



ing programme in India in the organised sector and pointed out that as a consequence of this there is a manifold increase in the crossbreds with increased production characteristics along with enhanced efficiency of production. He pointed out that the decline in the energy output by draft animals needs investigation because some significant differences have been noticed among the various crossbreds in relation to the physiological parameters. He advocated that before these results are transferred to field condition it needs to be confirmed in a wider net work. Further for the impact of cross breeding programme he stressed the role of cattle improvement programmes, germplasm resource centres, herd registration programme, semen banks, gaushala herds, operation flood programmes and dairy technology missions.

Sh. R.C. Garg discussed in detail the various cattle breeding policies and pointed out that at present, Govt. of India have adopted crossbreeding because of tremendous increase in the milk production which has been found to be the largest component of economic change in the lower section of the rural community. He pointed out that the draft power of crossbred bullocks can be exploited in a efficient way if they are given rest for some time at equal intervals of work. The importance of biomass and slurry produced by crossbred animals was also emphasised in the sense that biomass can be best replacement of fuel wood and dung cakes for burning, with the resultant saving of energy. The slurry is a good fertilizer and can be used to fertilize the ponds for mixed fish farming. Apart from these direct gains from crossbreeding, he also pointed out some indirect gains such as creation of employment opportunities for manufacturing of livestock feed, fabrication of dairy and agricultural implements and animal base industries.

Sh. Sudershan Kumar while highlighting the impact of crossbreeding programmes on rural economy, discussed the results of one of the project carried out in Punjab on crossbred animals. He pointed out that the performance of crossbred cows in the field condition for  $F_2$  generation has dropped significantly with the corresponding increase in age at 1st calving. Because of this reason, the farmers are not very happy with the overall performance of crossbred animals and this needs to be examined thoroughly.

Dr. Shivtar Singh initially reviewed the crossbreeding work done in cattle in India and other tropical countries and then examined its impact on rural economy. He reported the results of one of survey carried out to study the impact of crossbreeding programme under field conditions. He pointed out on the basis of his results, that crosses from Jersey bull may be preferred in hilly and heavy rainfall areas in comparison to crossbreds from Freisian bulls. While discussing the plus points of cross-

breeds in comparison to non-descript in field conditions for various production and reproduction characteristics, he pointed out that the cost incurred in rearing the crossbred cow is much more than non-descript. He also laid emphasis on high returns from crossbreds. For maintaining the level of exotic inheritance between 50 to 75% he highlighted the role of criss-crossing, wherein the proportion of exotic blood increased or decreased in alternative generations and finally equilibrium is obtained with the resultant enhancement of heterosis.

Dr. Bhupal Singh stressed that while the crossbreds on the organised dairy farms with unconstrained fodder supply, proper health care, breeding and management practices have shown promising results but their performance in field conditions are not very impressive. He pointed out various bottle necks of poor performance of crossbreds in rural areas: Mainly these are breeding problems (low conception rate with a effect in increase in cost of A.I.), feeding (inadequate availability with poor nutrition value), health cover (higher mortality rate and poor vaccination facilities), marketing of final produce (low fat contents which result a significant drop in returns) and non-suitability of male calf (poor drafting power). In order to support the above mentioned points he reported the results of the study carried out by him to evaluate and examine the economic returns from crossbred cows vis-a-vis local cows and buffaloes and thereafter he suggested some ways to solve the problems in rearing the cross-bred animals in village conditions.

Dr. V.K. Bhatia highlighted that for studying the impact of crossbreeding programme, in addition to various production and reproduction traits, the information on stayability of an animal may also be considered. He gave the two notions of stayability viz. true and functional. The first one i.e. true stayability is actual culling rate in the herd. The second, functional stayability, measures the importance of involuntary disposal. Both of these concepts of stayability are important from an impact point of view because they represent a nice direct as well as indirect measure of the overall economic excellence of the animal. He further discussed different measures of stayability. On employing the different measures of stayability to one of the study it is seen that crossbreds perform well in comparison to local breeds of cattle and also concluded that crossbreeding programmes may be implemented in such a way that proportion of exotic inheritance remains around half. He also showed that the concept of stayability becomes all the more important for economic evaluation of an animal because the association between stayability with first lactation production and reproduction traits is found to be very close and thus concluded that milk yield in the first lactation by and large can be considered as a good indicator of stayability. The relationship between

stayability and profit further add to the importance of stayability in evaluating economic returns of different categories of dairy animals.

