

SHEEP BREEDING PRACTICE IN INDIA

M.A. Rather¹, S.Shanaz², S.Alam³

¹In-charge Assistant Research Officer, Kralpathri, Department of Sheep Husbandry(J&K).

²Associate Professor, Division of Animal Genetics and Breeding, SKUAST-K. ³Head, Division of Animal Genetics and Breeding, SKUAST-K.

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ABSTRACT

Animal breeding is an age old practice started parallel with human civilization. Different forms of breeding practices were experimented to meet the need of the human beings. Further, India is repository of enormous sheep genetic resources. Therefore, due considerations were required to upgrade and simultaneously conserve the native genetic resources to meet the food needs of vast human population for present and future. Hence, proper attention is paid to livestock breeding practices in India. The present article deals with Sheep Breeding Practice in India for genetic improvement and conservation of sheep genetic resources of country.

Key words: Animal, Sheep, Breeding.

Livestock sector is one of the most dynamic fields of human activity on global level. At present, it is one of the fastest growing agricultural subsectors in developing countries including India where it contributes 4.11% to the Gross Domestic Product (GDP) and plays a significant role in the welfare of rural population (Anonymous. 2012; Islam *et al.*, 2016). It employs a major section of the countries labour force and also provides a large share of draft power being used to cultivate crop land. India's livestock sector is one of the largest in the world with a holding of 11.6% of world livestock population with 512.05 million numbers (Anonymous. 2012; Islam *et al.*, 2016). Besides other domestic animals' sheep breeding is an important enterprise in animal production yielding foods such as meat and milk which are very important for people's nourishment all over the world (Eyduran *et al.*, 2009). Sheep is one of the important species of livestock and contributes

around 12.71% of the total livestock population in India (Anonymous, 2012). It contributes greatly to the agrarian economy, especially in the livelihood of a large proportion of small and marginal farmers and landless labourers (Lalit *et al.*, 2016). The sheep population in India is estimated to be about 65.07 million ranking second in the world (Anonymous, 2012). There are 42 distinct breeds of sheep distributed in various agro climatic zones of the country (Anonymous, 2017). It is well-known that the sheep rearing provides nutritional security and insurance to the farmer at the time of crisis due to crop failure. Therefore, sheep is seen as, "finance elevator" by the countryside poor farmer (Sharif *et al.*, 2011). Two major sources of income; meat and wool make sheep industry a very profitable enterprise. In addition, a rich source of nitrogen, phosphorus and potash present in the droppings of sheep improves the soil fertility. Indian sub-continent is a rich source of diverse ovine germplasm. The

native breeds of sheep of from India are well adapted to geo-physical and agro-climatic conditions. Most of the breeds of sheep in India have evolved through natural selection. Most of the breeds have generally been named after their place of origin and on the basis of prominent characters. This vast ovine biodiversity in India is being eroded rapidly and more than 50% of sheep breeds are currently under threat. Sheep biodiversity in India is characterized by high degree of endemism and variations in agro-climatic conditions of the different regions have led to the development of various breeds/strains (Yadav *et al.*, 2017).

Animal Breeding: Animal breeding is an age old practice started parallel with human civilization. Different forms of breeding practices were experimented to meet the need of the human beings. India was not lagging behind and its ancient civilization paid proper attention to livestock breeding practices (Mishra *et al.*, 2017). This branch of animal science (Animal breeding) addresses the evaluation (using best linear unbiased prediction and other methods) of the genetic value (estimated breeding value, EBV) of livestock. Selecting for breeding animals with superior EBV in growth rate, meat, milk, or wool production, or with other desirable traits has revolutionized livestock production throughout the world. The scientific theory of animal breeding incorporates population genetics, quantitative genetics, statistics, and recently molecular genomics and is based on the pioneering work of Sewall Wright, Jay Lush, and Charles Henderson. Breeding means, the manner in which selected males and females are mated. The breeders identify and select desirable qualities in animals for future mating and discard less desirable qualities. For the improvement of livestock (farm animals) selection and breeding must be practiced simultaneously. Continuous selective breeding leads to homozygosity in a population resulting in loss of variability. If all the individuals are alike, the breeder cannot make progress in future. Hence, there is a need to create variability in population. This can be achieved by breeding. Therefore, selection and breeding go hand in hand for the improvement of livestock.

