotypic variance of all trait
(ii) " Covariance among all tr
(iii) Economic value of all traits based on price data and profit.

☆☆ Selection index is the best method of Selection or Total score or discriminant function test.

Page No.
Date

Limitation of S.-Index.

(i) Complicated and Combustion method
(ii) Estimation of relative economic value of traits is very difficult to establish.
(iii) An index constructed for one herd can't be widely applied in general.

Mating

3. types of mating system-

1. Random mating (Panmixia)
2. Mating on the basis of phenotypic resemblence
3. " genetic relation

S.N. 1. Random mating

It is simplest of all mating system. In words of J.L. Lush mating is random when mates are no more and no less alike either as indiv. or in pedigree than if they have been mated by drawing lots form within the groups selected to be parents.

In general words, Any one individual of one sex is equally likely to mat with any ind. of opposite sex. Random matin further assumes that all indi. are equally viable and there is no different fertility. This means that all individual contribute an equal no. of offspring

Page No.
Date

to next generation.

2. Mating on the basis of Phenotypic resemblence

- Given by Crow & Kimura.

(i) ~~Aka~~ ~~phene~~ Assortative mating

- In this, individuals mated, are more similar for some phenotypic trait than if they were choosen ~~at~~ randomly from population

- eg. Mating of (i) white with white
  (ii) Dwarf with Dwarf.

- Major effect of this mating is that it causes ↑se in homozygosity.

(ii) Phenotypic dissortative mating

Mating of individuals which are more dissimilar for some phenotypic trait than they would be mated under assortative mating

eg. white x Black

Consequences of this mating are exactly opposite to phenotypic assortative mating i.e. it ↓ses homozygosity.

→ The mating of unlike is practiced where an ideal is an intermediate or to compensate for defects by choosing contrasting parent each of which compensate for weakness of others. This is why this type of mating is sometimes called compensatory mating.

Page No.
Date

→ Most usefull in holding the population together in whole group and hence for source of germ plasm for later exploitation.

3. Mating O.b.O. genetic relation
2 types

(i) Inbreeding (ii) Outbreeding

(i) Inbreeding

Major Q. Mating of individuals which are related to each other by ancestory. or It is a mating system in which progenies are produced by the parents more closely related than the avg. of population from which they come. It is aka genetic assortative mating.

fill up

2 types

(a) Line breeding (b) Close breeding

(a) Line breeding :- fill up

It is a mild form of inbreeding in which the relationship of an individual or individuals is kept close to some admired or outstanding ancestors in pedigree.

2 types/ways

Page No.
Date

→ Mating of animals which are more distinctly related like Cosine mating.

→ Mating of animals in such a way that their decendents are kept closely related to an outstanding animal.

Definition: The type of inbreeding in which an attempt is made to Concentrate the inheritence of an outstanding ancestor among its decendents.

b. Close breeding

3 types/ways
→ Parent - offspring mating
→ Full sibs mating
→ Half sibs mating

★ Most intensive breeding or mating system of animal

Genetic effects of Inbreeding

Fill up (i) It ↑ses the homozygosity, means the no. of homozygotes are ↑sed at the expenses of heterozygotes.

T/F • Inbreeding doesn't affect the gene fr. but changes the genotype fr. However, the inbreeding has some effect of fluctuation on gene fr. depending

Page No.
Date

~~It~~ upon population size

→ In small population, gene fr. fluctuates more extreme and certain genes may be lost while some are fixed.

In large population, the fluctuation in gene fr. is less extreme and few of allel would be lost.

Very Imp

Due to inbreeding, there is uncovering of recessive traits and due the nature S. against recessive homozygotes, the gene fr. may be change in pop.

Phenotypic effects of Inbreeding

The Inbreeding has adverse effect particularly on fitness traits (Reproduction, Vigour (ताकत) growth traits).

(i) The Inbreeding tends to depress the growth rate in farm animals, however growth rate in some lab species (Rat) is not affected by Inbreeding

(ii) The reproductive efficiency is ↓sed with Inbr in farm animals

(iii) The reproductive efficiency is affected adversley in terms of dely in puberty, testicular development, ↓sed gamete genesis

20 generations
full sib
mating

Page No.
Date

↑se in embryonic loss.

(iii) It results in ↑se in death rate and disease incidence.

(iv) The inbred animals are more susceptible to environment condition and therefore they have less immunity.

(v) The Inbreeding Causes uncovering of genetic defects that's why the fr of genetic disorders and Congenital deformaties ↑sed.

(vi) Due to Inbreeding there is phenotypic uniformity among individuals.

(vii) Inbreeding causes reduction in mean value of trait which is k/a inbreeding depression.

Applications of Inbreeding

(i) Inbreeding is used to test for recessive alleles the sire may have. So it helps to eliminate the undesirable genes.

(ii) It is used to produce distinct families within a breed.

(iii) To develop the inbred lines as a seed stock which can be crossed according to their combining ability.

(iv) Helps ~~in~~ to know the type of gene action. The traits governed by additive gene action don't show inbreeding depression.

(v) It ↑ses the prepotency (ability of an individual

Page No.
Date

to stamp its ~~char~~ characteristics on its progeny).

Prepotency depends upon the homozygosity of dominant genes.

→ Inbreeding depression is the gradual decrease in fitness of individual (fertility, body size) as a result of Tse in recessive genes

Survival rate

Inbreeding is often used b/c of necessicity rather than choice.

Imp. Reduction in mean phenotypic value shown by traits related with reproductive capacity or physiological efficiency as a result of inbreeding, is k/a Inbreeding depression

Since gene fr. don't change in Inbreeding Any change in pop. must be attributed to a change in genotypic fr. Therefore the change of pop mean on Inbreed must be connected with the difference in genotypic value b/w homozygotes & heterozygotes.

The change of mean resulting from Inbreed is ~~2PQdf~~ 2PQdf

F = Inbreeding Coefficient

If there is no dominance (d=0) then there will be no Inbreeding depression

d = degree of dominance
p, q = gene fr. → Mehsana = Murrah X Surti (0.5) Valu
Established breed

The change of mean is greatest when p, q, d is max., As the ↑ level of inbreeding ↑ses

(ii) Outbreeding (Mating b/w unrelated Individuals)

In this mating system, mates are less closely related than the avg. of pop. to which they belong. Aka genetic dissortative mating, which is opposite or Complementary to inbreeding.