Sh. S. W. Govitrikar discussed the impact of crossbreeding in the economy of Maharashtra State. He highlighted that in the field of milk production, the success is of such a magnitude that it can be termed as White Revolution. He compared the figures before and after crossbreeding programme relating to milk production, number of crossbred calves born, no. of artificial inseminations done, daily collection of milk, number of in-milk cows etc. and concluded that there is a manifold increase in each of the component. This he highlighted by either constructing indices or by working out growth rates. He further showed that increase in the procurement of milk is directly dependent to a certain extent on price paid for procurement of milk. While Summing up he emphasised that crossbreeding programme has not only reduced to a certain extent the pressure of rural under-employed and unemployed population but has become source of income generation in rural areas.

After the presentation of all the papers, Dr. Gopal Krishan of H.A.U. Hisar emphasised that there is a need that crossbreeding programme may be looked through another angle. The number of services required for conception, number of abortions occurred and correlation of milk yield with total energy intake must be taken into account for evaluating crossbreeding programme. He further stressed that while milk production vary from place to place, there is a need to come out with suitable mathematical models for milk production along with percentage fat and solids present in it.

Dr. K.C. Raut of I.S.A.S., New Delhi informed that because of various constraints farmers in some areas prefer buffaloes in comparison to high-yielding crossbred cows. He further pointed out that the concept of stayability may not be adopted easily in rural areas.

Sh. S.N. Arya of IASRI, New Delhi, pointed out that the picture emerged from the two papers presented by Dr. Bhupal Singh who showed the negative points of crossbreeding and Dr. Shivtar Singh who highlighted the plus points, has become very confusing. He stressed that some uniform policy of crossbreeding may be developed by incorporating the breed  $\times$  location effects etc.

In reply to this Dr. Bhupal Singh clarified that he has not pointed out disadvantages of crossbreeding programme but in fact he has tried to show that under constraints, buffaloes serve better animals in comparison of crossbred cows.

Dr. J.P. Jain of IASRI, New Delhi suggested that attempts should be made to carry out impact studies in different areas. Dr. O.P. Dutta of IASRI, New Delhi emphasised the role of data base development,

### Recommendations

During the discussions on the papers presented, the following points emerged :

- (1) Milk production should not be looked in isolation but there is a need to develop mathematical models for total milk production by considering information of fats and solids percentage in milk.
- (2) Length of productive life (the concept of stayability) need be given due weightage in evaluating economic returns from different categories of dairy animals.
- (3) There is a need to develop uniform policy of crossbreeding programmes for different regions by carrying out initially impact studies in different areas along with building up a strong data base for future work.
- (4) The studies on draftability of male crossbreds should be carried out more intensively so that crossbreeding on a overall basis be accepted as a more remunerative technology.

In his closing remarks, the Chairman after summing up the gains of cross-breeding programme, pointed out that in order to make crossbreeding more acceptable there is a need to change our technology by keeping in mind the farmer's attitude or predetermine notions, consumers preferences in terms of percentage solids and fats and over and above co-operative movement, marketing etc.

## 1. IMPACT OF CROSSBREEDING IN CATTLE ON RURAL ECONOMY

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After the introduction of high-yielding varieties of cereal crops which ushered in 'Green Revolution', the crossbred cow is expected to create the next major impact on the economy and progress of the rural areas. Similar to the case of cereal crops, suitable animal germplasm is available which has provided opportunity for a quantum jump in milk production. Rarely such opportunities arise which enable a rapid development of this magnitude. The farmers have, by and large, accepted the crossbred cow as a replacement of the indigenous cow and, in many cases, even as a replacement of the buffalo. This is happening because the far-

mer has found in the crossbred cow the qualities of an excellent dairy animal, combining capacity for high milk production, good dairy temperament, early sexual maturity and short non-productive periods between the calvings.