Objectives of sheep breeding: The main objectives of animal breeding are:

- >Improved growth rate,
- >Increased production of milk, meat, wool, etc.,
- >Production of superior quality of meat, wool, etc.,

- >Improved resistance to various diseases,
- >Increased productive life, and
- >Increased or, at least, acceptable reproduction rate.

> Conservation of breeds and gene pool for future use.

Traits of economic importance in sheep

Mutton and wool are the major products from sheep. In India mutton is more popular than beef and pork. Besides, India is deficient in fine wool and has to import fine wool from abroad to meet the demands with in the country. Thus the traits pertaining to mutation and fine wool production are important under Indian conditions. To produce more mutton and wool in less time, reproduction (Rather. *et al.*, 2020) and milk traits become more important for economic sheep rearing. The traits of economic importance in sheep production system can be classified as: Wool traits, Mutton, Reproduction traits and Milk traits.

1. Wool traits: Wool is a versatile product in demand mainly because of its physical characteristics that directly influence wearer comfort (Hatcher *et al.*, 2010). Wool is the textile fiber obtained from sheep and other animals. Wool can account for as much as a 20 percent of the total gross income. Of all the economically important traits in sheep, those related to wool are the easiest to improve. Generally, wool traits are highly heritable (Safari *et al.*, 2005) and easy to measure. Traits that most directly influence the value of a fleece include fleece weight, fiber diameter, and length of staple. Weight of the fleece, particularly clean fleece weight, is usually the most valuable trait. Some of important wool traits include:

Fleece weight: Wool straight off a sheep, known as "greasy wool" or "wool in the grease", contains a high level of valuable lanolin, as well as dirt, dead skin, sweat residue, pesticide, and vegetable matter.

Wrinkled skin: Fine wool breeds have tendency towards skin. The trait was once believed to have positive correlation with high wool production. However, it was recently proved that wrinkled sheep produce wool with dirt and grease. On the contrary, wrinkly types have shorter staple length, less uniform fibre diameter in different areas of body. In addition, sharing is difficult, lambs are susceptible to infections and fly strikes, ewes are susceptible to dystocia.

Face covering: Extreme face covering is undesirable. This covers eyes and cause wool

blindness. This trait bears negative correlation with litter size, weaning weight and feeding ability.

Fiber diameter (FD): Fiber diameter (FD) refers to the average width of a single cross section of wool fiber (Holman and Malau-Aduli. 2012). FD is widely established as the most important wool trait when assessing wool quality and cost (Rowe, 2010) accounting for approximately 75% of the total price of raw wool (Mortimer *et al.*, 2010). FD value is an indicator of the fineness with which a yarn can be spun. It is influenced by the amount of wool that can move through the processing machinery at any given time. Accordingly, low FD wools (or finer wools) can be processed into yarns which are rightly suited for high value apparel textile end uses (Warn *et al.*, 2006). Thus, finer wools can produce fabrics of characteristically light weight, soft, with superior handle and drape (Holman and Malau-Aduli. 2012). Paradoxically, coarser wools with high FD values are particularly suited for less luxurious and lower valued uses such as carpeting, outerwear or bedding (Poppi and McLennan, 2010). FD exerts a great influence on post-processing wool value, hence its large influence on overall wool quality (Rowe, 2010). Das *et al.* (2014) and Rather et al. (2019) reported fiber diameter of 20.95 ± 0.07 and $20.41 \pm 0.01 \mu$ in Kashmir Marino sheep, respectively.

