Cattle breeding programmes in India

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Cattle in India were primarily raised for milk and draught. The focus is currently on improving their milk production potential. This is in view of reduced requirement of draught animal power due to mechanisation and the need for more milk due to increasing demand.

Cattle are generally maintained on agricultural by-products and crop residues with some grazing and little grain supplementation. The average holding size is one to three animals per household. The majority of the cattle are still managed under low inputs with only a few being raised under intensive management. Dairy cooperatives at village level for milk marketing have been established. In some areas these cooperatives are being used for delivering inputs and performance recording. Medium to large sized herds of cross-bred cattle have also arisen in the periphery of large towns and cities, mainly for supply of milk. Little or no information on the performance status of cattle breeds in their native environment is available. AI coverage is less than 20 percent and the AI services are available mostly at fixed places. Improvement in cattle production is also directed through feeding, generation of marketing facilities, advisory services and veterinary aid.

Breeding policy and programmes

To begin with the cattle breeding policy was to improve the milch and draught breeds through selection and the local cattle through up-grading. Herds of pedigreed cattle of various indigenous breeds were established for production of superior bulls for use in up-grading and improvement of indigenous breeds in their breeding tracts. The local cattle have poor growth rate (100-150 g per day), late sexual maturity (age at first calving, 60 months) and low milk production (less than 500 kg per lactation). The lactation milk yield in some of the breeds like Sahiwal, Red Sindhi, Tharparkar, Rathi and Gir is about 1 500 litres and in all other breeds is below 1 000 litres. Although some increase in milk production through up-grading of local cows with improved indigenous breeds was obtained, the impact of these programmes was limited because of reluctance from farmers to castrate scrub bulls and due to non-availability of sufficient number of good pedigreed bulls of improved indigenous breeds. Other limitations of the up-grading programme were, the low yield levels of the improver breed used, long generation interval in indigenous breeds and five to six generations needed to up-grade the level of improver breed. As local cows are the core of our action plan, indigenous breeds having lactation milk yield of more than 2 000 kg, need be to be used in up-grading programmes. Bulls with such potential are rarely available. Progeny testing programmes on organized farms for some important indigenous breeds were also initiated for testing bulls for milk production using 300 cows and ten bulls in a breeding cycle of 18 months. This system also failed to make any impact.

Considering the need for rapid increase in milk production, cross-breeding of local cattle with exotic breeds in hilly regions and in urban areas around industrial township was started in 1961 as a matter of policy with the provision that bulk of the exotic inheritance should come from Jersey; Brown Swiss and Holstein may be tried on a limited scale. Subsequently, breeding of Holstein was allowed in areas which could support higher milk production. In hilly regions, use of Brown Swiss and Red Dane was recommended with exotic inheritance between 50 and 75 percent.

Cross-breeding work on scientific lines was initiated between 1910 and 1930 in various institutes and military farms. Between 1960-1970, planned cross-breeding experiments were initiated to answer some questions about the choice of exotic breeds and the level of exotic inheritance to be introduced through cross-breeding. Simultaneously, cross-breeding work in field conditions was initiated under bilateral aided projects focussing on synthesis of high yielding cross-bred strains of cattle.

Analysis of some of the well designed pure-breeding and cross-breeding programmes have been made to assess their impact including identifying their strengths and weaknesses and are used as input for re-designing the breeding programmes to make them more effective for bringing about faster genetic improvement in cattle productivity.

Selection within indigenous breeds

Analysis of selection schemes for milk yield in the indigenous breeds revealed that genetic gains, in general, were negative or insignificant and had large standard errors. Genetic gain in milk production in a closed Hariana herd at a Government Livestock Farm at Hisar, which had been under selection for over 20 years, was estimated to be 10 kg or 1.5 percent of average first lactation milk yield per year. Although, the bulls used were selected from high yielding dams on the basis of pedigree and type, the progeny test information in retrospect indicated most of them had poor milk potential transmitting ability. Similarly, analysis of data of the Tharparkar herd at the National Dairy Research Institute, Karnal (1936-1971), where young breeding bulls were selected on the basis of their dam's milk production, revealed that genetic gains in first lactation milk yield though insignificant were negative. The environmental trends were also negative. The milk production over the years in fact declined from 2 199 kg in 1936 to 1 443 kg in 1971. The genetic trends in 305 day first lactation milk yield in Sahiwal and Hariana herds in Uttar Pradesh were estimated to be 5.04 ± 0.48 and –0.82 ±0.26 kg/year, respectively. The negative genetic gain in the Hariana herd could be due to the use of bulls of inferior genetic merit, lack of systematic breeding plan and little or no culling of low producers. These selection studies suggested that final selection of bulls for intensive use for artificial breeding should be based on progeny test information only. Small herd size and use of few sires and few daughters per bull were the major limitations of these selection schemes. Non-existence of semen freezing facilities at some of these farms also contributed to the failure because by the time bulls became available after testing, they were too old to produce enough semen. There was hardly any culling of females on the basis of milk production in these herds.

