Conservation of Animal Genetic Resources **

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Introduction

Biological diversity is fundamental to agriculture and food production. From the millions of genes that serve as life's building blocks to the thousands of plants and animals that inhabit the earth, to almost limitless combinations of organisms that make up natural ecosystems, biodiversity makes an essential contribution for feeding the millions of population of the world.

A rich variety of cultivated plants and domesticated animals serve as the foundation for agricultural biodiversity. Inspite of a large genetic base of animals and plants, human beings depends only on 14 mammal and bird species for 90% of their food supply from animals and four plant species *viz.,* wheat, rice, maize and potato provide half of our food. Modern intensive agriculture has encouraged many farmers to adopt uniform high yielding varieties of plants or breeds of animals. When farming communities abandon diversity, varieties and animal breeds may die out along with their specialized and unique traits. The rapidly diminishing gene pool is serious concern at this point in history due to Climate Change, Urbanisation, Changes in Lifestyles and also the Food Habits and the emergence of new biology, notably Biotechnology and Genetic Engineering.

It has been estimated that about three quarters of the genetic diversity of agricultural crops have been lost over last century. Out of 6300 animal breeds, 1350 are endangered or already in extinction. Since the dawn of human civilization and the birth of agriculture, forest dwellers, fishermen, herders and farmers, have been managing genetic diversity by selecting plants and animals to meet constantly changing environmental conditions and the food requirements of an increasing population.

Biological diversity is a global asset of tremendous value to present and future generations for socio-economic development of mankind. It is unfortunate for all of us

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that overexploitation of bio resources has resulted into great threat to species and ecosystems. Species extinction caused by human activities continues at an alarming rate. Increasing concerns about dwindling biological resources led to international Convention on Biological Diversity which has been signed by 168 countries. Taking into considerations the clauses of CBD, Government of India has brought a legislation referred as Biological Diversity Act 2002 with the objectives of conservation of biological diversity, the sustainable use of its components and fair and equitable sharing of benefits arising out of utilization of genetic resources including animal genetic resources.

Biodiversity encompasses the variety of all life on the earth along with its ecosystem. India is one of the 17 mega Biodiversity countries of the world accounting about 7 to 8 percent of global recorded species. The biological diversity includes wild flora and fauna, marine and aquatic life as well as cultivated crops and domesticated livestock and poultry. Domestic Livestock and poultry are significantly contributing to our national GDP and helping in upliftment of socio-economic status of rural masses and also play an important role in income security and livelihood option for many farmers in rural areas. The livestock sector has shown constant growth rate in last few decades. The domestic animal diversity exhibits tremendous amount of diversity which is reflected in terms of 30 breeds of Cattle, 10 breeds of Buffalo, 42 breeds of sheep 20 breeds of goats, 8 breeds of camel, 6 breeds of horse and 18 breeds of poultry besides several lesser known populations of these species. The changing pattern of Indian agriculture and utility pattern of domestic livestock, many of these breeds are either showing declining trend or at the verge of extinction. Therefore, there is a need to create due awareness among masses for biological diversity in general and domestic animal diversity in particular.

Ethinic diversity

Within this small slice of biodiversity, about 40 species have been domesticated by man for food and agricultural production during last 12,000 years or so. The major share however comes from only 14 livestock and poultry species, which are economically important. In the process of domestication, separate and genetically unique breeds have been evolved under different agro ecological niches to meet the people's requirements.

According to FAO (2002), there have been 6300 breeds of livestock and poultry of which some 4,000 to 5,000 domestic breeds are remaining now. There are still nearly 80 species of their wild relatives, which comprise the world's animal genetic resources important for food. Animal production contributes from 30 to 40 per cent of the total global value of food and agriculture, while their direct contribution is around 19 percent.

