Dairy Cattle and Buffalo Breeding in Sri Lanka: Past Experiences and Current Issues

Prof. Asoka Gunawardena

Senior Professor in Animal Science, University of Ruhuna.

Why is Dairy Industry Important?

The promotion of milk production is one of the most rational options for developing rural areas and the overall economy of the country. Milk provides the most critical nutrients for people and a daily source of income with a relatively low risk for producers. In many instances, the modest cash flow from milk sales has been the only source of daily income that helps the rural poor to purchase their day-to-day essentials. The basal diet for milking animals can be supplied from crop residues and forages which have been mostly underutilised. Another advantage is that increasing milk production in the country will reduce the drain of foreign exchange on the importation of milk products. For all these reasons, the development of milk production has given a top priority in country's development program under the '*Mahinda Chinthanaya*".

Farm Animal Species used for Dairy Production

Milk is secreted by mammals to nourish their young ones, and milk of animals like cattle, buffalo, goat, sheep, camel, yak, llma, etc. *(Kutty & Khamer, 2004)* are being used as food for human beings. Of these animals, cattle and buffalo are reared as dairy animals in Sri Lanka while goat is hardly used for milk production. Dairy industry depends entirely on the ability of animals to produce milk for human consumption. The milk yield of animals varies greatly according to the species, breed and the environment in which they live. The composition of milk does not vary widely as the yield of different species, but the proportions of the constituents vary considerably.

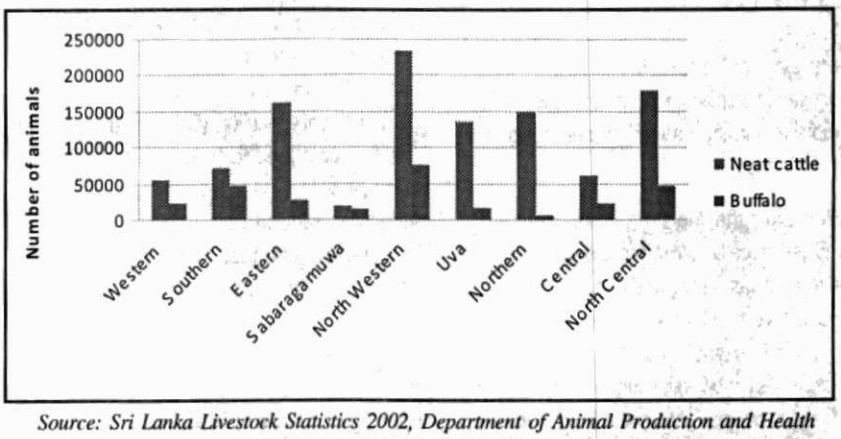
Importance of Animal Breeding for Dairying

Productivity of the animals has to be improved to make dairying a more profitable enterprise and to meet the growing demand for milk. However, milk production being a biological trait regulated by so many factors, the enhancement of productivity is not an easy task. Hence, there should be a continuous effort for the improvement of production potential and productivity of the animals. Production potential of any individual is determined by its genetic make up, and the expression of the genetic potential is regulated by interactions with so many environmental factors. Hence, for improvement of productivity, improvement of genetic make up, physical features of the animals and management situations should go side by side. However, it is important to mention that the genetic make up of the animal decides its maximum production level, and any herd improvement based on genetics of the animal is permanent and will be inherited from generation to generation, though it is a time-consuming exercise. Therefore, a planned, scientific animal breeding program should be given top priority in any dairy development effort in the country.

Distribution of cattle and buffaloes

The data available on cattle and buffalo populations are scanty and discrete. According to the 2007 livestock statistics, the total neat cattle and buffalo populations are 1.2 million and 0.4 million respectively. They are distributed in different agro-climatic regions of the country as shown in Figures 1a, 1b and 1c. The animal population in the country has reduced substantially during the last decade and the trend is continuing at present too.