Staple length: Staple length is length of group of fibers of any composition, which generally determines its end use i.e. whether it will be used in weaving or knitting. The trait is linked with wool processing performance. The longer wools, generally around 51 mm and above are processed to versatile yarn. Wool fiber staple length is becoming an increasingly important determinant of wool quality and value (Valera *et al.*, 2009). Wool with long SL are commercially more desirable as they tend to be easier to spin, give fewer stoppages and ultimately can form stronger and more even yarns (Holman and Malau-Aduli. 2012).

Density of fleece: Density of fleece is number of fibres per unit area of skin surface.

Medullation percentage: can only be adjudged under a lano-meter; no field-level visual method

Soundness: Healthy and uniform growth of wool on the skin surface

Purity: judged by the absence of hair, kemp, black and dark fibres.

Presence of foreign matter: this is a disqualification in grading of wool. Apart from vegetable matter, fleece may be contaminated

with dust and other matter.

Amount and distribution of yolk: A yellow wool fat "yolk" which accumulates on the wool fibres as a protective layer making the wool more resistant to water and snow, is important in determining the condition of wool.

Colour: The colour of the wool should be white and any deviation from it is regarded as disqualification except for the entire colours which are required for some specific purposes.

2. Growth traits: Body weights at birth, 3, 6, 9, 12, 18 months and fast growth rate from birth to 18 months are important growth traits. Rapid growth rate means lambs grow rapidly reach market weights at younger ages, which generally mean they require a shorter feeding period and have less risk of death loss with improved feed efficiency. Cut ability (the ratio of lean meat to fat), tenderness, juiciness and good flavor are some important carcass traits in sheep.

3 Reproduction traits:

These traits include reproductive efficiency, age at first conception, age at first lambing, inter-lambing period etc (Rather, et al., 2020). Sheep have the potential for multiple births, especially in farm flocks. Measures of reproductive efficiency include age at puberty, age at first fertility, lambing rate, and length of breeding season. Reproduction in sheep is strongly influenced by environment.

Classification of Breeding Systems:

Under the selected breeding system selected males and females are mated. The breeding system can be classified into five different ways depending on their phenotypic and genotypic relations.

The five breeding systems are:

1. Random mating or Panmixia: It is a system of mating in which each male individual has an equal opportunity to mate with the female individual and vice versa. This method is commonly adopted by village flocks (Tomar 2004).

2. Phenotypic assortive mating: In this type of mating animals which are phenotypically alike are allowed to mate among themselves. This is also called "like to like" mating (Tomar 2004).

3. Phenotypic disassortive mating: Here individuals which are phenotypically unlike are allowed to mate. It is also called "unlike to unlike" mating. e.g mating of tall with short individuals (Tomar 2004).

4. Genetic assortive mating: In this system individuals, which are closely related genetically are allowed to mate. This is also known as

inbreeding (Tomar 2004).

5. Genetic disassortive mating: This system is just opposite to the previous system where mating takes place between less closely related individuals (Tomar, 2004). This is also called as out breeding.

Breeding Methods:

The major types of breeding methods practiced are;

Purebred breeding: Mating animals of the same breed for maintaining such breed is referred to as purebred breeding. By "breeding the best to the best", employing a certain degree of inbreeding. The method is practiced to conserve native animal genetic resources (Tomar 2004).

