An approach to a Bovine Breeding Programme in India

C.T. Chacko

1.0 Introduction.

India's programme for reforms and economic liberalisation opens significant market led opportunities for the livestock sector. Livestock sector has been among the few fast growing sectors in rural India, extremely livelihood intensive, with nearly three fourth of the rural households depending on it for supplementary income crucial to their livelihood. This is the endeavor of small producers and as such investments in this sector would directly result in the welfare of the large section of the rural people. Sustained economic growth and rising economic incomes are the driving forces for the rapid growth that is taking place in this sector. It has a significant beneficial impact in generating employment and reducing rural poverty. The value of livestock out put grew at an annual rate of 6% during the period 1985-92 mainly contributed by the dairy and poultry sector. The percentage share of the value of the livestock products over the total GDP remained steady at around 6-8% between 1951 and 1992 while that of the total agricultural sector (including livestock) has declined from 52 to 29% over the same period indicating that the livestock sector is growing at rate faster than other agricultural sectors.

Livestock sector plays a significant role in the welfare of India's rural population. This sector employs 8% of the country's labour force, including small and marginal farmers, women and landless agricultural workers. About half the cattle population and 25% of the buffalo population are used for cultivating 60 million hectares of land (30% of the total cultivated area). The organic manure produced by the livestock sector is an important input to the crop production. Livestock also serves as an insurance substitute especially for the rural poor.

Very large numbers and very low productivity characterize livestock sector in India, across all species. Over the last four decades bovines increased by 40%.The value of livestock assets in 1991 was Rs.500 billion and the value of out put excluding draught was 436 billion at current prices. The draught out put was valued at Rs22 billion on fuel equivalent basis. The livestock sector thus represents among the lowest capital/out put ratio in the country. It may be noted that the cattle and buffalo population of India formed 15.4% and 55.3% of the world's population in 1987, which has decreased to 15% and 53.2% respectively during 1992

Livestock is an important source of supplementary income for the rural population. A nation wide survey indicated that the income from livestock averages 22.5% of the total household incomes. It plays a vital role in the rural economy by providing income from the products, by increasing the nutritive status of the rural household, by providing employment especially for the women folk and by supplying the highly valued organic manure for cultivation. In 1986-87, 73% of the rural house holds owned livestock. Small and marginal farmers account for three-quarters of them. It often leads to confusions while discussing breeding programme mainly because of the complexity of the topic and on account of the various elements involved in it. A breeding programme involves all operations required to improve the genetic level of a population. These are activities that depend on a given breeding concept and on the limitations of a given situation. The approach to a breeding programme can be described in the following steps described in figure 1.

2. Breeding policy

A breeding policy is a concept for improving the genetic level of animals. It depends mainly on the biological and economical factors and defines overall objectives, means and restrictions. The policies are governed by the requirements of the situation. For deciding on the breeding policy the flow diagram depicted in figuire2 will be of use.

In India the over-all guidelines for the breeding policy are set by the Government. These guidelines dictate the following as the policy;

Dr. C.T. Chacko MVSc.
MSc. (Edin.)
Former Managing
Director
KLD Board

· the non descript local cattle shall be crossed with exotic dairy breeds like Jersey and Holstein Friesian (HF) limiting the level of exotic inheritance to around 50 %.

· the recognized zebu breeds, both milch and draught types, shall be maintained as such and improved up on by with in breed selection

· the buffaloes both non descript and recognized breeds shall be graded up to any one of the dairy breeds.

The breeding policy for the zebu breeds is one of selective breeding with the objective of improving the wanted traits. Though there are organized attempts for the selective breeding of some of the dairy and draught breeds of the country, majority of the zebu breeds are not improving in their qualities on account of a lack of a planned breeding programme built on a sound objective.

The breeding policy for a given population should be developed applying the science of breeding, the experience till date generated in the area and to the conditions prevailing in the area. Government of India or for that matters any national body, can only suggest general guidelines of the breeding policy. In this context it is to be remembered that animal husbandry is a state subject as per the constitution of the Country. It is for the concerned state governments to lay down specific breeding policies suitable for their location/ locations with out violating the general guidelines proposed by the Government of India.

3. Breeding schemes

The breeding scheme defines the structure of the population, the gene flow from one generation to the next and the selection methods for each path. For a given population and for a given breeding policy, the breeding scheme (see figure 3.) depends on; the population and the method of selection.

The type of population like, breeds and species involved and the policies evolved for different populations should be clearly understood. In a population consisting of ND cattle, Sahiwal and ND buffaloes the breeding policy will be naturally three and the schemes also should for the three sub populations. Again one should have an idea of what proportion of the population is at present covered by the organized breeding programme and what is the targeted coverage is envisaged through the revised breeding programme in the years to come.

