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Conservation of animal genetic resources in India: The gene bank approach

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Abstract
India being home to a large number of livestock breeds is facing with the risk of extinction of some of the breeds. There is a necessity for proper management of the animal genetic resources. Conservation and improvement of livestock breeds is essential for maintaining the biodiversity and for sustainable production. *Ex situ in vitro* (gene bank) method is one such conservation method. A gene bank is an *ex-situ* (off site) genetic material collection stored over long periods for security of germplasm or for its easy access. For conservation of germplasm in a gene bank, firstly the risk status of all breeds is assessed and after identification of the breeds under risk, they are prioritized for conservation based on their risk status. The different types of germplasm maintained in an animal gene bank are semen, ova, embryo, other types of germinal cells, tissues, DNA etc. Gene banks are an inevitable aspect of conservation programmes. They have wide applicability for breed reconstitution, breed improvement, new breed development and reducing the inbreeding levels etc. Currently in India, several breeds belonging to seven domestic animal species have been conserved at the National Gene Bank, ICAR-NBAGR.

Keywords: Breeds, *ex-situ*, germplasm, gene bank, NBAGR

Introduction
Even though livestock has a huge potential in poverty and hunger alleviation, it still remains underutilized. Also, conservation efforts towards domestic animal genetic resources are inadequate. Due to limited conservation efforts, around 1000 breeds have gone extinct during the past 100 years (FAO, 1993; Chrenek *et al*., 2017) [6, 5]. India is home to a large number of livestock species and breeds and still there are many local populations which have not been registered as breeds. These different breeds have been formed over the centuries owing to the long-term natural selection and evolution. They are better adapted to the agro-climatic conditions of Indian subcontinent, to withstand tropical diseases and low-quality feed and fodder (Chapter VII, Breed improvement and conservation, DAHD, GOI). Conservation of animal genetic diversity is important for evolution and survivability of the species, for developing new breeds as per changing environmental conditions and market needs, and in farm animals, it is necessary for continuous genetic improvement (Saravanan *et al*., 2019; Paiva *et al*., 2016) [12, 11]. It is paradoxical especially with respect to cattle that even though India has large population of cattle, there is a need to conserve some of the breeds because their population size is decreasing. This decrease in population size is a result of inadequate inputs, inter-mixing of breeds leading to breed dilution, indiscriminate use of exotic breeds for cross-breeding, absence of specific conservation strategies and programmes and breed losses due to geographical re-organization (Chapter VII, Breed improvement and conservation, DAHD, GOI).

There are two ways of conserving animal genetic resources viz., *in situ* and *ex situ.* The definition of *in situ* conservation conditions as per Convention on Biological Diversity (1992) is "conditions and natural habitats, and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties", that is maintaining the animals in their native breeding tract. In *ex situ* conservation, the genetic resources are maintained either as live animals (*ex situ - in vivo)* or in the form of animal tissues, cells or any biological material (*ex situ - in vitro)* at a place other than the natural habitat or the breeding tract of the breed or species. As given by Linington and Pritchard (2001) [10], zoological gardens and parks, sperm banks, ova banks and DNA banks are the major animal *ex situ* collections. *Ex situ - in vitro* conservation is usually done a place called the gene bank. As defined by Linington and Pritchard (2001) [10], "a gene bank is an *ex-situ* collection of genetic

material held for long-term security or for ease of access."

Livestock breeds at risk in India

Determining risk status of breeds is important in order to plan their management, conservation and genetic improvement. The degree of risk is mainly assessed based on population size or more precisely the number of breeding animals and the population decline rate. Smaller populations are at a greater risk. Risk status classification of a breed or population as per ICAR-NBAGR is as per the table 1. (ICAR-NBAGR, 2016) [8].

Table 1: Risk status classification of a breed or population as per ICAR-NBAGR

Risk status of a breed	Criteria	
	Cattle, buffalo, sheep, goat, horse and camel, yak and mithun	**Pig and poultry**
Not at risk	• Total population > 20,000, or • Total number of breeding females > 10,000, or • Total number of breeding males > 40	• Total population > 10,000, or • Total number of breeding females > 5,000, or • Total number of breeding males > 40
Vulnerable	• Total population ≤ 20,000 but > 10,000, or • Total number of breeding females ≤ 10,000 but > 5,000, or • Total number of breeding males ≤ 40 but > 20	• Total number of animals ≤ 10,000 but > 5,000, or • Total number of breeding females ≤ 5000 but > 2500, or • Total number of breeding males ≤ 40 or less but > 20
Endangered	• Total population ≤ 10,000 but > 1,000, or • Total number of breeding females ≤ 5,000 but > 500, or • Total number of breeding males ≤ 20 but > 5	• Total number of animals ≤ 5,000 but > 500, or • Total number of breeding females ≤ 2,500 but > 250, or • Total number of breeding males ≤ 20 but > 5
Critical	• Total population ≤ 1,000, or • Total number of breeding females ≤ 500, or • Total number of breeding males ≤ 5	• Total population ≤ 5,00, or • Total number of breeding females ≤ 250, or • Total number of breeding males ≤ 5
Extinct	• There is no breeding males (or stored semen) or no breeding females (or oocytes) or no embryos remaining	

Table 2. gives the different breeds of livestock in India that are facing the risk of extinction (Breed Survey Report, 2013) [1].