Inbreeding: Inbreeding is the mating of related individuals of the same breed for 4-6 generations and results in some loci bearing alleles that are identical-by-descent (IBD). Identity by descent occurs because alleles from one common ancestor may flow through multiple offspring. When descendants of the common ancestor breed, copies of the same gene can be passed on to their offspring, who is said to be inbred. The proportion of genes that are IBD, typically designated as the coefficient of inbreeding, or F , can be calculated through knowledge of the pedigree or estimated by determining allele frequencies after detection of genetic polymorphisms. In order to estimate F , a base population must be established. Since the number of ancestors in a pedigree increases per generation by $2n$, where n is the number of generations, the pedigree increases exponentially and, eventually, all individuals are related. The base population is made up of founders, animals whose parents are assumed to be unknown and who are, therefore, treated as though they are unrelated and non-inbred (Falconer and Mackay, 1996). Founders contain all the genetic variation available for transmission to their descendants. However, founders selected from a larger population only contain a portion of the genetic variability and heterozygosity in that population, even if the selection is random. Small founder numbers and small family sizes in later generations can cause an increase in homozygosity, including alleles that are IBD or identical-in-state (IIS) (i.e., identical alleles that have not descended from a common ancestor) due to inbreeding and random genetic drift. Random genetic drift is a process used to describe the likelihood an allele is lost by chance, causing a change in gene frequency. Large founder populations and/or

large family sizes tend to maintain genetic diversity and, over time, may actually result in gains in genetic diversity and increased heterozygosity through mutation of common alleles into new unique alleles. Mutation and migration are the only processes to increase genetic diversity within a population (Lacy, 1989). The rate of inbreeding can change based on number of offspring, population size, and mating system, so it is customary to look at the change in inbreeding per generation, ΔF , for a more descriptive view of increased homozygosity. It is important to acknowledge that the quantity F is a probability. The inbreeding coefficient is the probability that for any given locus, two alleles are identical by descent. It is also the percent of the genome that is, on average, IBD. Alleles can also be identical and thereby contribute to homozygosity without inbreeding (IIS) since there are not an infinite number of alleles for any one locus. Therefore, the amount of homozygosity is always greater than F , especially in populations or breeds that started with only a few animals, and for loci with only a small number of alleles.

Depending upon the closeness among mated individuals, inbreeding are of 3 types.

Close inbreeding (mating individuals have relationship above 0.25),

Mild inbreeding (mating of relatives beyond 2nd generation and upto 6th generation),

Line breeding (mating of relatives between 4th-6th generations).

Advantages and disadvantages of inbreeding:

Inbreeding is necessary if we want to develop a pure line in any animal. Inbreeding exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes. But continued inbreeding reduces fertility and even productivity. This is called inbreeding depression. It is outcome of loss of heterozygosity. In this condition, the selected animals of the breeding population should be mated with superior animals of the same breed but unrelated to the breeding population. This often helps in restoring fertility and yield. Inbreeding also leads to lower birth weight, increased post-natal mortality (baby death after birth), poor growth, reproductive disorder and low resistance to diseases. It increases genetic variance between lines and reduces genetic variance within lines.

Out-breeding: It is opposite of inbreeding where unrelated individuals are mated. The breeding individuals have relationship less than the

average relationship of the population. Out-breeding results in increase in heterozygosity and decrease in homozygosity.

Advantages of out-breeding:

1. Out-breeding increases heterozygosity which results in hybrid vigour (increase in weight, faster growth, increased resistance to disease, low mortality).
2. It covers the defects of recessive lethal and semi-lethal genes.
3. It increases genetic variance within lines.

In India following major types of out-breeding are practiced in sheep;

> **Out crossing:** It is the mating of animals within the same breed but having no common ancestors on either side of their pedigree up to 4-6 generations. The offspring of such a cross is called as an outcross. Out-crossing is the best breeding method for animals that are below average in productivity in milk production, growth rate, etc. Sometimes only one outcross helps to overcome inbreeding depression (Tomar, 2004)