Indian sub-continent present a unique and wide spectrum of agroclimatic conditions ranging from humid tropical to semi-arid and temperate to alpine. The cultural and ethnic diversity includes 550 tribal communities of 227 ethnic groups spread over more than 6.2 million villages. Probably due to the anthropogenic and climatic diversity, India has been bestowed with immensely rich domestic livestock diversity besides some of their wild relatives. The spectrum of genetic differences within each breed and across all the breeds within each species, provides the variation and diversity necessary for the survival of animal species. This biodiversity of domesticated livestock and poultry has developed during millions of years of evolution within specific ecological niche, forming and stabilizing each species. The interaction of environmental and human selection has lead to the present biodiversity in domestic animal diversity. India's diverse agro-ecological, regional topography and the preponderance of indigenous tribal population and their ethnic groups have contributed significantly in the diversification of agricultural and animal biodiversity.

Animal genetic diversity is part of the earth's natural heritage. Man started domestication of animals both as companions (pets) as well as for food much before he adopted agrarian practices. During prehistoric times, there are numerous archeological evidences when man used to follow the herd of animals as a pastoralist until many of them settled to agricultural farming. During past 12000 years or so, a wide spectrum of livestock and poultry germplasm has been created through well planned strategies and named them either according to some feature or for location of its main breeding tract. Therefore, the loss of a breed with some unique characteristic is an irreplaceable reduction in the nature's profusion of life forms, which not only contains the set of genes but their interactions with specific environmental condition. The indigenous livestock breeds having some unique genetic characteristics resulting from thousands of years of natural and human selection can not be put at risk of permanent loss.

In India and other developing countries, there are many breeds whose unique genetic qualities are associated with the ability to survive under different set of weather conditions. The loss of such breeds means the loss of specific adaptation traits and the DNA sequences coding for this ability which we may require to introduce in pure bio - technologically evolved productive germplasm.

Animal husbandry scenario in India

Animal husbandry has always been an integral part of Indian civilization and our country possesses rich biodiversity of animal genetic resources which are spread over diverse agro-climatic regions. *In spite* of multiple threats of change, replacement, degradation and extinction this biodiversity of farm animals continue to sustain under varied agro climatic conditions in different regions in India. This mega-diversity is not accidental, nor it is purely natural, rather, it is the outcome of thousands of years of deliberate selection and planned exposure to a range of natural conditions. India is hub to the global domestic animal diversity. Most of these indigenous breeds have been evolved over centuries through the intervention of natural and human forces and are locally adapted to their respective agro-climatic and eco-geographical conditions, prevailing in the respective breeding tracts. This has made Indian livestock breeds very well adapted to harsh and extreme climatic conditions with ability to survive in stress and develop special gene combinations such as resistance to the prevalent tropical diseases and better efficiency to utilize coarse feed and fodder, which generally are not found in high yield producing exotic breeds. Indigenous animal genetic resources are unique in many respects and applications of recent biotechnological tools will unravel secrets of nature with respect to specialty of these animals. Extensive efforts are being intitiated at NBAGR and its several cooperating centres all over the country to characterize and document these diverse genetic resources both at phenotypic and genotypic levels to define their precise population structure.

Role of Indian livestock in the national economy

India possesses the largest livestock population in the world. According to the 2003 census data, the country had the highest number of cattle (185.18 million) and buffaloes (97.92 million), second highest in number of goats (124.36 million), third highest in number of sheep (61.47 million) and fifth highest in number of chicken (489.01 million) in the world. India also harbours population of animal genetic resources such as 10.6 million pig, 1.0 million camel, 2.0 million equines, 0.13 million mithun and 0.04 million yak. Livestock constitutes one of the important sub-sectors of Indian agriculture. Although, the share of GDP from agriculture as a whole has been declining over the years, the contribution of livestock to the GDP increased from less than 5% in 1980 – 81 to over 6% in 1988 – 99 at current prices. According the estimates of the CSO, gross value of output from the livestock sector at current prices was about Rs.1231 billion during 1998 – 99, which was about 24% of agricultural and allied output.

