

Farm Animal Genetic Resources: Evaluation and Conservation in India

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Present farm animal diversity has evolved together with development of human society since ancient time. The agriculture and food requirements of the society have laid down the basis for the domestication of diversified farm animals and development of specialized populations called breeds and their production systems. This treasury in numbers of breeds of farm animals could be accumulated over the centuries by the judicious selection by human to molding them for specific purposes coupled with natural selection favoring the traits for adaptation to specific geo-climatic conditions. Our country is more privileged to possess large farm animal diversity, considering its vast geographic and ecological regions along with diversified necessity of the farmers of the region. In fact, Indian subcontinent remained as a major hotspot for the domestication of a number of farm animal species including humped cattle, buffalo, goat and red jungle fowl. Today, the country possess 512 million population of 10 livestock species – cattle, buffalo, sheep, goat, pig, horse, donkey, camel, yak and mithun and 729 million poultry distributed over a large range of geographical, ecological and climatic regions. Statistics shows that the country stands second in total livestock population in the world including first in buffalo comprising about half of the buffalo of the world, second in cattle and goat, comprising about one-sixth cattle and goat population of the world, third in sheep and fifth in chicken populations.

Nonetheless, livestock dynamics always keep changing, although immense increase has been seen for a number of farm animal species after Independence, the

overall livestock population decreased by about 3.33% over the previous census during year 2007-2012. Decline was much apparent in cattle (-4.1%), yak (-3.64%), sheep (-9.07%), goat (-3.82%), donkeys (-27.17%), camels (-22.63%), pigs (-7.54%), among different livestock species. In same duration, there is an increase in buffalo (2.3%), Mithun (12.88%), horses and ponies (2.12 %), mules (43.47%) and fowls (12.13%) populations.

Characterisation and evaluation of Farm animals

With the efforts of hundreds of years, a large number of livestock breeds specialized for specific production system has been evolved worldwide, possible with one of the most numbers in Indian subcontinent. At present in India, there are 160 registered indigenous breeds of farm animals - 40 for cattle, 13 for buffalo, 26 for goat, 42 for sheep, 6 for horses and ponies, 9 for camel, 6 for pig, 1 for donkey and 17 for chicken, so far. In recent past, majority of the so far registered livestock breeds have been characterised and also developed all type of physical and genetic database for these breeds. Although, the population recognized as registered breeds does not account even 30 percent of total livestock population of the country, there is still large proportion which is to be characterised, so far. There is a large gap for population under defined breed particularly for cattle (75%), goat (62%) and horses (80%). Among these, 31 breeds of different farm animal species were registered in last ten years only, from different parts, particularly remote of the country. Although, this trend seems increasing in coming years, there are still many more specialized

Table 1. Livestock population and breeds in India and share in world

Species	Population 2012 (million)	% of world population	Breeds	% of world breeds
Cattle	190.9	14.7	40	1.2
Buffalo	108.7	57.2	13	7.3
Goat	135.17	16.7	26	1.9
Sheep	65.07	6.8	42	1.6
Pig	10.29	1.1	6	0.15
Poultry	729.2	4.5	17	0.63

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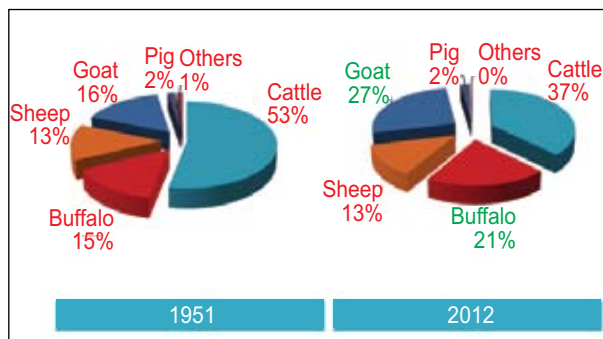


Fig. 1. Proportion of different livestock species in India during year 1951 and 2012

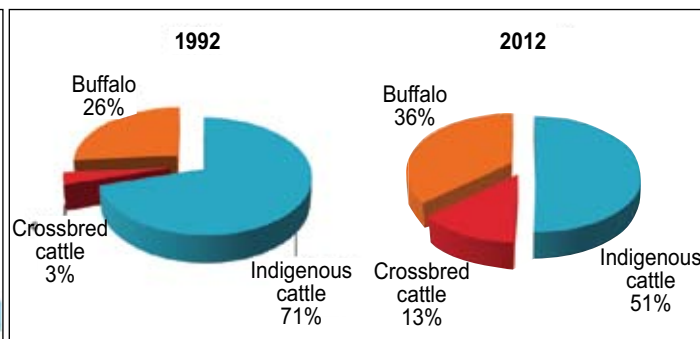


Fig. 2. Pie diagram showing proportion of bovine species in year 1992 and 2012

populations, as having breed potential. Still, the country has at least three to four less number of breeds in every million livestock in world.