4 types

(a.) Outcrossing :- Mating b/w the individuals which are unrelated but of same breed. they don't have Common ancestors upto 4-6 generations)

V.V. Imp: Outcrossing within a herd by use of selected sire is k/a selective breeding. It is the best mating plan to conserve the breed.
→ Widely adopted in domestic animals.

(b) Cross breeding — atleast 1 exotic breed

The mating of animals from different established breeds is k/a Cross breeding

Effects of Outbreeding :-

(i) Effects of outbreeding are generally opposite to inbreeding i.e. it ↑ses heterozygosity which is max. in first generation and goes on

Page No.
Date

↓sing in subsequent generations.

(ii) Due to outbreeding there is no change in gene fr. but there is change in genotype fr.

Uses of Outbreeding

(i) By producers of market animals (pork) b/c by outbreeding breeder can get max. use of heterosis

(ii) Outbreeding is used to combine the desirable char. of 2 or more breeds in their offspring

(iii) It may be used to compansate the deficiency of one of the breed which is excellent.

(iv) It used to establish a broad genetic base for development of a new breed.

S.N.
(c) Grading Up

In this, a pure sire is mated to non-discri. females. The breed of sire should be adaptable to that environment and it is desirable that the area of must be the home tract of that animal.

Fill up → About 6-7 generation of this type of mating produces 2 true breed individuals

→ Performed in India for genetic improvement of non desri.

Non-discriptive animal ⇒ The animal whose breed can't be determined.

The In a pop. of unisex org. every indi. has 2 parents 4 grandparents, 8 great grand parents etc. and there after at (t) - generation where any individual will have 2^t ancestors.

Pairs of mating at random are more closely related to each other in a small pop than in a large one.

Hence, the properties of small pop. can be prepared as the concequences of Inbreeding.
The essential con of 2 individuals having a common ancestor is that they may both carry replicates of one of the genes present in ancestor and if they were mate, they may pass on these replicates to their offspring thus inbred individual may carry 2 genes at a locus which are replicate of one and a some gene in previous generation

Consideration this shows that there are 2 sort source of identity among allelic gene and 2 sources of homozygotes

→ 2 genes that have originated from replication of one single gene in previous generation called identical by descent

36.5 Inbreeding Consequences → Homozygosity ↑ses III

Page No.
Date

→ 2 genes that are not identical are k/a ~~identical~~ independent by descent.
Homozygotes of identical genes are k/a identical homozygotes or ~~protozygotes~~ autozygotes.
Homozygotes having the independent genes are k/a Allozygotes.

It is the production of identical homozygotes that give rise to an ↑se of homozygotes as a Consequence of Inbreeding.

Define Imp.

Identity by descents provides a basis for a measure for dispersive process through the degree of relationship b/w mating pair, the measure is the coefficient of inbreeding, which is probability that the (2) genes (alleles) at any locus in an individual are ident by descents. It refers to an individual and expresses the degree of relationship b/w the individual's parents. It is symbolise by (F).

The degree of relationship expressed in Inbreeding Coeff is essentially a Comparison b/w the pop. in Q. and some specified base pop. Without this point of reference it is meaningless

The 'F' only becomes meaningfull if being it specify sometimes in past beyond which ancestry will not be pursue and at which all genes present in pop. are to be regarded as independent. This point is the base po

'F' at base pop. is '0'

Page No.
Date

Fillup

And it's Inbreeding Coefficient is considered as (zero)

→ The Inbreeding Coefficient of a subsequent generation expresses the amount of the dispersive process that has taken place since the base pop. and compares the degree of relationship b/w the indi. now with that b/w the ind. in the base pop.

→ Base pop. is a hypothetical pop. from which all the lines were derived.

* To reduce the 'F' in successive generation ~~st~~ satisfied with the base pop. and it's progeny constituting gen. 1. The situation may be visualize by thinking of a hermaphrodite marine org. capable of self fertilization shading eggs and sperm into the sea. There are N indi. each shading equal no. of gametes ~~with~~ which unite at random.

cal

All the genes at locus in base pop. have to be regarded as being non-identical. So considering only (1) locus* ~~any~~

icient

* Among the gametes shade by base pop. there are 2N diff. source in equal number.

The gametes of any one source carrying identical genes

Page No.
Date

→ Inbreeding coefficient (F) denotes the probability that 2 alleles at a locus in an individual are identical by descent from a common ancestor.

→ 2 genes are identical by descent if they have identical nucleotide sequences in their segment.

→ The inbreeding level indicates the probability that an animal receives the same allele from both parents b/c they are related. (Or) In other words it indicates the probability that an animal becomes homozygous for an allele that both parents share b/c they have a common ancestor. The inbreeding level of an individual animal is also called the inbreeding coefficient.

The method of calculating the Inbreeding Coefficient of an individual is -

$$F_X = \left\{ \sum \left(\frac{1}{2}\right)^{n+1} \times (1 + F_A) \right\}$$

F_X = Inbreeding coefficient for individual 'X'
n = Number of connecting links b/w the 2 parents of X through common ancestors.
F_A = Inbreeding coefficient of the common ancestor (A)

Relationship	F (Inbreeding Coefficient)
1. Animal mated to its own parent (♂/♀)	0.25
2. Half sib mating	0.125
3. Full sib mating	0.25

A. S. Shekhawat

Shekhawat

Page No.
Date

Coefficient of Relationship

The coefficient of relationship is a measure of the degree of biological relationship b/w 2 individuals. The term Coefficient of relationship was defined by Sewall Wright in 1922.

Relationship	Relationship Coefficient
Identical twins	1
Parent - offspring	0.50
Full sib	0.50
Half Sib	0.25

→ Each ancestor contributes half of its common genes to its descendants.

$$R_{XY} = \sum_{CA=1}^{k} (1/2)^{n_1+n_2}$$

n_1 = Number of paths connecting common ancestors from X
n_2 = Number of paths " " Y

{Inbreeding Coefficient of an individual = $\frac{1}{2}$ Relationship Coefficient b/w parents.}

☆ Currently in India Crossbreeding is discouraged to maintain the purity of indigenous breeds.