The method of selection indicates on which information selection is based or in other words the method of estimating the breeding value. (Please see figure 4). The information can be on the individual performance and/ or those of its relatives. The most common methods of estimating breeding values are:

Individual selection: individuals are selected in accordance with their own phenotypic values;

Sib selection: individuals are selected based on the performances of their sibs;

Progeny testing: individuals are selected based on the performance of their progeny;

Selection index: individuals are selected in accordance to their own and/or performances of their relatives; and

Animal model: individuals are selected in accordance to their own production and/or the breeding value of their relatives.

The schematic representation of a breeding scheme where there is no sub population and the selection is applied only on the male side is shown on the right side of figure 4

In the organized breeding programs there are sub populations under the control of the breeding organization. It is these breeding sub population generally described as nucleus herd that the intensive selection is exercised. Please examine the right side of the figure 4.

The selection methods considered in a breeding scheme are to take in to account;

The nucleus herd is responsible for the production of the breeding material for the population generally in form of semen for AI. These nucleus herds are in majority of

the cases owned by the breeding organization. However it can be also contract herds belonging to farmers.

-the traits to be selected,

-the infrastructure facilities that can be made available ,

-the types of activities that are envisaged and

-the actual genetic structure of the population

Selection of traits in a breeding scheme is related to the requirement of the farmers keeping animals in the area. The farmers' needs are properly understood before detailing the breeding scheme. Gathering reliable information from the farmers is rather difficult in India However a properly designed survey and conducted by specially trained personnel together with case studies would make available the relevant information.

Breeding schemes are generally designed for increasing the milk production; very little importance is given for draught power Factors like, cultural background of the area, farmers habits, importance of other agricultural and allied occupations, the expected returns from dairying, etc. have to necessarily be considered. Also before selecting the methods for genetic improvement, the farmers' needs and the facilities that could be made available should be looked into.

Infrastructure facilities that can be made available vary from place to place. An analysis of many breeding programs in India reveals that they were designed for optimum conditions and could not be successful in the given situation. Success of a breeding programme will depend on the use of a condition friendly programme. It is always possible to update the programme in line with the improvements taking place. Put the cart behind the horse; not the other way round. In summary what is required is a programme, which is in harmony with the facilities available, with the wishes and likes of the end user, the farmer.

4. Breeding plan

4.1 Developing a breeding plan

Breeding plan is the quantified breeding scheme. The breeding plan is to be developed for a certain time period. Normally for cattle and buffaloes the breeding plans are made for a period not less than 5 years. It indicates the number or percentage of animals born, identified, lost, bred, evaluated, selected etc, in a breeding scheme. It further elaborates on the means of breeding (artificial or natural) the requirement of bull, semen, its placements, movements, preservation and the like. The breeding plans have to be elaborated separately for each of the sub populations. Steps for calculation of breeding plan is described in fig. 5.

4.2 Quantification of the breeding plan

The steps necessary to quantify the breeding plan where AI is the means of reproduction is shown in the box below.

The assumptions used for the above calculation are made. Plugging in factors like mortality, heifers coming into production, etc. can further complicate the calculations. An analysis of the census figures indicate that around 80 % of the breedable females among crossbred population is heifers. All animals above 1.5 years are considered as breedable. It can be deduced that only 60 % of the heifers are getting in to the reproductive cycle because of the delayed age at first calving (around 40 to 46 months) and need be inseminated. This would mean that the absolute figures so obtained reckoning the AI performed on the heifers would not be far different from those obtained through the above calculation. The number of AI to be carried out in a population can be calculated using the following formula

Number of AI per year = BFP * COV * AIC * 12/CI

Where: - BFP; is the total number of breedable female population

COV; is the proportion of animals covered

by the programme

AIC; is the number of AI required per calf born (related to the conception rate)

CI; is the calving interval in months.

Steps to quantity a breeding plan

		Example
Breedable female population	5 million	
Annual coverage	40 %	
Breedable female covered by AI	2 million	
Calving interval m.	20	
Animals calving in an year	2*12/20 = 1.2	
No of AI required per calf	2.5 (40 %CR)	
No. of AI to be done annually	***2.5*1.2 = 3 million***	
Wastage & minimum surplus	10% & 25%	
No of doses to be produced/year 10,000	3*135% = 4.05	*# no. of doses /bull/year*
Bulls in regular collection	4.05/0.01 = 405	
# productive life of bulls	5 years	
Bulls to be replaced annually	405/5 = 81	
Selection intensity on male	25 %	
Bull calves to be produced/year	81/0.25 = 324	
Calving rate of bull mothers	70 %	
Bull mothers to be maintained	324*2/0.7 = 926	

The breeding plan should also examine the availability of infrastructure available with respect to AI centers, semen production stations, semen distribution centers, liquid nitrogen production/ procurement facilities and the like. Additional requirements can be worked out based on the optimum requirement and the quantity available.