Each animal population is specific combinations of alleles forming specific genepool, which serves particular purpose for mankind in their defined geographical region. Similarly, our diverse livestock species with unique characteristics such as sustenance on low quality feed and fodder, better thermo-tolerance and resistance to tropical diseases and parasites may avert the future

concerns arising from climate change. Indian bovines are very well acknowledged for tick resistance, protozoan diseases and parasitic resistance. Sahiwal, Gir, Ongole cattle and most of the best buffalo breeds were imported by many countries of the world for these traits. The Indian native cattle viz. Tharparkar, Rathi, Gir, Nagori, Kankrej etc. can survive in arid agroclimatic region. With changing global climate, these traits are going to be more important for sustainable animal production. Buffalo germplasm is known for high fat rich milk; drought tolerant, adapted to hot-dry climate and excellent draft power. Traits like prolificacy, meat quality, and parasitic resistance are also unique to Indian sheep and goat breeds. Further evaluation of the traits related to adaptation – disease resistance, heat tolerance, better thriving ability is also needed for different indigenous livestock breeds. Most of the information related to these traits and attributes are objectively described in literature, however, quantification of such traits is much required and justified with data. Performance of population in their production environment as well as outside also needs to be compared for complete evaluation of the breed characters. Finally the molecular basis of these traits and specificities should also be explored. Although sporadic research on this aspect is being carried out, more efforts are needed to unravel the genetic basis of thermotolerance, disease resistance, prolificacy and to validate the claims.

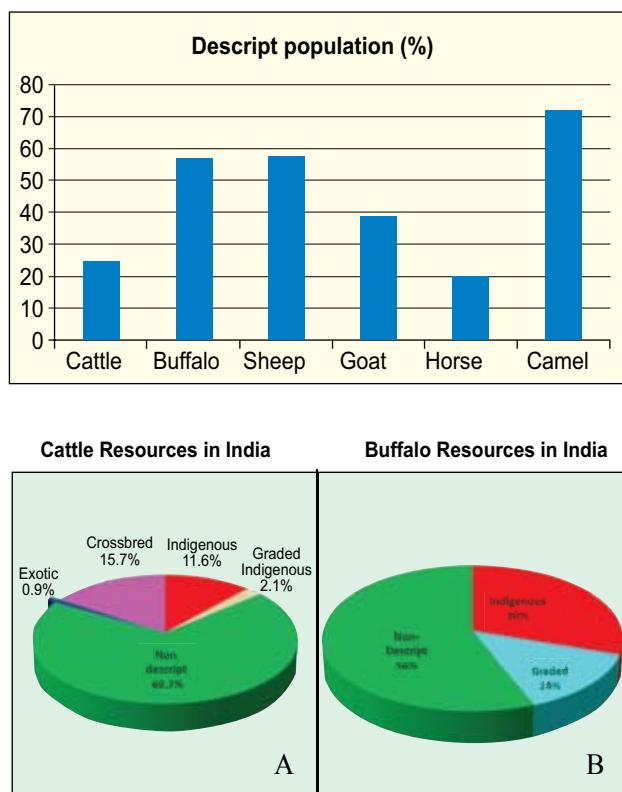


Fig. 3. A) Descript population (in %) of different livestock species, B) Descript and other categories of cattle and buffalo genetic resources of India

Declining Breed Populations – a Cause of Concern

Presently, the population of a number of registered breeds is declining. The cattle in Indian sub continent have been bred to produce males for draught power which was vital for agriculture. Mechanization has replaced animal draught power and low milk yield of our cattle

breeds except Gir, Sahiwal, Tharparkar, Kankrej, etc. put majority of them in risk category. The reasons behind the decrease of most of the indigenous populations vary in general, but most evidently are decreasing utility; increasing pressure for production, low productivity. Consistently high demand with changing production scenario has derived the preference for highly specialized breeds, which has attributed to the loss of genetic diversity of the livestock in general, and of indigenous breeds in particular. Low productivity of indigenous livestock can be adjudged as biggest reason for threatening of a breed, further hampering the conservation efforts as such breeds are not economical as farmers point of view. It is well evident that there is high rate of loss in the indigenous livestock biodiversity in the country. Still, a large number of livestock breeds with unknown population status may be at risk. Serious threat has been observed in indigenous cattle genetic resources, particularly those which are not good milk yielder. More presence of certain exotic cattle breeds-HF, Jersey and their crossbreds, has laid down the foundation of dependency on certain type of breeds only. Likewise, about 22 states have adopted Murrah for crossbreeding of their native buffalo stock. Possibly trend seems worsen in coming years for few of the breeds evolved for drafting.