Food security

The development of animal husbandry has been envisaged as an integral part of a sound system diversified agriculture. With its large livestock population, India has vast potential of meeting the growing needs of its under nourished millions particularly in respect of livestock products such as milk, meat, eggs and other livestock products. This sector also provides animal protein an important ingredient of complete food. This becomes more significant in a country like India where great majority of people are vegetarians and are mostly dependent, upon milk and milk products for animal protein. Indian livestock sector plays an important and vital role in providing nutritive food, rich in animal protein to the general public. White revolution, which started with the implementation of "Operation Flood Programme" launched in 1970 under the aegis of the National Dairy Development Board(NDDB), has raised per capital availability of milk to 220g/day, which is not far from the minimum recommended level of 240g/day.

Introduction of exotic breeds and genetic erosion of local breeds:

The discovery of artificial insemination in middle of 20th century opened new ways of improvement. Crossbreeding became a major force in increasing animal productivity. However the process had other side effects, namely the overall reduction of genetic variation in a species. It simultaneously placed some of the breeds with lower productivity at risk. In India a number of programmes were undertaken since early sixties to increase the animal productivity by introducing exotic germplasm either as pure bred or through crossbreeding. But in this process, the preservation of local breeds was adversely affected. Silently and unnoticed the number of animals of the indigenous type conforming to pure animals or true to breed declined. In this way some of the native breeds become threatened, rare and may eventually extinct. In many instances, the process of extinction of a breed occurs without public awareness.

Biotechnology in Characterization of Animal Biodiversity

Genetic uniqueness of populations is measured by the relative genetic distances of such populations from each other. Polymorphisms in gene products such as enzymes, blood group systems and leukocyte antigens which have traditionally been used for measuring genetic distance are being rapidly replaced by polymorphism at the level of DNA, both nuclear and mitochondrial as a source of information for the estimation of genetic distances. The first DNA polymorphism to be used widely for genome characterization and analysis were the restriction fragment length polymorphism (RFLP), which detects variations ranging from gross rearrangements to single base changes.

Complete sequencing of the genome is the ultimate form of genetic characterization. Sequencing has traditionally been expensive and laborious, but with the advent of automated sequencing this is changing rapidly. However, sequencing is unlikely to be used as a technique of choice for genetic characterization. Microsatellite polymorphism may be more suitable when trying to discriminate between closely related populations. Regardless of which method is used, the ultimate goal in genetic characterization for conservation is to obtain a measure of available diversity.

The DNA-based selection where knowledge of which DNA sequences are associated with improvement in a given trait is required and selection is focused on those known DNA"markers" to make genetic improvements in the trait. Recently Biotechnologists have started to identify regions of DNA that influence these production traits. The molecular techniques are now being used to find differences in the sequence of the nucleotide base pairs in these regions. Tests have been developed to identify these subtle differences in the DNA. This has allowed for the development of genetic markers which can be used to identify whether an animal is carrying a segment of DNA that is positively or negatively associated with the trait of interest.

Cryopreservation of gametes, embryos or DNA segments can be quite an effective and safe approach for breeds or strains whose populations are too small to be conserved by any other means. The safety of these methods has been demonstrated by background irradiation studies. For example, studies based on irradiation mouse embryos exposed to the equivalent of hundreds of years of background mutation showed no detectable damage.

Regeneration of offspring following transfer of frozen-thawed embryos has been successful for all major domestic species, except the buffalo. In cattle, the transfer of frozen-thawed embryos is now a commercial practice and embryo survival rate after thawing can be as high as 80% with a pregnancy rate of about 50%. Cryopreseravtion of oocytes followed by successful fertilization and live births have been achieved in the mouse. Cryopreserved bovine oocytes have been successfully matured and fertilised in vitro and zygotes developed to blastocyst stage. These trends strongly suggest that long-term cryopreseravtion of mammalian oocytes is possible. Pregnancy rates of 50-60 % for fresh and frozen-thawed *in vitro* produced embryos have been reported from advanced laboratories. Also, calves have been produced from transfer of both split and frozen-thawed *in vitro* produced embryos in India also.