The pattern of distribution of the national herd among the various parts of the country shows that almost 70 percent of the population is concentrated in the dry zone of the country, but it accounts for about 40 percent of the total milk production. The balance 60 percent comes from the wet zone, including up country and mid country where cross-bred and pure-bred cattle are reared. The buffaloes also contribute around 25 percent to the total collection of milk, which are used for curd production and not for direct consumption as fresh milk or other processed milk. According to the available statistics, the average milk production per animal is less than 1 litre/day and is very poor under any given standard.



Source: Sri Lanka Livestock Statistics 2002, Department of Animal Production and Health

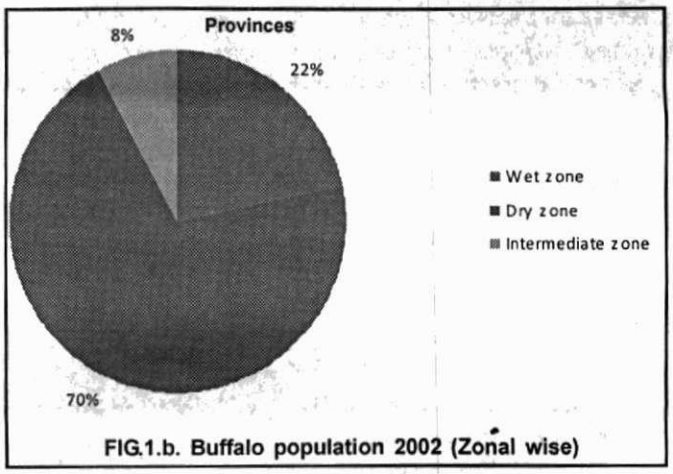


FIG.1.b. Buffalo population 2002 (Zonal wise)

Source: Sri Lanka Livestock Statistics 2002, Department of Animal Production and Health

FIG.1a. Livestock population by province (2002)

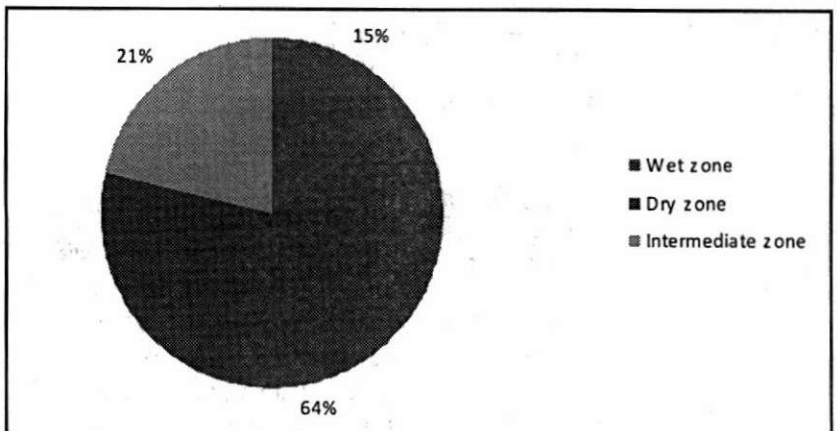


FIG.1.c. Neat cattle populational 2002 (Zonal wise)

Source: Sri Lanka Livestock Statistics 2002, Department of Animal Production and Health

Animal genetic resources

The success of any animal breeding program depends on the availability of genetic resources. Indigenous cattle in Sri Lanka, although well adapted to harsh environments, are poor producers of milk. The improvement of genetic potentials of indigenous cattle through selective breeding is difficult, and therefore, the genetic gains that could be expected would at best be not very significant. Furthermore, their numbers have been drastically reduced due to the genetic improvement programs based on cross breeding carried out in the country. Therefore, conservation of indigenous cattle has become more important than using them for genetic improvement.