> **Crossbreeding:** In cross-breeding superior males of one breed are mated with superior females of another breed (Tomar, 2004). Crossbreeding in India was started during colonial era by East India Company and European missionaries. Military Farms were the first to start systematic crossbreeding work in India. After independence, ICAR has launched several crossbreeding programmes in sheep with the aim to meet out ever growing demand of livestock products (Mishra et al., 2017). Every state has its own cross breeding policy which is agro climatic and breed specific. Crossbreeding of non-descript animals with exotic germplasm has although resulted in increase in production and reproduction potential, but, indiscriminate crossbreeding resulted in breed dilution of valuable indigenous livestock in their native breeding tract. Many new animal breeds have been developed by this strategy. Crossbreeding in sheep for improving wool production was started in 19th century by the East India Company using Cape Merino breed around Poona which produced more wool of superior quality (Anonymous, 1976). In the first decade of 20th century, crossbreeding of indigenous sheep with Romeny Marsh was undertaken both in plains and hilly areas. With the establishment of Indian Council of Agricultural Research (ICAR), research programmes were taken up on sheep development on regional basis, covering almost all the important sheep rearing states. During the Fourth Plan, Indo-Australian (now Central) Sheep Breeding Farm was set up at Hissar with Corriedale breed for production and distribution

of Corriedale stud rams to different states for cross breeding to improve wool and mutton production (Tomar, 2004). Corriedale did not perform well especially with respect to reproduction and survival and was later replaced by Rambouillet. The crossbreeding of Bikaneri ewes with Australian Merino rams at GLF Hissar resulted in development of a new breed 'Hissardale'. Similarly, 'Kasmiri Merino' breed was developed by crossing Gaddi, Bhakrawal and Poonchi ewes with Merino and Rambouillet rams (Table 3). In CSWRI Avikanagar, two new synthetics (Chokla and Nali synthetics) breeds were developed by crossbreeding with Merino and Rambouillet. Three different native breeds (Malpura, Chokla and Jaisalmeri) were also crossed with Rambouillet at CSWRI Avikanagar which brought to a conclusion that exotic breeds can be used for crossbreeding with 50-75% inheritance depending on managerial conditions. As indigenous carpet wool breeds (Chokla, Nali, Bikaneri, Marwari, Jaisalmeri, Malpura, Sonadi, Deccani, Patanwadi and Bellary) have been crossed with exotic fine wool breeds improvement in wool quality and quantity was observed. The three new synthetic mutton strains were developed by crossing of Malpura and Sonadi with Dorset and Suffolk at CSWRI Avikanagar and crossing of Nellore and Mandya breed with Dorset and Suffolk. These were named as Avimaans, Mandya synthetic and Nellore synthetic, respectively. The native breeds of India (Chokla, Nali, Malpura and Sonadi) were crossed with Karakul at Avikanagar for improving pelt production in India. From those crossbred experiments it was revealed that crossing of coarse carpet Indian breeds with Karakul had good potential for pelt production. Along with these, crossbreds are poor to adapt harsh climate, susceptible to tropical diseases and require constant input of good managerial conditions compared to our indigenous livestock genetic resources which are far superior in these aspects. So, even though crossbreeding had initial success but it is necessary to evaluate crossbred animals on large scale basis (Mishra et al., 2017).

> **Controlled Breeding Experiments:** These are carried out using artificial insemination and Multiple Ovulation Embryo Transfer Technology (MOET) (Tomar, 2004).

a. Artificial Insemination (AI): The semen of superior male is collected and injected into the reproductive tract of the selected female by the breeder (Tomar, 2004). The semen can be used immediately or can be frozen for later use. When a ram inseminates ewe naturally approximately

billions of sperms are deposited in the vagina. However, when semen is deposited artificially, considerably fewer sperms are required to achieve conception. Therefore, artificial insemination is very economical. The spread of certain diseases can be controlled by this method.

b. Multiple Ovulation Embryo Transfer Technology (MOET): In this method, hormones (with FSH-like activity) is given to the ewe for inducing follicular maturation and super ovulation instead of one egg, which they usually give per cycle, they produce 6-8 eggs (Tomar, 2004). The ewe is either mated with a best bull or artificially in-seminated. The embryos at 8-32 cell stage are recovered and transferred to surrogate mothers. The genetic mother is available for another super ovulation. MOET has been done in cattle, sheep, rabbits, buffaloes, mares, etc. High milk giving breeds of females and high quality (lean meat with less lipid) meat- giving bulls have been bred successfully to obtain better breed in a short time (Tomar, 2004).