A person specially trained for AI, its follow up and extension activities can man the AI center. The AI center can be stationary or mobile; in the former cows reach the AI center for getting an AI and in the latter the technician reaches the cow at its abode. The setting of an AI center will depend on the type of the AI center

On a general scale it can be seen that 500 to 750 breedable females spread in an area of 4 to 7 km radius can be covered by one stationary AI center. The area that could be covered will be considerably more when mobile AI is practiced and the technician is moving around in motor vehicles. The quantification of AI centers and the AI equipment required would be related to the type of the service provided. A comparative statement of the number of centers and the requirement of equipment etc can be seen in table 1.

It can be shown that mobile AI is far too cheaper and more efficient on account of

Table 1. Requirements under stationary and mobile systems of AI.

Details	Stationery	Mobile
Breedable population	1 million	1 million
Breedable females per center	750	2500
No of AI centers to be set up	1334	400
Type of container	25 to 50 lit	25- 50 lit + 1- 3 lit
Annual requirement of LN/center lits.	100	200

the fact that the cows will be in a better physiological condition at their homestead and the conception rate will be better. The milk production loss and risk of dragging the cow through busy townships can also be avoided. However good transport and communication facilities should be available for the operation of a mobile AI programme.

A divisional control is necessary for the coordination and monitoring of the AI centers. These divisional centers are responsible for the monitoring of the AI and allied programs, data collection and farmers contact. The administration of the employees of AI centers will be vested with the divisional control.

A regional control unit should be instituted for taking care of the supply of frozen semen as per the breeding policy and requirement of the AI center. Production/ procurement and supply of the LN to all the AI centers shall be one of the major responsibilities of the Regional control. The Regional control station should have facilities to procure, store and dispatch frozen semen and LN to the centers under its control.

At the top of the AI organization is the frozen semen production stations. The capacity, type, etc of a frozen semen production station is determined based on the breeding policy, the semen requirement and the average production ability of the bulls (please refer to earlier calculations). The organizational structure of AI organization is shown in figure 6.

4.3. Selection plans

Genetic progress through operation of a breeding programme is brought about through the selection. Selection theory is based on the accumulation of additive effects from generation to generation. In practice it generally delivers genetic gains in line with the theoretical expectations. The selection plans are to be incorporated to the breeding programme considering the practical feasibility.

Plans are to be developed separately for the selection of bull mothers and bulls. Bull mothers are generally maintained in the farms of the AI organisation. However it would be possible in the case of crossbred and zebu breeds to have bull mothers registered with the farmers, in areas where filed performance recording programme can be operated. Selection of bulls for characters not expressed by them is based on the performance of their mothers or female progeny, the former being more reliable.

5. Breeding operations

5.1. Establishment and maintenance of AI centers.

The breeding operations are described in the context of a frozen semen AI programme. As described earlier the AI centers can be mobile, stationery or a dual-purpose type where AI is conducted at the Center as well as at the doorstep of the farmer. The type of liquid nitrogen containers to be used, area and animals covered and the infrastructural facilities differ according to the system employed. The over all cost per calf born in the mobile AI system would be far too cheaper than the stationery type.

Another aspect to be considered is the ownership of the AI centers. Government, cooperative organizations, NGOs or private inseminators can own it. Selection of the right type of ownership depends on various factors like; social, political, socio economic, farmers awareness, financial aspects, who pays the services and so on.

It can be seen that the services provided by private agencies would more efficient and expensive to the farmers. It is expected that well trained private inseminator paid for the services by the farmer would be more cost effective. A comparison of the |AI centers manned by different agencies based on the experience of the AI programme in Kerala is given in table2.

Even in the case of private AI centers the frozen semen and the liquid nitrogen are to be supplied by the AI organization as per the breeding policy and guidelines of the State. These inputs can be supplied at cost price or at varying levels of concessional

Table 2. Comparative statement of AI centers manned by different agencies

	Government	NGO/ Co-operative	Private
Accountability	Low	Medium	High
Efficiency	Low	Medium	High
Service	Satisfactory Good	Good	
Cost effectiveness	Low	High	High
Farmers preference Medium	High	High	

rates. In this case the charges to be levied by the inseminator have to be fixed by the AI organization.