However, the indiscriminate breeding of indigenous cattle with Indian and European cattle through AI as well as natural mating during the past have resulted a large number of non-descriptive type cross-bred animals with enormous bio-diversity within the national herd. They are crossed with various European breeds as well as Indian breeds imported to the country from time to time. At present, pure-bred animals are found only in farms of the National Livestock Development Board (NLDB) and Ambewela and New Zealand farms which are managed by the private sector.

In addition to dairy cattle, buffalos also play a very important role in milk production, and they are mainly distributed in dry zone and low country wet zone. There is enough scientific evidence to show that the buffalos are efficient milk producers under tropical climates converting poor-quality feed. (Das Guptha 1975) Furthermore, buffalos produce quality milk with higher processing value and thus better returns for the farmer. Unfortunately, in the breeding programs of the country during the past, the potential of buffalos have not been recognised and genetic improvement carried out in this species has been very limited. The majority of the buffalos are of indigenous type while 10% of the population consists of cross-bred animals of indigenous x Indian origin.

Government Involvement in Cattle Breeding

Government involvement in dairy cattle breeding dates back to1936 with the establishment of Karagoda, Uyangoda and Polonnaruwa farms, and Ridiyagama farm a year later, by the Department of Agriculture (Bandaranayake 1970). The first pure-bred temperate breed farm was established in 1941 at Bopattalawa followed by Ambewela farm in the hill country. However, temperate breeds of cattle known as "Cape" were introduced to the hill country many years before by the European settlers in the plantation sector and were used for upgrading local cattle in the region (Mahadevan 1970). Later, more cattle breeding farms were developed by the Department of Agriculture in the different agro-climatic zones in the country and a range of temperate Europian dairy breeds *(Bos taurus -[AP2])* and Indian Zebu *(Bos indicus[AP3])* breeds were introduced. These farms were established for:

- Serving as nucleus breeding centres to provide improved animals to the livestock farmers in the country.
- Rearing imported exotic animals of European and Indian origin for breeding purposes.
- Upgrading indigenous cattle by cross breeding with exotic breeds.
- Increasing milk production in the country.

During the late 70's, the total number of breeding farms in the country was 21 and were well developed to fulfill the national requirement. Among the dry zone farms, Thamankaduwa complex in Polonnaruwa district was the largest and consisted of four farms with several large units. The total number of animals reared in Thamankaduwa complex alone was around 30,000 heads of cattle and buffalos. These farms reared cattle breeds of Indian origin such as Sindhi, Tharpakar, Kilari, and Buffaloes Surithi , Murrah , Nilliravi. The nucleus herds of these farms were well-managed, and scientifically-selected bulls were used for upgrading animals in the dry zone and other parts of the country. Those programs have had enormous impact on overall dairy development, particularly genetic improvement, which exists today. Unfortunately, the contribution of these farms on livestock development at present is negligible, and the only existing unit of the Thamankaduwa complex has left with few animals, which are also being not used for breeding.

These farms were eventually taken over by the Department of Animal Production and Health (DAPH) in 1978 with the creation of the new department for livestock sector. Few years later, they were handed over to National Livestock Development Board (NLDB) which functions under the same ministry under which the DAPH functions. At present, all the government cattle breeding farms in the country are managed by the NLDB which is responsible for fulfilling the above-mentioned objectives, and the department's activities on breeding are limited to policy making and providing technical support and services to the needy farmer.

In addition to the above agencies, Mahaweli Development Authority of Sri Lanka is also actively involved in dairy cattle breeding in dry zone settlements under their command to a certain extent. They also established many cattle breeding centres in several parts of the Dry Zone in North Central Province and in Uda Walawe scheme in the Hambanthota district. But none of these farms exists today.

Animal Breeding for Increasing Milk Production

The breeding programs for increasing milk production in developed countries have been very successful. They have been favoured by resourceful environments and well-developed infrastructure and markets. However, aspects of developing genetic improvement programs

for tropical conditions are more complex than in favourable climates of the developed countries.