Conclusion and recommendations

Sheep breeding in India is an important and age old practice. The country has vast repository of

sheep genetic resources which are managed to meet present and future requirements of vast human population. Mutton and wool two main products from sheep were improved through crossbreeding during 19th century but at cost of adaptability traits. Therefore, a trend among breeders and animal scientists has arisen to conserve the native sheep genetic resources of country for sustained use. Selective breeding based on individual performance of animal has been practiced for improvement of growth and wool throughout country. Further, reproduction traits have received little importance in selection programmes as compared to growth and wool traits owing to their sex limited nature, low heritability, closer association with fitness traits and late expression. Reproductive efficiency of sheep is among most important factors affecting production rate and generation interval. Therefore, it highly recommended that reproduction traits should be considered while framing sheep breeding programmes. Further, for sustained use of sheep genetic resources all native sheep breed should be conserved and crossbreeding should only be practiced on non-descript sheep populations.

Registered breeds of Sheep:

S.NO	Home Tract	Breed
1	Orissa	Balangir, Ganjam and Kendrapada
2	Karnataka	Hassan , Kenguri, Mandya and Bellary
3	Jammu and Kashmir	Bhakarwal, Changthangi, Gaddi, Gurez, Karnahand Poonchi
4	Sikkim	Bonpala
5	Jharkhand	Chottnagpuri
6	Tamilnadu	Coimbatore, Kilakarsal, Madras Red, Mecheri, Nilgiri, Ramnad White, Tiruchi Black, Chevaadu, Katchaikatty Black and Vembur
7	Andhra Pradesh	Deccani
8	Maharashtra	Deccani
9	Himachal Pradesh	Gaddi, Rampur Bushair
10	West Bengal	Garole
11	Rajasthan	Jaisalmeri , Magra, Malpura , Marwari, Nali, Pugal, Chokla and Sonadi
12	Uttar Pradesh	Muzzafarnagri and Jalauni
	MP	Jalauni
13	Gujarat	Marwari, Patanwadi Patanwadi
14	Uttarakhand	Muzzafarnagri
15	Andhra Pradesh	Nellore
16	Bihar	Shahbadi
17	Arunachal Pradesh	Tibetan

Source: Yadav et al. (2017).

Sheep breeds can be classified on the basis of agro-ecological regions viz:

- >North temperate region
- >North Western arid and semi arid region
- >Southern peninsular region and
- >Eastern region

Breeds of Sheep in different agro-ecological regions in India and their major products

North Temperate	North-Western Arid and Semi Arid	Southern Peninsular	Eastern
Bhakarwal (CW)	Chokla (CW)	Bellary (MCW)	Balangir (MCW)
Changthangi (CW)	Hissardale (AW)	Coimbatore (MCW)	Bonpala (MCW)
Gaddi (CW)	Jaisalmeri (MCW)	Daccani (M)	Chottanagpuri (MCW)
Gurez (CW)	Jalauni (MCW)	Hassan (M)	Ganjam (MCW)
Karnah (AW)	Kheri (MCW)	Kanguri (M)	Garole (M)
Kashmir Merino(AW)	Magra (CW)	Kilakarsal (M)	Tibetan (CW)
Poonchi (CW)	Malpura (MCW)	Madras Red (M)	
Rampur Bushair(CW)	Marwari (MCW)	Mandya (M)	
	Muzaffarnagari(MCW)	Mecheri (M)	
	Nali (CW)	Nellore (M)	
	Patanwadi (CW)	Nilgiri (AW)	
	Pugal (MCW)	Rammand White (M)	
	Sonadi (MCW)	Tiruchy Black (M)	
	Munjal(M)	Vembur (M)	

Source: *Yadav et al.* (2017). Within parenthesis is the major product of the breed. (AW), Apparel wool; (CW), Carpet wool; (MCW), Mutton and Carpet wool; (M), Mutton.

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