Table 2: Livestock breeds at risk in India

Cattle	Vechur, Punganur, Krishna Valley, Pulikulam, Siri, Bargur, Mewati, Ponwar
Buffalo	Bargur, Chilika, Toda, Nagpuri, Banni, Kalahandi, Luit (Swamp), Niliravi, Pandharpuri
Sheep	Bhakarwal, Gurej, Karnah, Poonchi, Changthangi, Rampur Bushair, Tibetan and Bonpala, Muzaffarnagari, Malpura, Chokla, Magra, Pugal, Jaisalmeri, Mandya, Nilgiri, Kilakarisal
Goat	Jamunapari, Beetal, Jakhrana, Surti, Sangamneri, Osmanabadi, Salem black, Malabari and Attappady Black, Ganjam, Chegu and Changthangi
Pig	Doom, Gurrah, Agonda Goan, Nicobari, Tenyi vo
Horse	Manipuri, Bhutia, Kachchi Sindhi, Spiti, Kathiawari, Marwari, Zanskari
Camel	Double humped, Kharai, Malvi, Marwari, Kutchi, Mewari

Prioritization of breeds for conservation

AS per Food and Agricultural Organization (FAO; 2012) of United Nations and National Bureau of Animal Genetic Resources (NBAGR; 2016), India, there are some guidelines for prioritizing the breeds for conservation in cases where a many breeds are assigned to same risk category so as to judiciously and efficiently utilize the economic and infrastructural resources. It is suggested to consider as many breeds as possible for conservation. When prioritizing, first thing to consider is the breed's risk status; a breed that falls under high risk status needs priority for conservation. If two or more breeds are falling under the same risk category, then priority should be given based on genetic diversity (more diversity, higher weightage) and similarly, higher weightage for genetic superiority in economically important traits and unique traits. When faced with selecting a number of breeds for conservation based on varied criteria, ranking must be given to each breed based on the conservation value determined by using index method as explained by FAO (2012). All breeds or populations of livestock categorized under any risk category need urgent conservation steps. A strategic conservation plan needs to be developed and implemented in order to increase the population and prevent further population reduction.

Functioning and application of gene banks

Freezing of genetic materials like semen, ova, embryos, tissues etc., to be used in the future for breeding or population regeneration is cryopreservation genetic resources. The process of cryopreservation of animal genetic resources involves collection, testing, processing and banking of germplasm. As per FAO, 2012, at least one national level gene bank must be present in each country supported by regional gene banks. In India, ICAR-NBAGR, Karnal has been designated as a domestic animal genetic resources repository in 2008 and the first gene bank of the country "National Gene Bank" was established at ICAR-NBAGR. All steps must be in accordance with the prescribed high sanitary requirements and standards (ICAR-NBAGR, 2016) [8]. The cryopreservation capacity of the gene bank must be good enough to store sufficient number of semen doses and embryos along with the storage of other germplasm. Half of each type of germplasm must be kept at the regional gene bank and other half must be transferred to the national gene bank. Only the breeds belonging to the particular region or state must be preserved at the regional bank. Gene banks must be open for transfer of germplasm that is the semen doses and other type of germplasm must be transferred to the field for

use in the field and equal quantity of fresh doses must be replenished (ICAR-NBAGR, 2016) [8].

The primary function of gene banks is conservation of AnGR for use in the medium or long term to provide the possibility of recreating breeds or breeding lines if they are lost as the result of a calamity. A second potential purpose is to support in vivo conservation. Frozen semen and embryos can be used to minimize inbreeding and genetic drift in small managed populations; the combination of live animals and cryopreserved germplasm can be a powerful tool in conservation. Material stored in a gene bank may also serve as a backup that can be used if genetic problems occur. Such as a decrease in effective population size (Ne) which results in inbreeding. A fourth important use of cryo-conserved material is in the development of new lines or breeds, or for quickly modifying or reorienting the evolution or selection of a population. Finally, gene banks can serve as the primary source of material for scientists performing DNA research (ICAR-NBAGR, 2016) [8].

Gene bank for animal genetic resources in India

In India there is only one gene bank for the purpose of conservation of animal genetic resources named National Gene Bank. It was established by National Bureau of Animal Genetic Resources, Karnal, India with the objective to conserve the biodiversity of livestock. It presently holds in total 129174 deep frozen semen doses which are from 311 males of 44 different breeds of livestock belonging to the species, cattle, buffalo, sheep, goat, camel, yak and horse. The details of different breeds of livestock for which the semen has been cryoconserved is given in table 3. (NBAGR: https://nbagr.icar.gov.in/en/gene-bank/)

Table 3: The details of different breeds of livestocks which semen has been cryoconserved at the National Gene Bank.

Cattle	Amritmahal, Dangi, Gangatiri, Gir, Hallikar, Hariana, Kangayam, Kankrej, Kherigarh, Khillar, Krishan Valley, Ongole, Ponwar, Punganur, Rathi, Red Kandhari, Red Sindhi, Sahiwal, Tharparkar, Vechur, Frieswal, Gaolao
Buffalo	Assamese Swamp, Banni, Bhadawari, Jaffarabadi, Murrah, Nilli-Ravi, Pandharpuri, Surti, Tarai, Mehsana, Toda, Nagpuri
Goat	Black Bengal, Chegu, Osmanabadi, Assam Hill
Sheep	Garole
Equine	Marwari, Zanskari, Poitou
Yak	Arunachali
Camel	Jaiselmeri

Conclusion

The efforts that have been taken with respect to cryoconservation of animal genetic resources are very less in India. Many livestock breeds are at the risk of extinction which shall be a huge loss to the nation with respect to its rich biodiversity. Breeds should be selected for conservation based on the principles laid out by the FAO. Exclusive measures must be taken for the conservation with a well-drawn plan including the conservation of live animals and cryoconservation. This should maximize the utilization of resources and minimize the wastage of resources while aiming to conserve as many breeds as possible.

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