(T/F)

Page No.
Date

Imp. Different Crossbreeding System ☆

1. 2 way Cross (Pure breed Cross)

Breed A 100% ↓ Breed B 100%

eg. Poultry

F_1 – (AB ⇒ 50% A & 50% B)

The F_1 Crossbred is used for production only not for breeding

2. 3 Way Cross

Breed A 100% ↓ Breed B 100%

Breed C 100% X AB → 50% A & 50% B

↓

F_2 – ABC

25% A 25% B 50% C

3. 4 way Cross (double Crossing)

Breed A 100% X Breed B 100% ↓ F_1 – AB [50% A, 50% B]

Breed C 100% X Breed D 100% ↓ F_1 – CD [50% C, 50% D]

↓

F_2 – ABCD

[25% A, 25% B, 25% C, 25% D]

(A), (A) → Here, (A) & (B) are the different individuals from same breed. not only a single individual is used for multiple times

(4) 2 way rotational Cross (Criss crossing)

(A) 100%

→ A 50%, 50% B

(B) 100%

(B) 100% — 25% A, 75% B

(A) 100% — 62.5% A, 37.5% B

(B) 100% — 31.2% A, 68.8% B

(A) 100% — 65.6% A, 34.4% B

(B) 100% — 32.8% A, 67.2% B

$\frac{37.5}{20}$ (18.75)

2 | 375
20
175
160
15

Inheritence of immediate size $= \frac{2}{3}$

Inheritence of maternal grand size $= \frac{1}{3}$

18.75
50
68.75

Starting at 50/50%, the rotation stabilises at 65/35% or 35/65%, giving 65% from the last size line used.

(5) 3 way rotational Crossing (Triple or Rotational Crossing)

(i) Inheritence of immediate size $= \frac{4}{7}$

(ii) maternal grand size → $\frac{2}{7}$

(iii) maternal great grand size $= \frac{1}{7}$

A 100%	C 100%	A 100%	B 100%	C 100%	Successive A, B, C .....
B 100%	Crossbreds A 50%, B 50%	Crossbreds A 25, B 25, C 50	Crossbreds A 62.5, B 12.5, C 25	Crossbreed A 31.25, B 56.25, C 12.5	A 15.6, A 28., C 56.2

Holstein Friesian → HF

CCS – HAU :- Chaudhary Charan Singh Haryana Agricultural University

Imp.

MPKV :- Mahatma Phule Krishi Vidyapeeth, Rahuri (MH)

PDC :- Project Directorate on Cattle

Crossbred Cattle in India

1. Taylor ⇒ (Short horned bulla) × (Local Patna Cows)
   (Patna, Bihar) (Allahabad)
2. Jersindh ⇒ Jersey × Red Sindhi
3. Jerthar (Bengal) ⇒ Jersey × Tharparkar
4. ☆ Smandini ⇒ (Brownswiss & Jersey) × Local Cows
   (Kerala) ☆
5. Karanswiss ⇒ Brownswiss × Sahiwal
   (NDRI, Karnal)
6. Karanfries ⇒ H.F. × Tharparkar ☆
   (NDRI, Karnal)
   (5/8 = 62.5) (3/8 = 37.5%)
7. Frieswal ⇒ HF × Sahiwal
   (PDC, Meerut)
8. Phule Triveni ⇒ (HF & Jersey) × Gir
   (MPKV, Rahuri)
9. Vrindavani ⇒ (HF, Jersey & Brownswiss) × Hariana
   (IVRI, Izzatnagar)

Crossbred Sheep in India

♂ ♀

1. Hisardel = Australian Merino (Magra) × Bikaneri ewes (HAU, Hisar)
2. Avikalin = Ramboullet × Malpura (CSWRI, Tonk)
3. Avirastra = Ramboullet × Chokla
4. Avimans (अविमांस) = (Dorset & Suffolk) × (Malpura & Sonadi)

Inbred is pure but pure is not inbred.

Page No.
Date

5. Avishaan = Patanwadi (GJ) x Garole (WB) x Malpura (RJ)

6. Indian Karakul = Karakul x Marwari & Malpura
(ARC, Bikaner)
Arid Region Campus.

(D) Species Hybridization

→ mating of different individual of different species

→ Wildest possible kind of outbreeding

eg. Mule → Jack (गधा) Ass x Mare
Hinny → Stallion x Jennet
★ Pien Niu → Cattle x Yak
Geep → Goat x sheep
Zebroid → Zebra x Mare
Cattalo → Cattle x American Bison (Buffalo)

1. Top Crossing :- Inbred males x Non-inbred female or female of base popul.n

2. Inter sex mating $F_1 \times F_1$

mating of F_1 hybrids among themselves.

3. Incrossing :- Mating b/w inbred lines of same breeds

4. Incrossbreeding :- Mating b/w inbred lines of different breeds.

Page No.
Date

☆ Uses of Outbreeding

(i) To synthesize a new breed/variety/strain
(ii) To take advantage of heterosis

☆ Panmictic Index

$P = 1 - F$

$P_t = \frac{H_t}{H_0}$ → Heterozygote for the t gene
H_0 → Heterozygote for the base population

Heterosis: The complementary to phenomenon of Inbreeding depress it yields opposite, hybrid vigour of heterosis when inbred lines are crossed, the progeny show an ↑se of those characters that previous suffered from inbreeding or heterosis accounts for fitness lost on inbreeding tends to the restored on crossing. Heterosis is an ↑sed vigour of offspring to that death of parents when indinduals are unrelated & crossed

The superiority of outbreds over the avg. of their both parents is called heterosis or hybrid vigour

- The basic principle of heterosis is that when animal differ genetically are crossed then heterosis occurs.
- More is the difference, more will be the heterosis
- The heterosis may be ⊕ or ⊖
- ⊕ heterosis is k/a hybrid vigour.
- Heterosis is opposite/Complementary phenomenon of inbreeding depression.

Dix

Page No.
Date

It is The phenomenon by which crossbred progeny are better then avg. value of 2 pure breds used to produced crossbred progenies.

- The Crossbred progeny exceeds even the better parent in some cases then it is k/a Heterobelteosis.

→ Hybrid rigour acts max. in first generation and then it is half in each subsequent crossing either of parent.

T/F

→ The cause of heterosis like inbreeding depression is non-additive gene action that is dominance, over dominance, epistatis

Imp.

→ No heterosis is observed, governed by additive gene action.

→ Amount of heterosis is ~~estat~~ estimated by following formula-

$$\text{Heterosis \%} = \frac{\text{mean of } F_1 \text{ progeny} - \text{mean of both parent}}{\text{mean of both parent}} \times 100$$

→ Crossbreds have a more efficient metabolic system resulting from normal functioning of many gene pairs in heterozygous individuals.