Keeping these qualities in mind, the farmers particularly in the State of Punjab are heading towards a near total replacement of the indigenous cows with the crossbreds. This will not only increase total milk production, but significantly lower the cost of milk production. In addition to increased milk production, the cross-bred cows will go a long way in reducing the imbalance between the summer and winter milk production which has been a serious constraint to dairy development in the country. A natural consequence of increased milk production would be generation of substantial employment opportunities, not only in dairy farming, but even more so in marketing and processing of milk, input supplies, artificial insemination, veterinary services etc. Further the availability of high-yielding animals is providing impetus to commercialisation of dairy farming. This trend has already started in Punjab and some other parts of India. Finally, the crossbreeding will help to reduce the total cattle population and thus to create a better land-animal-man ratio. Regarding draftability of the crossbred bullocks there is still a need to carry out more intensive studies for proper recommendations, because studies carried out earlier do not give a clear picture of the draftability power of an crossbred bullock.

Besides the above mentioned advantages of crossbreds, there are number of constraints which must be looked into for maximising benefits from them. Basically the problems are related to breeding, feeding and management and disease control. Regarding breeding there is need to formulate programme which will prevent the genetic deterioration in the crossbred populations. Further programme to evolve superior breeds may also be initiated by applying the new biotechnological techniques. As crossbreds are more susceptible to disease so efforts are required for effective disease control. Although the crossbreds have been accepted by and large but still necessary feeding and management practices have not been correspondingly upgraded. Thus there is a need to provide them proper feeding and management so as to avoid depressing effect on the production and health status of these high-yielding animals. Finally research and development efforts should be made towards proper utilisation of crossbred bullocks and mechanisation of dairy farming operations particularly the milking, fodder-harvesting etc. so that crossbreeding on an overall basis becomes more economical.

## 2. CROSS BREEDING OF CATTLE IN INDIA AND ITS IMPACT ON RURAL ECONOMY

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In the pre-independence era, cattle population in India was primarily used for generating work animals and only very few well defined breeds namely Sahiwal, Red Sindhi, Gir, Tharparker were being maintained at the organised farms in large herds and are used as individual units by the public to meet their milk requirement. The Ministry of Defence recognized the ever increasing need of milk and for that purpose, establishment of large scale military dairy farms was a step forward for maintenance of dairy breeds and animals in India. To meet this challenge, introduction of *Bos taurus* in the form of Holstein Freisian, Jersey as well as some of other important breeds like Guernsey, Ayershire were introduced. This led to the production of different grades of crossbreeds resulting in higher milk production. This process of raising various crossbreeds was adopted by various organised herds and had shown manifold increase in the production characteristics as well as the efficiency of production. In addition to studies on production characteristics the studies on draftability were also being carried out throughout the country. Since the results of these studies are of confusing nature, it thus needs to be confirmed by the application of such results under rural conditions.

Although research endeavours were made for finding out the suitability of exotic breeds and level of exotic inheritance under different agro-climatic and socio-economic situations of the country but realising that the achievements of research might take long time, therefore, the developmental efforts by the Govt. of India and other State Governments were initiated almost simultaneously. The programmes mainly include setting up bull mother farms, germplasm resource centres, semen banks, Central & State Govt. dairy farms *gaushala* herds, military dairy farms, operation flood programmes and dairy technology missions. All these programmes have significantly contributed for an improvement in the rural economy.

The impact can easily be visualised by looking up the figures on expenditure in different Five Year Plans. It may be amazing to note that against an expenditure on Animal Husbandry and Dairying in the First Five Year Plan of Rs. 160 million, it rose to Rs. 10760 million in the 7th Five Year Plan i.e. 1985-90. This was incurred on starting large number of veterinary institutions, semen banks, AI centres, bull mother farms result-

ing in increase of artificial insemination from 8.44 million with exotic semen in the year 1984-85 to 9.68 million in the year 1988-89.

Through these efforts the milk production has also increased in the 1980-81 from 31.6 million tonnes to 48.0 million tonnes in the year 1988-89. Though we can boast of being the third highest milk production country in the world yet the impact of the investment made in this sector has not been fully known and exploited. This is primarily due to lack of monitoring i.e. follow up of the various programmes for actual impact analysis in terms of cost benefit and plugging the loop holes where efforts and the expenditure are not worthwhile. It would, therefore, be pertinent that every State Government must have a strong statistical and monitoring cell to undertake a regular impact analysis of the various animal husbandry development programmes particularly the cattle improvement.