Causes of Genetic Erosion in Domestic Animals

Three factors are considered as being largely responsible for the declining genetic diversity of livestock:

- Destruction of the native habitats of livestock breeds.
- The development of genetically uniform livestock breeds.
- Farmer and/or consumer preferences for certain varieties and breeds (and changes in these consumer preferences over time).

Among these, commercial interests are considered as the most important pressure on livestock diversity. Important factors in determining the direction and nature of change include: growth performance (productivity), pest and disease resistance, ease of handling, adaptation to current levels of technology, and to a relatively minor extent consumer choice.

Breeds which are Facing Threats

- Most of the draft cattle breeds like Krishna Valley, Nagori, Khillar, Bargur, Amritmahal, Punganur, Ponwar, etc.

- Many of the buffalo breeds like Bhadawari, Toda, Surti are facing threat as Murrah is being used as improver breed throughout the country due to increased demand of liquid milk.
- Due to very little value for the wool from the Indian breeds and scarce grazing resources most of sheep breeds are losing ground. The sheep are being maintained as meat animal but has to compete with goat which are more prolific and have an advantage over sheep for value of meat in large part of country.
- All most all the native breeds of chicken face extinction due to over emphasis on commercial chicken farming.
- The pack animal species like camel, equines, donkey, Yak etc. face threatened due to their very limited utility and changing production systems.

Table 2. Indigenous breeds/populations showing declining trends

Species	Breeds/populations
Cattle	Vechur, Punganur, Krishna Valley, Bargur, Ponwar, Binjharipuri, Red Sindhi, Sahiwal, Tharparkar, Amritmahal, Kasaragode Dwarf, Tarai, Kumauni
Buffalo	Chilika, Toda, Bhadawari, Nili-Ravi, Manda, Kujang
Sheep	Ganjam, Bhakarwal, Gurej, Karnah, Niligiri, Poonchi, Pugal, Magra
Goat	Attapady Black, Chegu, Jamunapari, Beetal, Surti, Changthangi
Camel	Marwari, Mewati, Kutchi, Double humped camel
Horse	Bhutia, Manipuri, Zanaskari, Spiti, Marwari, Kathiawari, Malani
Chicken	All indigenous breeds of poultry except Aseel and Kadaknath

Conservation of Farm Animal Diversity

Realization that animal genetic resources are at risk of being lost has stimulated national livestock conservation efforts. The need for conservation is based on economic, cultural, and ecological values; unique biological characteristics; shifts in market demand; and research needs. A first step in assessing genetic conservation needs is development of baseline information on population and genetic relationships. It is clear that livestock breeds are not biological taxa but rather represent the outcome of social processes. They are therefore unlikely to survive outside the social contexts and production systems that formed them. However, these losses weaken the potential of breeding programmes that could improve hardiness of livestock. Traditional pastoralists have often tended to foster biodiversity, in both plants and animals. Many

pastoral societies have developed elaborate systems that result in the preservation of genetic resources. Pastoralists have deliberately developed livestock to meet different needs and conditions.

Commercial breeds of livestock possess greater genetic variability than most crop varieties do. Diversity allows intensification of selection within breeds to be a fruitful approach for improving livestock productivity. However, if continued emphasis on breed replacement and increasing selection intensity (e.g. for greater productivity) take place at the expense of maintenance of genetic diversity, including the advantages of disease resistance and environmental adaptation, there may be significant long-term costs. As an example, Holstein cattle have become the pre-eminent dairy breed worldwide and have enjoyed sustained improvements in milk production potential, but only at the cost of declining genetic diversity within the breed.

Given the above conditions, there are two areas in which to base conservation efforts. These consist of developing a conservation infrastructure (a public service) and breeder actions (a private-sector activity). Nongovernmental organizations have to play a key role in the conservation of indigenous breeds, and their engagement is likely to continue by assisting breeders with technology transfer. Conservation infrastructure consists of a set of actions taken by the public sector for the public good. These actions include development of cryopreserved germplasm reserves that can be used to regenerate the breed, reduce inbreeding levels, and use molecular genetic tools to evaluate genetic diversity and/or genes of interest. A sufficient quantity of semen and, potentially, embryos should be collected to regenerate the breed if necessary and to relieve potentially high levels of inbreeding.

In situ maintenance of the genetic diversity is the responsibility of the breeders. To aid in conserving indigenous breeds, there is a need to develop market for indigenous breeds that provides breeders with an economic incentive for raising respective breed. Breeder, participation in the breed association provides a linkage for technology transfer and marketing activities.