→ The heterosis in 1st generation $= dy^2$

d = degree of dominance

y = difference in gene fr. of both parental lines.

V.V. Imp.

Page No.
Date

→ In F_2 generation, the heterosis is halved and it is $\frac{1}{2} dy^2$

but in subsequent generations heterosis remain Constant ~~same~~. $\left(\frac{1}{2} dy^2\right)$ after F_2-generation

Thus, heterosis just like Inbreeding depression also depends on dominance or loci without dominance cannot cause neither heterosis nor inbreeding depression

Hence, Heterosis depends upon -
(i) Difference in gene fr. b/w 2 populations or
(ii) Level of dominance. both parental lines
(iii) Heritability of traits (Low heritability → High heterosis) vice versa

If population don't differ in gene fr, there will be no heterosis.
The Heterosis will be greatest when one allele is fixed in one generation and other allele in other population

Conclusion

(i) If some loci are dominant in one direction and some in other, ~~there~~ then their effect tends to cancel out and there is no hete inspite of the dominance of individual loci.

- Thus heterosis depends on directional dominance and Once of heterosis isn't sufficient for concluding that loci show no domin

(ii) The amount of heterosis is specific to each part cross, so diff. pairs of lines will have different value of heterosis

Page No.
Date

(iii) If the lines crossed are highly inbred and so completely homozygous, the differ of gene fr. b/w them can either be 0 or 1 only. The heterosis is then the sum of dominance variance of those loci that have diff. alleles in 2 lines

Complementation

The ability of 2 or more breeds to combine well to produce superior ~~CD~~ crossbreed offspring is k/a breed complementation.

Selection Limit or Selection Plateau

Definition

After continuous selection for many generations the response slowely deminishes and finally ceased ~~siezed~~. Thus, the point of selection at which there is no response to selection is k/a selection plateu and the population is k/a plateued population.

· In large farm animals hardly any economic trait had reached the point where selection response is ~~siezed~~ ceased.

(i) Directional S.
(ii) Stabilising S.
(iii) 2 way/Disruptive S.

Asymmetry of response

In two way selection the response to selection isn't equal in both dirn, this is k/a asymmetry of response

A B C D E Additive variance ← GCA → Line, main effect
A×B A×D A×E SCA → Cross, Interactio
A×C Non-additive g. Verian

Page No.
Date

Diallelic Crossing

When a line is crossed with other line in all possible combinations then it is k/a diallelic crossing. and the mean performance of a line expressed as a deviation from the mean of all crosses then it is k/a general combining ability of line (GCA) It is the avg. value of all F_1's having this line as parent & the value being expressed as a deviation from overall mean of ~~all~~ crosses. Thus GCA stands for a single line

Any particular cross has an expected value which is the sum of GCA of its parent lines. The cross may, however deviates from this expected value to a greater or ~~later~~ ~~sta~~ lower value, this deviation is called Specific combining ability.

Deviation of performance from the sum of GCA of (2) parental lines in a particular cross is k/a specific combining ability of that cross. Thus SCA stands for a particular cross

Fillup GCA or ~~mean~~ main effect and SCA is an interaction

$$X - \bar{X} = GCA_P + GCA_Q + SCA_{PQ}$$

$\bar{X}$ = mean of all crosses

P, Q = 2 lines

X = ~~True~~ True mean of a Cross.

$\bar{X} = 20$	Mean of Cross in which A line is used = 23	$GCA_P = 23 - 20 = 3$ $GCA_Q = 19 - 20 = -1$

→ The differences of GCA are due to additive variances and additive x additive interaction in base population whereas differences of specific combining ability are attributable to the non-additive genetic variance

The variance of GCA ↑ses linearly with Inbreeding Coefficient (F) while the variance of SCA ↑ses high power of 'F'. It is therefore the SCA is expected to ↑se in variance more rapidly as the inbreeding reaches high levels.

- The concept of GCA and SCA was given by Spragug and Tatum (1942).

☆

GCA	SCA
1. It stands for single line.	1. It stands for particular cross.
2. It is main effect.	2. It is an interaction
3. The variance of GCA ↑ses linearly with inbreeding coefficient (F).	3. Variance of SCA ↑ses high power of inbreeding coefficient (F).
4. The differences of GCA are due to additive variance and additive x additive interaction in base population	4. The differences of SCA are due to non-additive genetic variance.

A × T = T × A
♂ ♀ ♂ ♀

Page No.
Date

Selection for improving GCA & SCA

1. Recurrent Selection :- It was proposed by Jerkins (1940) for improving GCA and modified by Hull (1945) to utilize it, for SCA & GCA.

- This method is used in poultry breeding.
- It is a method in which A highly inbred line is selected as tester and a large number of individuals of line under testing, are tested in crosses with tester line known to have good GCA.

- The ♂ & ♀ of the testing population are selected on the basis of the performance of the crossbred ~~family~~ progeny.
- The Crossbred progeny are not mated for breeding.
- The selected individual from source popⁿ are base popⁿ are mated again & again to produce next generation this next generation is again mated with tester and the cycle is repeated for several cycle.

- ~~This~~ It is difficult to maintain the highly inbred lines.

RRS

(2.) Reciprocal Recurrent Selection

Given by Comstock & Robinson & Harvey (1949)

There is no tester line and 2 testing popⁿ or source popⁿ are crossed with each other. The crosses are made reciprocally

Major Q.

RS

A ♂ × T ♀

A ♀ × T ♂

Sample Base population/line

AT (A ♂ & T ♀)
TA (T ♂ & A ♀)

Tester popⁿ (Highly inbred)

F_1 Crossbred discarded after selection of parents

Selection of ♂ on b.o. performance of AT and selection of ♀ o.b.o. performance of TA

Selected A ♂ × Selected A ♀

A ♂ × T ♀

A ♀ × T ♂

Iˢᵗ generation

Next generⁿ

Random mating within popⁿ

AT (A ♂ & T ♀)
TA (T ♂ & A ♀)

Selection of parents

Random mating within popⁿ

Selected A ♂ × Selected A ♀

A ♂ × T ♂

A ♀ × T ♀

IIⁿᵈ generation (Several cycles)

Aishish

RRS

Page No.
Date

A ♂ — B ♂
A ♀ — B ♀

(Sample base hop. A) (Sample base hop

AB (A ♂ & B ♀)
BA (B ♂ & A ♀)

F_1 - progeny (discarded after selection of parent)