### 3. IMPACT OF CROSS-BREEDING PROGRAMME ON RURAL ECONOMY

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Predominantly an agrarian country, India possesses 70% of its human population dependent on agriculture. The livestock is next to crop and complementary to agriculture, mainly raised for milk and draught. In latter sense the 75% of energy required for agricultural production is meted out from animal power, a renewable and inexhaustible source of energy.

India possesses 201.4 m cattle, 18% of which conform to 26 well-defined breeds but the rest 82% are non-descript and 75.6 m are buffaloes. Ninety seven per cent of entire milk production of the country (40.2 mt) is produced by cattle and buffaloes together. The current milk availability of 176 gm per capita per day is far below the recommended level of 205 gm. The breeding objective, therefore, is to increase the productivity per animal to achieve this goal. Accordingly the present cattle breeding policy broadly defined by GOI includes cattle improvement for milk through crossbreeding with superior exotic breeds which leads to two to three fold increase in milk yield over the local cows. Milk production has been found to be the largest component of economic change in the lower section of the rural community.

Next to milk, draught animal power is the most important factor still to remain complementary to agricultural and rural economy for another at least 40 years to come. It is estimated that 125 m bullocks would be

required to obtain a food production target of 250 MMT by 2000 A.D. The studies conducted on crossbred bullocks reveal that the crossbred bullocks are as good as the local bullocks and are able to sustain heavier loads for a longer distance if they are essentially provided 15-20 minutes rest after every 2 hours.

Value-added products like slurry and biogas, from animal biomass are the best replacers of fuel wood and dung cakes for burning. The gas so produced could be best used for community lighting and source of energy required to run pumps and thus save diesel and electricity. The slurry is a good fertiliser and can be used to fertilise the ponds for mixed fish farming.

Apart from aforesaid direct employment opportunities, there are certain indirect avenues through crossbreeding like manufacture of livestock feed, fabrication of dairy and agricultural implements and animal-based industries.

With a little emphasis on literacy campaign, the rural youth could be associated with certain activities of cross-breeding programmes like heat detection, A.I., vaccination, performance recording and the like activities.

Nearly 65 lakh milk producers including small and marginal farmers in about 49000 villages have been benefitted by Operation flood scheme so far.

Greater avenues for uplifting the rural economy could be adopted through massive programmes of R & D on fodder crops, multi-purpose trees and legume pastures, treatment of straws, better utilisation of whole plant as such etc. to meet out the nutrition deficit of crossbreds.

#### 4. IMPACT OF CROSS-BREEDING PROGRAMME ON RURAL ECONOMY

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Cross-breeding programme in the State was taken up during the 4th Plan period which was extended on a large scale in the subsequent plan periods. For cross-breeding 4 breeds (H.F., Jersey, Brown Swiss, and Red Dane) were used.

According to the breeding policy adopted by the Department the exotic blood level in the field is to be maintained between 50% to 62%. This is being achieved through inter-se-mating. From the analysis of the breeding data about the performance of crossbred cows in the field, it was

observed that there was a significant drop in the milk production in  $F_2$  generation. Similarly, the age at 1st calving has also increased significantly. With the performance in  $F_2$  the farmers are getting disillusioned.