Some of the biotechnologies offer tremendous potential to address real problems facing farmers in developing countries. For example, the area of genomics, allowing the identification and characterisation of individual genes influencing traits such as disease or stress resistance, growth rate or yield, promises to

be of great value. The genetic material (genomes) of several hundred species, including mammals, plants, fish, bacteria and viruses, has already been sequenced or sequencing is in progress and the information generated from genomics studies in other fields, such as human medicine or basic science, may also be useful for the application of genomics to food and agriculture.

In vivo Conservation Models

- Establishment of nucleus herd in the tract with field agency (ONBS mode).
- Raising of breeding males from elite females.
- Production, processing and cryopreservation of semen from breeding males.
- Registration of farmers' animals and recording for desirable traits by animal keepers.
- Incentive for retaining the animals in shape of feed/mineral mixture/de-worming/vaccination etc.
- Health care and management help.
- Use of elite breeding males in farmer's herds/flocks either by AI or NS.
- Improvement and conservation of various breeds in the field.
- Creation of breed societies to take care of the conservation and improvement of breed/population after the project period.
- Value addition, creation of niche marketing and branding of animal products having specialty of a breed.

With Organized Farm

- Unrelated young male progeny of elite animals from the breeding tract to be procured and maintained at the organized farm.
- A total of 2000 semen doses per male to be produced and 1000 semen doses from each male to be added to NBAGR genebank.
- Utilisation of frozen semen doses in the field through state agencies for breed improvement in the tract.

With Livestock Keepers

- 100 unrelated elite females in the farmer's herds, spread over the breeding tract to be identified and registered.
- Part of the maintenance cost of these elite females to be given to the farmer/stakeholder.

- Minimum of 50 unrelated males to be produced from these elite females.
- Incentive per male to be given to the farmer for raising the male progeny till maturity.
- These males to be used for further breeding in the tract.

Various conservation programmes being executed by the agencies is yielding little of the desired results as these are not able to improve the profits from the uneconomic breeds/species of livestock. Conservation is a long-term activity and the benefits are not generally appreciated by the planners and the masses as one cannot account these benefits in short term foreseeable time. Thus conservation activities have to be undertaken with long-term commitment in form of finances as well as continuity of the programmes. Most of the time the conservation/improvement in livestock resources is compared with plant resources which are entirely different and due to long generation interval and per year gains are very nominal.

Conservation Programmes

A number of programmes are running which are directly or indirectly involved with the indigenous livestock breed conservation. These programmes should give more emphasis to the indigenous livestock breeds and population, covering large number of breeds.

1. Conservation of threatened breeds (endangered breeds of livestock and poultry)
2. All India Coordinated Research projects (cattle, buffalo, sheep, goat, pig and poultry)
3. Network projects (different breeds of livestock and poultry)
4. Mega Seed projects (Sheep and pig)
5. National project for cattle and buffalo breeding (NPCBB)
6. Rashtiya Gokul Mission
7. Registration of livestock and poultry breeds
8. National plan for action of AnGR
9. National Kamdhenu Breeding centre

Factors Affecting Conservation

Indigenous breeds tend to contain high levels of genetic diversity and capabilities to be adapted to specific environments, being especially important in environmentally marginal areas. Developing countries typically rely on landraces for much of their production. They are important genetic resources, representing an insurance policy against uncertain markets and environmental conditions for food and agriculture in the future. Characteristics of the indigenous breeds (low growth rate, lower level of production) imply that the potential for altering gross income is lower than more prevalent breeds under current marketing conditions. However, adaptation to the environment and reproductive performance may alter this situation. Short-term ownership negatively affects breed conservation by creating an unstable situation for maintaining or increasing animal numbers. However, it is doubtful that any effective selection will be implemented; therefore, the population may behave as if it is a randomly mated population, with minimal loss of alleles due to selection. With the relatively small total population size and small individual flock sizes, genetic drift is an important factor affecting within-breed genetic diversity. With the small flock/herd sizes, one should expect random gene frequency changes that are cumulative over generations.

No doubt, the country possess the farm animal germplasm and their diversity as one of the best in the world – the evaluation of their characteristics and assessing true socio-economic importance and values are the responsibility of research institutions and other government agencies concern with. Although, the government for the development of indigenous livestock has initiated a number of programmes, these programmes needs to enlarge its cover to larger number of livestock breeds and populations. Similarly, efforts for conservation of our valuable germplasm in collaboration with government agencies and farmers are also needed to be enhanced – in fact identifying and demonstrating the unique characteristics, assessing economic contribution of indigenous livestock resources would also help in making indigenous farm animal resources more valuable, leading to their sustainable use and conservation.