Selection of A ♂ A/c to AB & Selection of A ♀ A/c to BA

Selection of B ♂ A/c & Selection of B ♀ A/c

Selected A ♂ x Selected A ♀

A ♂
A ♀

Ist generⁿ

Selected B ♂ x selecte

B ♂
B ♀

Ist generⁿ

AB (A ♂ & B ♀)
BA (B ♂ & A ♀)

F_2 progeny discarded after selection of parents

Selection of A ♂ A/c to AB & Selection of A ♀ o.b.o. BA

Selection of B ♂ A/c to BA & Selection of B ♀ A/c to AB

Selected A ♂ x Selected A ♀

Selected B ♂ x Selec

A ♂
A ♀

IInd generⁿ

B ♂
B ♀

(And so on crossing takes place)

Ashish S. Shekhawat

Page No.
Date

RS	RBS
(i) Continuous requirement to maintain highly inbred ~~time~~ line, whose maintenance is very costly.	(i) No need to maintain inbred line.
(ii) Faster genetic improvement due to more difference in gene fr. b/w sample line and tester line	(ii) Genetic improvement is comparatively slow
(iii) Only one line is improved at a time	(iii) 2 lines can be improved at a time

Nucleus breeding Scheme (NBS) :-

It is a concept to change the breed str. and to ↑se the overall genetic merit of breed at a large scale in developing countries facing the problem of non-availability of proven sire at village level and small population size at organized herd.

It is based on the principle that in each herd there is a small no. of genetically very superior animals which if brought together will form a number whose average genetic merit

Ashish

RRS

Page No.
Date

A ♂ — B ♂
A ♀ — B ♀

(Sample base pop. A) | (Sample base pop. B)

AB (A♂ & B♀)
BA (B♂ & A♀)

F_1 - progeny (discarded after selection of parent)

Selection of A♂ A/c to AB & Selection of A♀ A/c to BA

Selection of B♂ A/c to BA & Selection of B♀ A/c to AB

Selected A♂ x Selected A♀ → A♂ A♀ — Ist generⁿ

Selected B♂ x Selected B♀ → B♂ B♀ — Ist generⁿ

AB (A♂ & B♀)
BA (B♂ & A♀)

F_2 progeny discarded after selection of parents

Selection of A♂ A/c to AB & Selection of A♀ o.b.o. BA

Selection of B♂ A/c to BA & Selection of B♀ A/c to AB

Selected A♂ x Selected A♀ → A♂ A♀ — IInd generⁿ

Selected B♂ x Selected B♀ → B♂ B♀ — 2 generⁿ

(And so on crossing takes place)

Ashish S. Shekhawat

Page No.
Date

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Page No.
Date

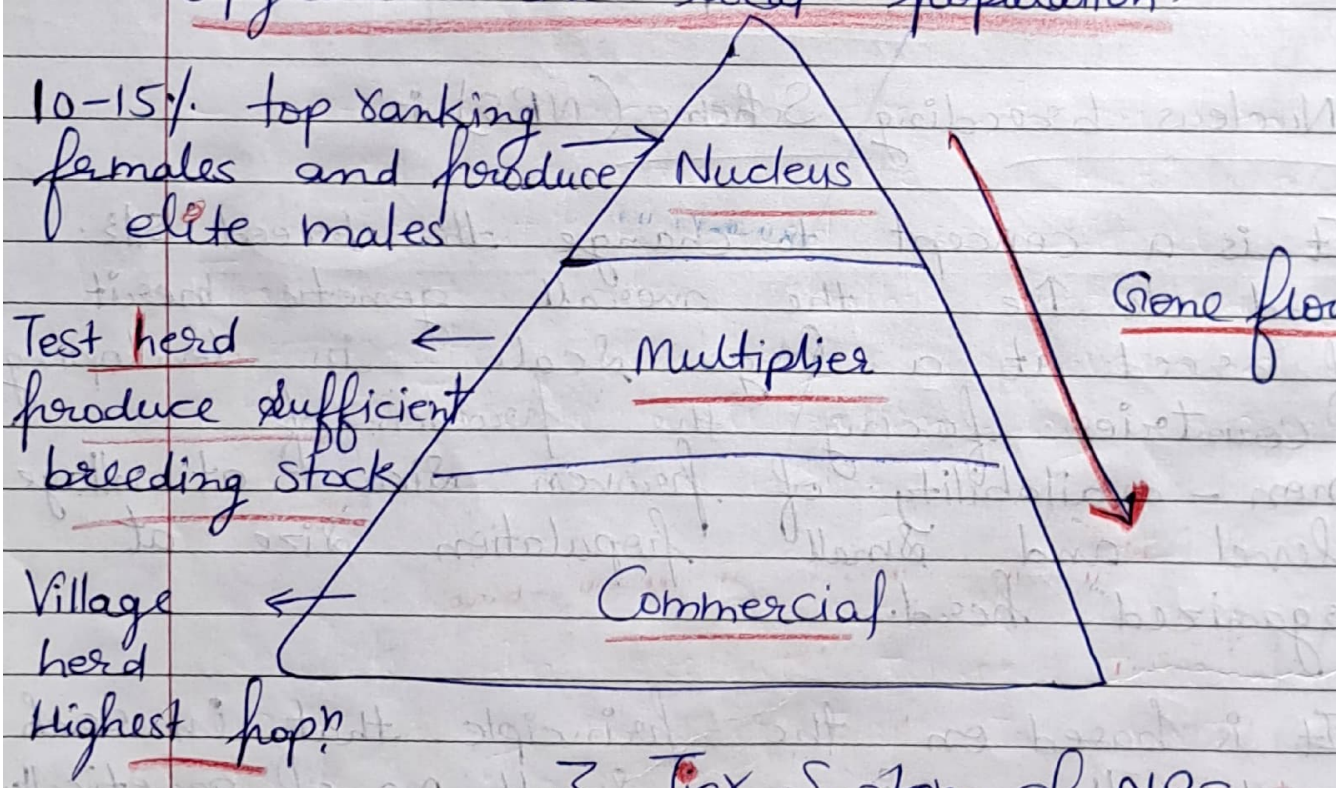
Nucleus Herd :- A herd of elite animals. (10-15% top ranking)

It is used for production of males for breeding in the population.

Selection and mating in the nucleus is under full control.

The nucleus herd breeds its own ♂ & ♀ replacements. ~~and~~

A nucleus herd programme is used to conserve an indigenous breed and to upgrade the local population.