Development in genetic engineering, cryobiology, cell biology and embryology will provide techniques that may enhance our ability to preserve germplasm *in vitro.*

Techniques such as transfer of DNA within and between species and the production of viable transgenic animals are far from practical application. However, biotechnology will certainly contribute newer and cheaper methods for preservation such as storage of catalogued DNA. At present, other than live animal and embryo preservation, the other techniques do not allow preservation of genomes in a form which can be reactivated *in Toto* at a later stage, but they permit the preservation of individual genes or gene combinations for possible future regeneration.

Conservation of indigenous animal genetic resources should be one of the priority livestock development activities for India. The critical importance of these resources to their owners in developing countries need not be emphasized. Their importance to developed countries is also becoming evident as indicated by the increasing importation of tropical germplasm by these countries. It is highly likely that these resources will become of increasing importance to the industrialized countries either as sources of unique genes or when environmental concerns necessitate change in production systems. Technology for cryopreseravtion of semen and embryo is sufficiently developed to be applied in India. There is also a strong case for support of animal genetic resources conservation.

The impact of transgenic animals on animal breeding will also be limited in the short term as the propagation process of a transgene in a population is relatively slow. The development of transgenic animals will increasingly and most appropriately be driven by the information base being generated by the genomic research.

Despite the present low efficiency and the high cost of the technology, cloning technology could have an impact on the conservation of animal genetic resources is it offers a way to preserve and propagate breeds and or species at risk. The Demonstration of the feasibility in mammals of reversible DNA sequence and rapid follow-up prove that somatic cloning is possible and suggests that the cost of adequate yield sampling for conservation of animal genetic resources may be dramatically reduced, although currently breed re-establishment costs would be high. One practical field sampling protocols are developed for the important farm animal species utilizing skin, milk, blood

samples rather than the more fragile and time consuming semen and embryo collection, somatic cell/tissue conservation of animal genetic resources at risk will be feasible.

Strategy for Conservation of Livestock Bio-diversity

A number of methods have been used for conservation of livestock genetic resources. These include *in-situ* conservation of the breeds/populations; cryopreservation of semen, ova, embryos, skin, blood, DNA fragments etc. These methods are relevant when the breed is rare or near extinction. In India the situation is not so acute as to call for large-scale *ex-situ* conservation efforts. What is, however, necessary is technology evaluation and perfection at selected institutions which can be used whenever and wherever required.

It is recommended that research institutions of ICAR, Agricultural Universities and other research laboratories initiate programs to study and identify valuable adaptive traits at all levels (phenotypic, genotypic, DNA/RNA levels) and locate structural genes / QTLs responsible for these traits. Special emphasis should be laid on resistance to various diseases, resistance to harmful endo- and ecto- parasites, tolerance to large fluctuations in quantity and quality of feed, tolerance to non availability of adequate quantity and quality of drinking water, tolerance to extreme temperature, humidity and other adverse climatic factors, adaptation to low capacity management conditions, ability to survive, regularly reproduce and produce for long periods of time.

The viability of a livestock genetic resources programme is enhanced when it focuses on traits which increase the economic value of the breed to the communities involved. The assumption is that the model of economic value provides for all inputs and outputs from the herd, or flock, over time. A number of approaches have been used to stop or reduce the decline of livestock genetic resources, and these models can be mutually supportive for short and long term insurance. "Wise use" forms a highly desirable form of conservation. The maintenance of a breed in its native environment whose components helped it to sustain also satisfies the requirements of Article 8 of the Convention of Biological Diversity, which gives first priority to *in-situ* conservation. It is

therefore, suggested that "wise use" should form the basis for framing conservation policies.