5.2. Semen production and supply

The requirement of frozen semen for the AI programme is predetermined as described in the breeding plan. These requirements are to be calculated separately for the different genetic groups and species. The requirement of crossbred semen will gradually increase in a situation where the breeding policy is one where the ND cattle are converted into crossbreds. How ever the system becomes complicated on account of;

increasing coverage over the years- leading to higher requirement of frozen semen,

reduction in the calving interval due to better reproductive management- leading to increase in the number of calving and here by higher requirement of semen,

improvement in the efficiency of AI - resulting in lesser number of AI per calf

5.3. Liquid nitrogen supply

Liquid nitrogen is essential for production, storage and supply of frozen semen. Liquid nitrogen can be produced in house or procured from industrial sources. While procurement from industrial sources is found to be cheaper it may not be available at all places and in the required quantity and frequency. The quantity of liquid nitrogen required can be calculated based on the type of field containers used and the number of doses produced. It is estimated that around 30,000 liters of liquid nitrogen is required fro the production of 8 - 10 lakh doses of frozen semen. 5 -10 liter capacity liquid nitrogen refrigerator requires about 100 - 125 liters of liquid nitrogen annually. In addition to the above liquid nitrogen is also required for the storage and dispatch of frozen semen to the AI centers.

Efficiency in liquid nitrogen supply can be achieved by optimizing the supply routes, care full refilling of the containers, avoiding wastages of liquid nitrogen while transport and by using always wet containers. A study conducted in Kerala revealed that the expenses in liquid nitrogen and semen supply to the field AI centers could be considerable reduced by giving the supply on contract rather than attempting to make own arrangement for the supply.

6. Bull production

6.1. Bull type

In India Jersey and Holstein-Friesian (HF) are the important exotic breeds used for the crossbreeding programme. Other breeds used or sparingly used for the crossbreeding programs are Brown Swiss (both Swiss and American), Jersey is still the popular exotic breed of India. Jerseys are preferred by some farmers in Denmark and UK on account of their requiring low input and these farmers claim that the net income from the Jerseys are comparable to that of HF. HF is the most popular dairy breed of the Universe. The home tract of this breed is the Friesian Canton of the Netherlands. However most of the developed countries that has acquired HF developed their own types of HF to suit their specific requirements through selection. As such there are American Holsteins, Canadian Holsteins, British Friesians, Danish Friesians and so on.

There are many famous zebu breeds in India used for milk, draught and dual purpose. Development and conservation of these breeds are not given serious thought in the country though they have excellent qualities for the Indian conditions. Famous dairy breeds of India are Sahiwal, Tarparkar, Red Sindhi and Gir.

Murrah and Surti are the two breeds extensively used for grading up programme of the buffaloes in India. Of this more favoured breed is the Murrah. Surti is also used for the breeding programme.

After the first phase of crossbreeding where exotic breeds are employed for the production of F1 animals, the need for the crossbred bulls are on the increase. The genetic composition of the crossbred bulls will depend on the breeding policy adopted. It would be 50 % exotic when the policy is to develop a new breed from a foundation stock of 50 % crossbred. The exotic and zebu breeds that are involved in the making of the new breed will also be related to the breeding policy. There would be two types of crossbred bulls; viz.

F1 bulls born out of a mating between the zebu and the exotic and

Inter-se mated bulls born from mating between crossbred population.

6.2. Source of bulls

Bulls required in the breeding programme are obtained from, import; purchase from other farms and or farmers with in the country and in house production

The inheritances of exotic breeds selected for the breeding programme are brought in to the population mainly through males. This would be cheaper, fast and easy for practical operation. The advantages of import of male and females can be seen below

Import of males
import of females

Breeding stock can also be obtained from other farms or from pedigreed herds belonging to farmers. Information regarding breeding farms is available from the concerned State Departments, Government of India Ministry of Agriculture (Joint Commissioner Livestock farms, Department of Animal Husbandry, Ministry of Agriculture, Krishi Bhavan, New Delhi) and from Yearbooks published by private publishers (e.g. Dairy India). Those farms having the desired stock of animals have to be identified and corresponded with for getting a better understanding of the animals and availability. After deciding on the farms to be visited a team as proposed for the selection of animals from abroad shall visit and select the required number and type of animals.

The following aspects in addition to those recommended for the selection of exotic stock are to be looked into;

Whether the herd is free from sexually transmitted contagious diseases,

Growth and live body weight obtained at a given age,

The type of information collected in the farm.

Animals can also be purchased from good herds belonging to farmers. Purchase from farmer's herds is often resorted to in the case of zebu breeds and buffaloes. Data recording is not practiced by the farmers and as such the team going to examine and select animals should be able to judge the quality of the animal based on subjective assessment of the herd and its standing among other farms screened. Checking the milk yield for three consecutive milking and taking the daily yield as the sum of the second and third milking would give a general idea of the present daily milk yield. This milk yield as a deviation from the herd average can be used as a rough measure of the genetic potential of the animal. However while resorting to purchase of animals from farmers' herds the important point to be considered is the overall standing of the farm itself and the place of the animal in question among its contemporaries.

It would also be necessary to procure at least 25 to 30 % more than the required

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