3 Tier System of NBS

↓

Pyramid shape.

Page No.
Date

① Closed - NBS

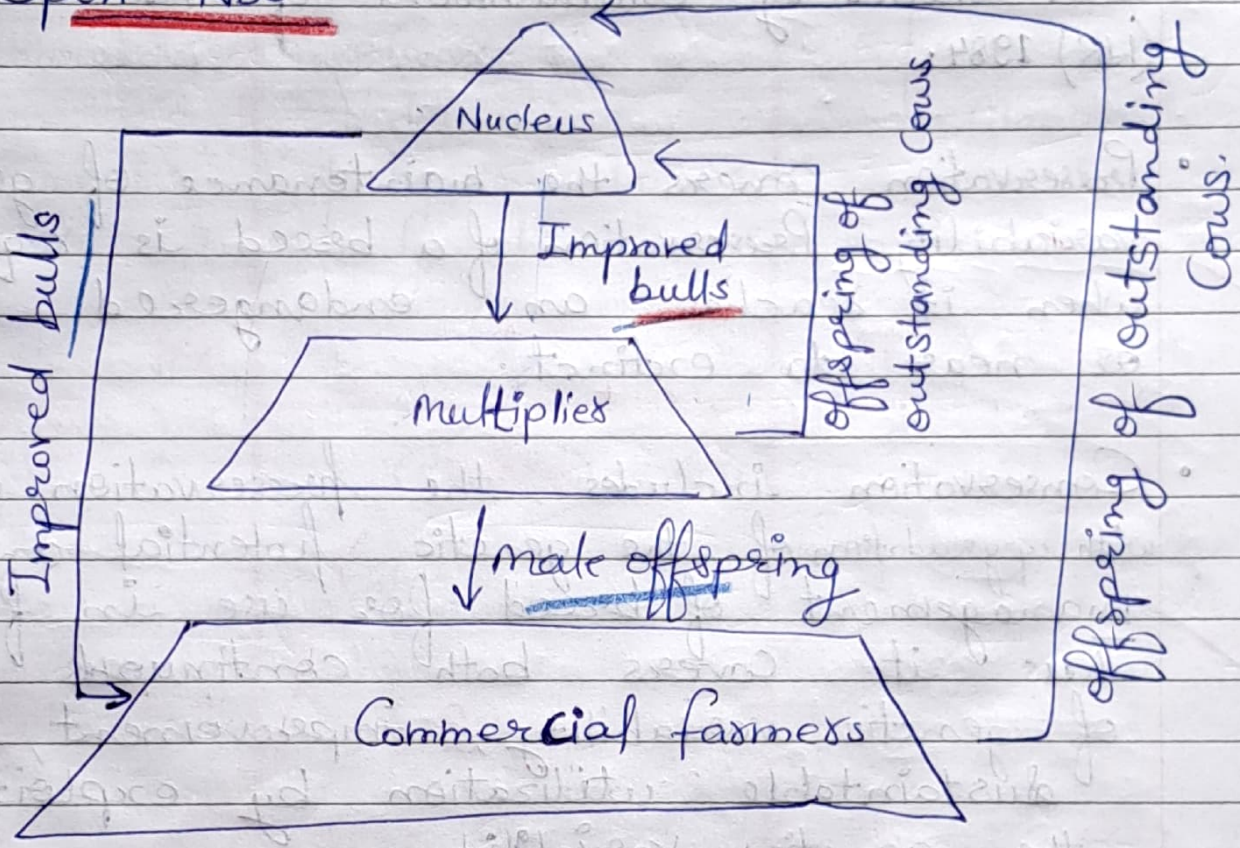
⇒ Unidirectional gene flow
(Nucleus → multiplier → Commercial)

→ Common in pig and poultry

→ chances of Inbreeding (+)

→ Avoids disease entry from outside.

② Open - NBS



Bidirectional Gene flow

ONBS-MOET :-

→ It explore the genetic worth of female.
(more progeny from elite females)

Annual gentic progress in MOET is 4% to 6% higher than classical methods of genetic progress.

Bureau

Page No.
Date

ONBS-MOET

→ ↓ses Generation interval.
→ ↑ses heritability due to controlled environment.

☆ Conservation of Animal Genetic Resources

The technical aspect of conservation of animal breeds which are at the verge of extinction were started by establishment of ~~na~~ NBAGR (HR) 1984.

- Preservation covers the maintenance of genetic variability. Preservation of a breed is required when it reaches an endangered level or near to extinct.

- Conservation includes, the preservation along with upgradation of the genetic potential and management of breed for use in future. Thus it covers both continuous mainten ance of genetic variability & improvement, sustaintable utilization by exploiting the genetic variability.

(OR) The management of biosphere of human use for benefits in present time together with maintaining its potential to meet the future needs.

→ Dilution of breed means impurity in breed.

E → Endangered
C → Critical
V → Vulnerable

A. S. Shekhawat

Page No.
Date

Cattle

E (4)
- Belahi
- Kharihar
- Krishna Valley
- Pullikulam

V
- Mewati, Ponwar
- Punganur, Siri
- Vechur

Not at Risk
- Amritmahal
- Bachur

Buffalo

BV

V
- Chilika
- Toda

Sheep

C
- Tibetan CEV

E
- Karnah
- Katchaikatty Black
- Nilgiri

V (5)
- Gurez
- Jalauni
- Kenderapada
- Poonchi
- Rampur Bushair

Goat

CEV

C
- Teressa

E
- Chegu
- Sumi-Ne

V
- Konkan-Kanyal

Camel

C
- Malvi
- Mewari
- Mewati

E
- Jaisori
- Kharai
- Marwari

Pig

HE

Horse

E
- Bhutia
- Kachchhi-Sindhi
- Manipuri
- Spiti
- Zanskari

PgE

Pig

E
- Agonda Goan
- Tenyi Vo

PV

Poultry

V
- Kalasthi

Page No.
Date

Reasons for decreasing the number of individual in a breed
or Causes of breed dilution

1. Unrestricted interbreeding among the different breeds in rural areas.
2. Unplanned Crossbreeding
3. Some breeds are not economical viable (intake > outcome)
4. Modern techniques in agriculture

Endangered

① Number of breeding ♀ of a breed is main factor to decide the endangered level/status

② A/c FAO (Food and Agricultural Org.), the survival risk of a breed should be studied when breed pop. size reaches 5,000 breedable females and ~~total~~ total pop. of 10,000 female.