Management and conservation of animal genetic resources need involvement and support of farmers and groups of people with active support of government agencies, legal coverage and institutional financing. The approach should be need based and measures .taken must not upset the natural environment and Participation of farmers in the conservation programme is very important in order to balance the delicacy of animal biodiversity. However, conservation for the sake of conservation may not be economically viable and sustainable. It has to be integrated with breed improvement programmes in all categories of livestock. Hence, conservation of animal biodiversity, particularly of our domestic animals, should be made as an integral part of the overall national plan of biodiversity conservation.

Vechur Cattle Conservation

Vechur cows are considered the pride of Kerala. The Travancore State Manual of 1940 by T.K. Velu Pillai has a particular mention of Vechur cows. Vechur Cattle were very popular and available in large numbers in Kottayam, Alapuzha and Ernakulam districts about a half a century ago. These cattle are small sized with an average weight of about 135 Kg for cows and 170 Kg for bulls and height below 90 cm. The lightweight strong bulls were commonly used for ploughing the rice fields. The adaptability to the hot humid environment and low feed requirement are some of the good qualities of the cows. However, the farmers preference to the cow had been due to their relatively higher milk yield. The milk of Vechur cattle was considered having high medicinal and was extensively used in the Ayurvedic system of medicine.

An extensive search was made in the home tract as well as in other areas throughout Kerala to find out whether Vechur cattle were available. This was a voluntary work initiated by Dr. Sosamma Iype and her team of environmentally conscious students of the College of Veterinary and Animal Sciences of the Kerala Agricultural University. Veterinarians and the people of Vechur and nearby area actively involved in the "Save Vechur Campaign".

Due to initiative of the KAU and the strong support of the ICAR the valuable Vechur cow has been saved from the jaws of extinction. The first scientific work undertaken was developing a breed descriptor. This resulted in recognition of the breed. This dwarf cow, the smallest in the world today has a place in the latest calendar on Indian breeds of cattle published by National Bureau of Animal Genetic Resources, ICAR. The FAO has also listed the Vechur cattle among the Indian breeds in their Domestic Vechur Conservation Trust initiated by Dr. Sosamma Iype, Former Director, CAS in Animal Genetic Resources and Breeding, Kerala Agricultural University and Dr. P.G. Nair, Former Director, NBAGR, Karnal have take up excellent initiatives in conserving the Vechur through Vechur Conservation Trust with participatory mode played a key role in conserving the Vechur Cattle.

Conclusion:

It is important to document the status of the animal genetic resources with respect to demographic data, geographical distribution, physical conformations of the animals, performance characteristics, socio-economic aspects of breed utilization by the stack holders and the utility of the breed. The priorities for breeds to be conserved should be determined. Certain breeds which are threatened or endangered due to neglect, natural disaster and other factors such as poor productivity, low marketability etc. It is highly essential to prepare a watch list of breeds which are under the categories of endangered and threatened breeds as well as genetically eroded breeds. The extension wing of the Departments of Animal Husbandry in every State should take aggressive extension strategy with the participation of the farmers at local level for conservation of indigenous domestic animal diversity will be an important steps for protecting animal wealth of every State of India. The use of appropriate tools like field recording, cross breeding, different methods like progeny testing etc. and biotechnological methods like artificial insemination, Embryo transfer, Molecular genetics could be exploited for conservation and improvement of domestic animals. The participation - farmers, NGO's and Research and Development organization is the only way for better conservation of domestic Animal Biodiversity.

Some of the scientific and regulatory issues are to be addressed:

- Biodiversity levels in animal genetic resources.
- Impact of introduction of exotic germplasm on domestic animal biodiversity.
- Biosafety concerns of introduction of exotic germplasm.
- Conservation methods and strategies.
- Data base management and documentation of animal genetic resources.
- Regulatory mechanisms for handling of animal biodiversity as per the provisions of Biological Diversity Act, 2002.
- IPR issues related to Animal genetic resource biodiversity.
- Patenting
- Use of Biotechnology and genetic engineering for conservation of domestic animal biodiversity and genetic enhancement.

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