Therefore, the challenge is how to design an efficient breeding program using low productive stock under local conditions where resources are limited and feed availability varies in harsh environments. How could productivity including fitness and adaptive traits be maximised without adversely affecting the environment and diversity needed for the future. Furthermore, such programs must be developed in the context of prevailing cultural and socio economic conditions. Hence animal-breeding programs should be seen in the context of long-term development programs contributing to the production of both more food and other livestock commodities as well as to improve resource utilisation and livelihood of the livestock keepers. Therefore, livestock breeding programs play a very important role in increasing the production and income of the livestock keepers. In Sri Lanka, policies on livestock development have been well documented, but no proper strategies have been implemented to achieve the policy objectives. Though a variety of dairy cattle breeding strategies was proposed (Ranasinghe & Selvaraj 1986) and applied according to the breeding guidelines of the country, none of the implemented programs was evaluated and monitored to ascertain their success and nor are their records available for further references. This has resulted in a highly nondescript population of animals within the country.

Options for the breeder

Practically, a breeder has three different options for increasing milk production by genetic improvement. They are:

1. Replacing local animals with imported exotic animals
2. Selection within the existing animals
3. Genetic improvement through cross breeding.

Importation of animals: The alternative of replacing the indigenous stock with genetically superior exotic stock, particularly of European origins, is not a viable proposition, because of nutritional demands and environmental adaptation problems and the poor management practices adopted by farmers. No country in the world has been successful in increasing its milk production by replacing the indigenous animals by imported animals. The importation of costly exotic animals of European origin for increasing productivity should not be promoted. However, importation of animals for development of nuclease herds for use in future breeding programs may be justifiable since need for genetically-superior breeding animals has become an urgent need at the moment.

Selection from the existing animals: The challenge of increasing milk production in Sri Lanka lies primarily in efficient exploitation of genetic diversity exists among and within the existing dairy cattle and buffalos in the country. The indiscriminate breeding strategies adopted during the past decades have contributed to enormous genetic diversity among the national herd, particularly in neat cattle. Therefore, any future breeding program aimed at genetic improvement of the existing herd should make use of this valuable genetic resource. For this, the most productive and adapted animals for each agro-climatic zone must be identified scientifically for breeding purposes. Only then will it be viable to increase milk production without further expansion of animal numbers with subsequent effect of land degradation and environment pollution. However, the improvement that can be achieved from selection is somewhat slow, and application of cross breeding simultaneously will speed up the process.

Cross breeding for dairy cattle improvement: Crossbreeding will be a simple and quick means of effecting genetic improvement, and this has been a common tool used in our breeding programs during the past. Because of the large population of nondescript zebu type cattle and buffaloes in the dry zone of Sri Lanka, even a minor improvement through cross breeding could bring about a substantial increase in the national milk production (Buvanendran 1975). For that purpose, the optimal and pragmatic approach is cross breeding the existing stock with genetically-superior animals of *Bos taurus*, and *Bos indicus* to a level appropriate and relevant to a particular agro-climatic zone in the country(Buvanendran & Mahadevan 1975). It has to be stressed that such genetic upgrading needs to be accomplished by suitable improvements in nutrition, animal husbandry practices and management. Economic considerations will also have to be borne in mind.

Of the three options, selection within the existing animals combined with cross breeding are the most practical approaches to the present problem faced by the industry. Therefore, long-term, well-planned, flexible breeding strategies designed by experienced animal breeders should be implemented with the participation of the livestock keepers to realise the full potential of the dairy industry in the country.

Why have the past breeding efforts failed?