Normal → > 10000 female
Insecure → 5K to 10K female
Vulnerable → 1K to 5K female
Endangered → ~~Under 2K~~ 100 to 1000 female
Critical → below 100 female

Needs of Conservation

① Genetic Insurance
All the breeds have developed over 1000 of years and they are adapted to this environment

Page No.
Date

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Needs of Conservation

(1.) Genetic Insurance
All the breeds have developed over 1000 of year and they are adapted to this environment

Page No.
Date

The loss of the breed, means loss of DNA sequences responsible for specific adaptive traits which may be required to introduce in highly productive germplasm evolved through new biotechnology techniques.

As a genetic security the conservation of native breeds for future uses, is required.

(2) The conservation of native breeds provides useful research materials to understand evolution domestication & effects of selection in that area.

(3) Indian breeds are tolerant to high temp. & many tropical diseases, hence to produce F_1 - crossbreeds pure breeds are needed.

(4) Domestic breeds are integral part of our ecosyst. So, to maintain ecological eq. breed should be conserved.

(5) The breed can be preserved for historical importance as they are part of our national heritage & culture

Principles of Conservation

(1) Population Size :- The stock should be maintained at optimum population size.

(2) The stock of conservation should be of pure form & having special traits, for this diverse stock should be selected.

(3) Locally adapted breeds should be maintained in

native envir. and all feeding and envi. Cond.n should be given according to their tradition or habit.

(4) Genetic merit and diversity should be maintained using appropriate breeding programmes

V.V. Imp. ☆ Methods of Conservation of animal genetic resources

1. Insitu :- It is involves the maintenance of live popn. of animals in their adaptive envir.

There are 2 aspects of insitu conservation:-

a. Active - Insitu Conservation is equivalent to breed development through animal breeding programme.

b. Maintenance of live animal popn within their envir. for the breeds which are at risk of loss. → Passive - insitu

- This method is the best for conserving a breed.
- The limiting factor for its implementation is the high cost involved in maintaing large herds or flocks.
- Insitu - conservation can be done at the organised farms under control of govt. or NGO or in the form of farmers ~~herds~~ hubs.
- The organised farm having a nucleus herd of 100 breedable Qs at place can run the selective breeding prog. for improvement

Shekhawat

Page No.

Date

1. Central Cattle Breeding farms

→ 06 CCB in India → under Control of central govt.

eg. ✓ Suratgarh (Shri Ganganagar) → Tharparkar Cattle ✓

✗ Hessarghatta (Bengluru) →

LRS (Nohar) → Rathi

RAJUVAS, Bikaner — Bikaner → Rathi

Chandan (Jaisalmer) → Tharparkar

Navania (udaipur) → Gir

RAJUVAS Jobner ← Jhalawar → Malvi Cattle

② Exsitu Conservation :- When the animals are conserved at a place other than their native areas it is k/a E.S.C.

2 types

(i) Invivo :- Ex-situ Conservation of live animals in small number at a place away from the main breeding tract of breed.

→ This type of Conservation has limitation in terms of popn size to avoid the adverse effect of inbreeding.

→ It is not possible to keep the large herds of breeds which are not economically viable.

→ Inbreeding in small popn is unavoidable and hence genetic defects appears

(ii) In vitro :- Storage of living cells for long period of time, done by deep freezing of sperms, Oocytes, embryo, DNA, Stem cell.

& insitu Consn.

Fill up Quinquennium → 05 years { 1st 5-year prog. → 1951 to 1956 }
Annus → 1 year

Page No.
Date

Chapter (16) Cattle & Buffaloes improvement programme

Tomax

1. After independence, in 1952 Central Council of gau samvardhan (CCG) setup a central coordinating agency for cattle development

(1). Key village Scheme (KVS) was launched → 1951
→ First organized attempt to develop village cattle
→ It involves these selection methods – AI, Grading up, Selective breeding

MCQ (2) Intensive Cattle development Project (ICDP) (1966-67) ✓ Full form
→ 130 ICDP exist.

(3) { Central Gaushalas → Established in 1949
Development Board

Progeny Testing Prog. → in 3rd five year plan (1961-66)
The prog. was first started with Hariana (Cattle) & Murrah breeds at Hisar

In 4th five year plan
For Sahiwal, Red Sindhi, Gir and Surti.

Types
Single herd P.T. Scheme
Associated herd P.T. Scheme
Field P.T. Scheme

CHRS → Central Herd Registration Scheme.

Dystokia
Dystochia

Mega Sheep Seed Project (MSSP)
↓
Ram provide किए जाते हैं

Page No.
Date

* All India Coordinated Research Project (AICRP)
AICRP on Cattle was started at 1968 & now AICRP converted to networking project.

* Networking Project for Cattle ✓
→ Plain areas → Hilly areas → Coastal areas
(HF, Jersey, Brown Swiss) X. Indigenous Cattle breed
[Superior exotic Cattle breed]

☆ → In India exotic inheritence is b/w 50% to 62.5%.

☆ → Crossbreeding has been done in those areas where presence of feed & fodder is abundant

* Networking Project for buffalo

· AICRP for buffaloes (1970-71).

* 1st Military dairy farm was started in 1889 at Allahabad/Prayagraj (UP).

* PDC → CIRC (Meerut)
(Project Directorate on Cattle, Meerut) in 1987

* Anand Milk Producer's union Ltd. → AMUL

* Operation flood :- NDDB in 1969 formulated the (prog. of O.F. for dairy industry development in India)

O.F. Phase 1 1970 – 1980
Phase 2 1981 – 85
Phase 3 1985 – 96

Imp. for Fill UP

RGM → Only for indigenous Cattle breeds

Page No.
Date

Rashtriya Gokul mission is being implemented for development & Conservation of indigenous bovine breeds since Dec. 2014

This Scheme is important in enhancing milk prod.n & productivity of bovine to meet growing demand of milk and making dairy more Remunerative (मानदेय) to rural farmers of country. The Scheme is also Continued under Umbrella Scheme Rashtriya Pashudhan Vikas Yojana.

National Livestock Mission (NLM).

This scheme was launched in 2014-15 by Central govt. It aims towards employment generation, Entrepreneurship development, increase in per animal productivity and thus targeting ↑sed prod.n of meat, goat milk, egg & wool.

Thus it focus on breed development in poultry, goat, sheep & piggery including feed & fodder development.