### 5. DAIRY CATTLE CROSSBREEDING IN INDIA—AN OVERVIEW AND OPTIMAL CROSSING STRATEGY UNDER VILLAGE CONDITIONS

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This paper reviews the crossbreeding work done in cattle in India, and other tropical countries, examines its impact on rural economy and suggests the more efficient and operationally convenient crossbreeding strategy under field conditions. All the studies on cross-breeding till date, both under organised farms and field conditions indicate its potential for effecting quantum jump in milk production. Friesian is the preferred breed as its crosses produce more milk irrespective of the indigenous breed and the ecology involved. However, in hilly and heavy rainfall areas Jersey would be more suitable because of its size, early maturity and shorter calving interval. The comparative performance of crossbred and indigenous cows based on sampling investigations conducted by the Indian Agricultural Statistics Research Institute (IASRI), New Delhi one in the rural areas of Nadia and 24 pargans district of West Bengal (1977-80) and the other in the rural areas of palampur district of Himachal Pradesh (1981-83) is also reviewed. These studies showed that crossbreds excelled the non-descripts in all production traits in both the areas. They had significantly lower age at freshening, longer wet period, shorter calving interval and much higher milk yield than their local counterparts. The life-time production index of crossbred cows was 2.9 times that of the non-descript in West Bengal and was as much as 5.5 times in Himachal Pradesh. Further, the performance of crossbred and locals in terms of life-time costs and returns showed that return cost ratio in West Bengal for cost A (paid in cost) was 1.65 for crossbred and 1.08 for a non-descript indicating that an investment of Rs. 100 on a crossbred cow would yield an income of Rs. 65 as compared to Rs. 8 from a non-descript. The corresponding return ratio in Himachal Pradesh was 2.52 for a crossbred and Rs. 1.10 for a non-descript indicating much higher return from crossbred cows.

The crossbred animals produced under field conditions so far pertain mostly to first two generations having 50 to 75% exotic inheritance. In view of the optimum range of exotic inheritance being between half to

two thirds what should be the system of crossing under field conditions is a million dollar question. The possible alternatives of breeding from  $F_1$  or 3/4th generation onwards can be either to interbreed or to adopt criss-cross breeding. The former programme requires for its successful implementation rigorous selection among both sexes. This, can, therefore, be practised at well organised farms for evolving a new breed of dairy cattle by following a plan outlined by Amble and Jain in 1965. In the rural development projects, where cattle breeding is in the hands of numerous private owners and the Government has the responsibility of supplying semen or bulls the policy of criss-crossing seems to be the most practical system. In this system the proportion of exotic blood increases or decreases in alternate generation and finally when equilibrium is reached the cows will have 1/3 exotic or 2/3 exotic blood in alternate generations. If the scheme, is started by backcrossing half the  $F_1$  cows with the indogenous and half with the exotic breed the 1/3rds and 2/3rds will be equally numerous in the population. The balance is important for exploiting maximum benefit of the scheme. The population as a whole will have 50% of the genes from exotic breed. Once equilibrium is reached the population continues to maintain 2/3rd of the heterosis at its maximum so far as heterosis based on allelic interaction is concerned. The criss-cros system has the advantage that, since purebred males are used in each generation, very small purebred nuclei are needed to service a quite large commercial population. This advantage is enhanced if artificial insemination is used. Thus in view of operational advantages of criss-crossing alongwith its genetic implications, it would therefore, be the future strategy for cattle development in India.

## 6. IMPACT OF CROSS-BREEDING PROGRAMME ON RURAL ECONOMY

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To meet the increasing demand of milk, efforts are being made at micro as well as macro level, to increase the milk production through various developmental programmes. The system of crossbreeding for enhancing the productivity of animals is one of the measures and is being implemented throughout the country at a very large scale. Further it is noticed that the returns of crossbreeding programmes are affected by techno-economic relationship and constraints in the milk production and its marketing. The management practices for scientific dairying involving

crossbreeding demand specialised attention in breeding, feeding and health care.

The performance of crossbreds as observed in rural areas vis-a-vis, local cows and buffaloes is relatively not very impressive. The problems in maintaining cross bred in rural areas are faced in breeding, feeding, health cover and marketing of the final produce. Artificial Insemination Programme has not been extended to envelop the entire geographical area. Low conception rate pushes the already high cost of A.I. The capability and suitability of male calf to supply draught power is yet to be widely recognised to dispel the fear of cattle keepers as low performer animal. In context of feeding the deficiency in meeting the nutritional requirement of elite group of animals particularly crossbreds has been noticed in the rural areas. It leads to significant drop in milk production and consequently economic returns are reduced. Regarding health status, the cost of keeping cross-breds in healthy state is more because of high mortality and more prone to diseases. It is, therefore, necessary that they may be assessed and discounted appropriately before evaluating economic returns from them. Lastly the marketing of the produce from crossbreds face lot of problems mainly because of low fat contents.