Many attempts have been made to improve livestock in the country mainly by "upgrading" with temperate and Indian breeds of cattle. Although improved livestock have been produced or introduced into favourable areas of the country, particularly up-country region, the success of those attempts has not been up to the expectation. The reasons for the failures have never been revealed due to absence of any follow up of the past programs. The programs were neither evaluated to ascertain their impact nor completed till the objectives are achieved. However, some common problems attributed to the failures can be summarised as follows:

- A major reason for the failure has been indiscriminate crossbreeding of indigenous breeds with exotic breeds without enough consideration for environmental conditions of production and resource availability.
- The breeding programs have been formulated without considering the infrastructure available and too complicated as regards logistics, technology and requirements of resources.
- Lack of plans on how to maintain a suitable level of "upgrading" or on how to maintain the pure breeds for future use in crossbreeding has contributed to non-sustainability of the breeding programs. High levels of upgrading have generally led to animals with less resistance to diseases and impaired ability to withstand environmental stresses.
- Limited participation of farmers in planning process of breeding programs and poor knowledge of farmers in animal breeding. The government has the sole authority on cattle breeding in the country and the involvement of private breeders does not exist, whereas in developed countries, animal breeding is completely dominated by private breeders associations.
- Lack of proper record keeping system and dissemination of information to evaluate and select genetically-superior animals for future breeding programs of the country. Detail economic assessments of costs and returns are rarely available in the country. The

objectives of the breeding plans have been defined by the breeders, solely in biological terms. Consequently, the testing and selection of animals have not been in consistent with the market, policy and environments of the country.

- The importances of qualified animal breeders and field-level technicians in the country to implement the programs and follow up process have been ignored by the relevant authorities.

Constraints to Dairy Cattle Breeding

Poor knowledge of farmers, lack of qualified animal breeders in the country, misunderstanding of production systems, lack of information on animal genetic resources and the past experiences in cattle breeding, poor extension service, collapse of the government farms causing unavailability of proven animals for breeding, lack of participation of private breeders or associations, lack of field-level research with participation of farmers, choice of erroneous technology and inefficiency of Artificial Insemination program are some of the major issues in dairy industry today. Though we have a well-develop infrastructure and communication system in the country, poor planning and implementation due to the above constraints hinders any progress in genetic improvement of dairy cattle. Some of the major issues at present are discussed in details below.

Shortage of breeding animals

The non-availability of proven animals in the country has badly affected the farmers to purchase high-yielding animals as required. The practical barriers that encounter in animal breeding aggravate the situation further. With the present demand for milk and milk products, farmers are looking for high-yielding animals and ready to pay a high price for them. There are instances of cheating by selling inferior animals at high prices. This may definitely have an adverse impact on the dairy industry in the future. Moreover, the country will not be able to make use of full benefit of the present situation (high demand for milk) and many people will leave the industry. Shortage of superior animals for breeding purposes is a major issue that encountered by the industry at present.

On the national basis, it is estimated a large number of stud bulls of various breeds and cross breeds will be required each year. The total numbers of animals for breeding in NLDB farms have reduced to less than ten thousand animals, and it has been difficult to produce their own replacement stock. Therefore, a strategy to produce more suitable animals has to be developed with private farmers having appropriate number of breeding animals. Farmer participation in the production of suitable animals is a vital component of any breeding program to provide the essential number of stud bulls. Guaranteed buy-back of bull calves derived from recognised breeding farms under the supervision of the expert breeders may be useful future strategy. The practice of contract rearing is not new to Sri Lanka except that with the estimated number of stud bulls required will become a "numbers" game and therefore needs proper organisation and implementation. The only foreseeable solution to the problem lies on efficient AI service with wider coverage to serve the livestock farmers distributed through out the country. However scientifically proven bulls should be used for semen collection. These can be achieved by reorganising the existing dairy farms belonged to the NLDB and promoting private breeders association to produce proven bulls under strict monitoring and control by experts.

Artificial insemination service

AI is one of the most common biotechnologies applied all over the world for dairy cattle management. The technique was introduced to Sri Lanka in 1951 and since then has been extensively used particularly for dairy cattle improvement.