AICRP → Goat, Pig, Poultry
(at present time)

Page No.
Date

Pet animal :- These are kept for Companionship and enjoyment, not for economic reasons.

Dog Breed → 370 dog breed. (world)

07 Types of dog breeds -

Herding	Hound	Toy	Terrier
↓ Control movement of other animal	↓ Hunting purpose	↓ For amusement	↓ Hunting purpose
eg. ① Germen Shepherd ② Collie ③ Corgi ④ Sheepdog	① Beagle ② Dachsund ③ Blood hound ④ Afgan hound ⑤ Grey hound	① Chihuahua ② Pomeranian ③ Pug	eg. Scottish terrier ①

Working ③ Saint
eg. ① Rottweiller, bernard, ② Great dane

Sporting
eg. ① Labrador ② Golden retriever

Non-sporting
eg. ① Lhasa apso, ② Bulldog, ③ Poodle, ④ Dalmatian

Indian dog breed.

1. Rajapalayam
2. Rampur grey hound
3. Chippiparai
4. Kanni
5. Mudhol hound → 1st indian dog breed introduced to indian army
6. Gaddi kutta (Himalayan Sheepdog)
7. Indian pariah dog
8. Combai
9. Jonagi
10. Pandikona
11. Bhakharwal dog
12. Kaikadi
13. Indian Spitz (Indian Pomeranian)

Page No.
Date

Houses of different Animals

Cattle, Buffalo → Shed/Byre/Barn
Sheep, Goat → Pen
Pig → Sty
Dog → kennel
Horse → Stable
Rabbit → Hutch

Yearling :- Uncastrated bovine b/w 1 to 2 year of age
Gilt :- Female swine that has not had a litter

~~Corona~~

Page No.
Date

Species	Newborn	Act of Parturation	Act of Mating
Goat	kid	kidding	Serving
Sheep	Lamb	Lambing	Tupping
Cattle	Calf	Calving	Serving
Buffalo	Buffalo calf	Calving	Serving
Horse	Foal	Foaling	Covering
Pig	Piglet	Farrowing	Coupling
Camel	Camel calf	Calving	Lakhana

Species	Male	Female	Young one
Cattle	Bull / Ox	Cow	Calf
Goat	Buck	Doe	Kid
Sheep	Ram	Ewe	Lamb
Horse	Stallion	Mare	Foal
Pig	Boar	Sow	Piglet

Veal → Meat of Calf below age of 3 months.
Beef → Cattle
Carabeef → Buffalo
Mutton → Sheep
Cheron → Goat
Vinsen → Deer

Sound Cry of different animals

Cattle & Buffalo → Bellowing
Sheep → Bleating
Goat → Bleating
Pig → Grunting
Horse → Neighing
Dog → Barking

Page No.
Date

1. Total milk production in the country (2023-24) = 239.3 million tonn
- Per capita availability of ~~egg~~ milk is 471 gm/day
- India ranks 1st in the world in terms of total milk production. (UP ranks 1st in India) → RJ = 2nd
  ↳ 25% of total milk production in world.

2. Total egg production in India (2023-24) = 142.77 Billion
- Per capita availability of egg is 103 eggs per annum.
  Andhra pradesh → 1st rank in egg prod.n
- India ranks 9th in the world in terms of total egg production.

3. Total meat production in country (2023-24)
- Per capita availability of meat is 10.25 million tonnes
- India ranks ~~8th~~ 5th in the world in terms of total meat production. WB → 1st rank in meat prod.n

4. Total wool production in India (2023-24) → 33.6 million kg

- Total livestock population = 535.78 million (20th Census, 2019) → 5
- Total Cattle population = 193.46 million (20th Census,
- Total Buffalo population = 109.85 million (21st Cens
- Total Goat population = 148.88 million (20th C.
- Total Sheep population = 74.26 million (20th C.)
- Total Camel population = 2.5 lacs (20th C.)
- Total Horse & Ponies population = 3.4 lacs (20th C.)
- Total Pig population = 9.06 million (20th Census)
- Total Donkey population = 1.2 lacs (20th census)
- Total Yak population = 58,000 (20th Census)
- Total mithun population = 390,000 (20th Census)
- Total poultry population = 851.81 million (20th Cens

13.94 (RJ) million
13.69 (RJ) million
20.48 (RJ) million
7.9 (RJ) million

Goat, Camel, Donkey highest in (RJ)

NAD → Nothing abnormal detected

PM - Report

Species = Bovine Owner's name = Manoj Kumar ~~Maja~~

Age = 5 years Date & time of P.M = 03/07/25

Sex = Female Reported date and time = 03/07/25 } 10:30 AM - 09:00 AM

History

According to the owner of animal the animal was healthy but become suddenly ill and presence of blotting

① External exam

There are presence of wounds on animal body and presence of blotting in rumen. and eyes are opened and pupils are dilated.

② Subcutaneous tissue & musculature

There is no changes in subcutaneous tissue & musculature. There is ⊕nce of Rigor mortis

③ Respiratory System

There is presence of bronchoconstriction and lung's volume have been ↓ed

④ Cardiovascular System

There is ~~clotting~~ Coolling of body b/c of liver mortis and lungs are congested

⑤ Digestive System

There is presence of undigested food in the rumen.

⑥ Urinary System

Kidneys are congested & haemorrhage is ⊕nt

NAD

⑦ There is no change in genital system

⑧ The animal is died due to tympani

Page No.
Date

NBAGR (National Bureau of Animal Genetic Resources), Karna
↓
(212) indigenous animal breeds in India.

	Indigenous Breeds Numbers	
✓Cattle →	53	Central Institute for Research on Cattle (ICA
Buffalo →	20	CIRB, Hisar
Goat →	39	CIRG, Makhdoom, Mathura
Sheep →	45	Central sheep & Wool Research Inst. (CSWRI), Avika agr
Horse & Ponies →	(8)	(National Research Centre on equines) NRCE, HA
Camels →	9	NRCC, Bikaner
Pigs →	14	NRCP, Rani, Guwahati, Assam
Donkeys →	3	NRCE, Hisar
Dogs →	3 ✓	
✓Yaks →	1	NRCY, Dirang, west kameng distt. of Arunachal Pradesh
☆☆ Chickens →	20	DPR or PDP
Ducks →	3	DPR
Geese →	1	

old name → DPR → Directorate of Poultry Research (Hydrabad)
new name → PDP → Project directorate on Poultry

Birds ← CARI (Central Avian Research Inst.), Izzatnagar, Bareli