Keeping the above factors in view an attempt has been made to evaluate and examine the economic returns from crossbreds cows vis-a-vis local cows and buffaloes. From the data collected from rural areas around Karnal. It has been observed that the average milk production of cross-breds is almost equivalent to Murrah buffaloes. The net return from a crossbred animal is far below the buffaloes. Finally if crossbreds are to be relied upon for the improvement of rural economy efforts should be made to provide proper feeding, health cover and marketing facilities.

## 7. IMPACT OF CROSS-BREEDING PROGRAMME IN RELATION TO STAYABILITY OF DAIRY ANIMALS

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It is well established that the rapid improvement in dairy animals can be achieved through crossbreeding programmes. It has also been observed that besides the number of advantages of crossbreeding programmes, they are also subjected to certain drawbacks too. Thus in order to measure the impact of crossbreeding programmes it is necessary to consider the factors other than production and reproduction characteristics. One such characteristic is longevity of an animal and because of this reason in the present article the role of longevity is emphasised. The two

aspects of longevity are considered : true and functional stayability. The first one deals with the actual culling rate in the herd. The second measures the importance of involuntary disposal. Both of these concepts of stayability are important from an impact point of view because they represent a nice direct as well as indirect measure of the overall economic excellence of the animal as farmer allows only better and more profitable cows to live longer and culls low producers.

A good measure of stayability is one which characterises the delay between some origin point and the culling date (the date of the event that ends the productive life of an animal). There are various measures of stayability which are available in the literature. The simplest one is the usual (real) time scale. It is the difference between the date of birth and date at disposal or culling. Thus stayability according to this logic is measured as the age at disposal. The second measure is based on the concept of length of productive life, also called herd life, as the difference between age at disposal and age at first calving. There are number of advantages of the later measure of the stayability. In this case length of productive life can also be measured as the number of completed or started lactations. This measure is rough and treats identically, animals with long or short calving intervals. Although this is not desirable but still serves as one of the way to measure stayability. Another possibility is to measure length of productive life in kgs of milk produced. Life span is then expressed as life time yield. This measure is particularly interesting because it is clearly related to the largest component of the farmer's income. These concepts are applied to the collected data from Military dairy farms and it is observed from the results that crossbreds with the proportion of exotic inheritance around half are more stayable in the herd in comparison to other category of animals and hence more viable from economic point of view. It is also seen that milk yield in the first lactation can serve as a good indicator of animals productive life as there is a close association between stayability and first lactation production and reproduction traits. The relationship between stayability and profit further add to the importance of stayability in evaluating economic returns of different categories of dairy animals.

## 8. IMPACT OF CROSSBREEDING PROGRAMME ON RURAL ECONOMY

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- Hybrid varieties in Agricultural Crops and Cross-bred cows in animal Husbandry are the product of recent genetic research, In Agricultural field the result is on set of 'Green Revolution' and in Animal Husbandry and Dairying we are witnessing 'White Revolution' or 'Operation Flood.'
- The milk production rose from 1062 thousands metric tonnes in 1970-71 to 2495 thousand metric tonnes in 1987-88 i.e. a rise of 2.3 times.
- The number of Crossbred calves born rose from 1467 in 1970-71 to 2,08,879 in 1987-88 i.e. a rise of 142 times.
- In case of graded buffalo calves born, this rise, during the same period, was 4.5 times.
- The daily collection of milk increased from 4 lakh litres to over 20 lakh litres.
- The number of in-milk cows rose from 16.3 lakhs in 1961 to 21.0 lakhs in 1982.
- The number of in-milk Buffaloes rose from 8.3 lakhs in 1961 to 12.6 lakhs in 1982.
- A compound growth rate of number of crossbred calves born from 1970-71 to 1987-88 comes out to 13.6 percent per annum.
- A compound growth rate of number of graded Buffalo calves born from 1970-71 to 1987-88 comes out to 4.7 percent per annum.
- A compound growth rate of average milk yield of cow per day from 1970-71 to 1987-88 is 2.5 percent per annum.
- It is observed that increase in procurement of milk is directly dependent to a certain extent on price paid for procurement of milk.