For any service to be attractive, it has to be readily available, efficient, effective and inexpensive. Unfortunately, the present AI service does not meet any of these criteria. The availability of the service depends on the availability of the AI technicians, and also of the semen. The highest AI coverage is seen in the wet zone and the upcountry areas while application of the technique in dry zone have been some what neglected (Livestock Statistics 2002)

One of the major reasons for low performance was the inability of the field staff to provide more extensive field coverage. In most of the field AI centres, due to shortage of AI technicians, it is not possible to provide an efficient service, due to weekends and public holidays, limitation of transport facilities to them. Therefore, employment of village-level private AI technicians, preferably selected from committed young farmers following a proper training under the guidance of the DAPH will increase efficiency of the AI service and its coverage.

The other important constraint to the expansion of the program is the lack of a follow up service.

Poor detection of heat is another constraint that cannot be solved without active participation of farmers in the whole process.

For the AI service to be effective and progressive, a concerted effort has to be made to get more cows inseminated per unit area. Use of proven stud bulls is not effective in small-holder farming systems due to obvious reasons. Therefore, AI and progeny testing are the most effective and essential tools for genetic improvement of a large breeding population scattered over a number of small village holdings. However, application of AI has been partially successful due to various constraints attributed to the human factors. Use of natural mating is more appropriate in dry zone where large herds are managed.

Embryo Transfer as a Tool for Livestock Improvement

Embryo transfer (ET) may be loosely defined to include the super ovulation of a female, recovery of fertilised ova by flushing and subsequent transfer of the embryos (fresh or frozen) to recipient host females.

This technology is being used in developed countries for research and to a lesser extent for production purposes. Embryo transfer demands developed infrastructure and a planned breeding strategy. Furthermore, cost of ET is extremely high and the output depends on many biological factors that are beyond control of man. It may also cause shrinking the genetic diversity of the national herd. Therefore, if one is to use a high cost, advanced and sophisticated technology such as ET, the genetic gains should be maximised in terms of quality and the distribution of the population.

However some of the shortcomings of the whole process of upgrading livestock in the country can be expedited if large numbers of embryos are locally derived from superior mating for implantation into healthy non-descript host cows synchronised for heat. Embryos derived from suitable mating (AI with high-quality semen from local /imported sources) could make an important contribution to Sri Lanka where large number of healthy although genetically poor producers are available in the national herd including the animals in government farms.

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Research in Animal Breeding

The possibilities for improving milk production in the mid and hill country regions of Sri Lanka were studied in the early seventies and pure breeding and cross breeding were recommended as possible approaches(Buvanendran 1971). In pure breeding, the different exotic breeds used were compared based on their performance under the well-managed farms of the Government without giving much concern on economic milk production. Breeding suitable animals for the tropical countries like ours has always been perceived as and extremely complex problem involving many disciplines. Studies are needed to raise the efficiency of breeding systems involving the small herds of small-holder farming systems. However, conducting experiments on dairy cattle breeding are extremely difficult. They are long term, requiring a commitment of resources for ten years or more, and require sustainable numbers of animals for reasonable accuracy. A proper recording system has to be in place and the active participation of the farmers is essential. The lack of expertise in animal breeding and the financial assistance and multi-disciplinary approach that need for breeding research are other constraints to the animal breeding research in the country.

Conclusion

Genetic improvement of animals followed by adoption of better management practices and providing marketing facilities are extremely important in rearing dairy cattle for increasing milk production in the country. As far as the animal genetic resources are concerned, there is an enormous diversity among the national herd which could be effectively used for future breeding programmes. However, in the context of breeding program, an accepted national breeding policy based on breed and/or cross breed genotype recommended for the different zones, and supply of adequate number of stud bulls for natural mating and AI, are the main requirements for the program to be successful. The quality of the available bulls needs to be critically evaluated under local conditions and upgrading of the "quality" has to be considered in the context of national herd improvement program. The dairy cattle improvement through breeding is time consuming and depends on many factors. Therefore a long term plan with active participation of the farmers and the qualified breeders supported by the government institutions is in utmost importance for any future development programme.

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