In order to overcome the problem of small herd size, linking of the farms/herds of the same breed was adopted to increase the population size. Accordingly, progeny testing programmes for Sahiwal, Hariana and Angle breeds by associating the existing herds were initiated. The programme for Sahiwal was started in 1978 and involved testing of six to eight bulls/cycle using an approximate herd size of 700 breedable cow's spread over seven farms. A total of 33 bulls were used for progeny testing. Examination of the breeding value of the first two sets of bulls revealed that genetic superiority in the first and second set of bulls ranged from -0.2 to 9.5 percent and -15.6 to 12.9 percent, respectively. Bulls in a set were spread over four years which is too long a period. Only 25.4 percent of the breeding bulls produced freezable quality semen. The trait may be breed specific as Sahiwal bulls are lethargic in nature and many of them had poor libido. This would, however, call for raising four times the bulls required for semen production.

The programme for Hariana and Ongole breeds was started in 1986 and involved the recording of a minimum 12 female progeny for milk and five progeny per bull for draught. Averages of age at first calving, first lactation yield, first lactation length and first calving interval in various herds ranged from 44 to 61 months, 732 to 1 044 kg, 208 to 280 days and 15 to 17 months in Hariana cattle and 37 to 60 months, 407 to 778 kg, 179 to 261 days and 16 to 23 months in Ongole cattle. Surprisingly, milk production in first lactation of cows in the central unit both for Ongole (407 kg) and Hariana cows (790 kg) was lower than the associated herds (638-778 kg). This was perhaps due to the fact that more emphasis was placed on physical breed characteristics while selecting cows from the field for central units. Preliminary evaluation of Ongole bulls for first lactation milk yield revealed that the progeny average for milk yield of bulls having more than ten daughters ranged between 437 and 495 kg. At the rate of one percent genetic improvement per year, around 80-100 years would be needed to double the milk production. The major limitations of these programmes are (1) very long generation interval, around 15 years in Ongole; and (2) low milk yield of the two breeds. This project will answer the nature of the relationship between milk and draught and is being pursued with this focus only, although it is known that the two traits are negatively correlated.

Policy of pure-breeding in indigenous cattle breeds did not show any significant improvement due to non-availability of proven sires, lack of extension support and absence of breeder organizations / programmes for each breed. In view of focussing on improving yield levels of local cows through up-grading with selected indigenous breeds and conservation and improvement of indigenous cattle breeds, a large number of bulls of indigenous cattle breeds are needed to be produced use through AI or natural service to support breeding programmes of up-grading of local cows and selective breeding in defined breeds. Accordingly, breeding programmes to produce quality bulls for important indigenous milch breeds, for example, Sahiwal, Rathi, Gir and Tharparkar, need to be strengthened by networking the existing herds and involving farmers' animals in the breeding tract into a breed improvement programme. This is a difficult target and the costs are rather high.

Cross-breeding

Cross-breeding experiments have been undertaken both in the institutional herds and in field conditions to answer questions like superiority of exotic and indigenous breeds, level of exotic inheritance, non-additive genetic variance for milk production, genotype x environment interactions and synthesis of new breeds using cross-bred populations. Holstein, Ayrshire, Jersey, Guernsey, Red-Dane and Brown Swiss breeds have been used in cross-breeding. The information on the crosses generated has been analysed in relation to questions raised and results reported by a number of workers. Results are mostly available on two breed crosses barring a few planned experiments where three-breed crosses were also produced.

The results of various cross-breeding experiments have clearly demonstrated that increase in milk yield in cross-breds over the indigenous breeds was two to three fold. Friesian was the breed of choice for higher milk production. Jersey crosses had some advantage of early maturity and better reproduction but on over all merit, they were inferior to Holstein crosses. The ranking of the exotic breeds based on milk production was Holstein, Brown Swiss, Red Dane and Jersey. The exotic inheritance between 1/2 and 5/8 was most ideal for growth, reproduction and milk production and that grades with higher exotic inheritance had comparatively higher mortality and more reproductive problems than halfbreds. Differences among the Friesian crosses with various improved indigenous breeds (Sahiwal, Red Sindhi, Gir, Hariana) on military farms were insignificant thus suggesting that superior zebu breeds have nothing different to contribute in cross-breeding. The decline in milk production from F_1 to F_2 generations on account of interse mating attributable to heterosis was small. The large decline in some of the experiments was due to poor quality of cross-bred bulls used.

Indo-Swiss project

The Indo-Swiss Project in Kerala started in 1963 with the objective of developing a multipurpose breed for milk, draught and meat through cross-breeding of local cattle with Brown Swiss bulls. The project envisaged cross-breeding of local cattle with Brown Swiss bulls to produce halfbreds. These halfbreds were bred *inter se* and to Brown Swiss bulls to produce 1/2 and 3/4 grades. The 1/2 and 3/4 grades produced were crossed reciprocally to generate foundation population of 5/8 grade which were subject to interse-mating and selection and were called Sunandini. The origin of Sunandini can be traced to importation of 22 Brown Swiss bulls and 45 cows between 1964 and 1967. Subsequently, semen from 11 more bulls was imported. The major component of zebu in the Sunandini breed is the local non-descript cattle; although some attempts were made to introduce Sahiwal, Gir and Kankrej into the population. Halfbreds produced through mating of local cattle with Jersey, Holstein and American Brown Swiss bulls now also form part of the Sunandini population. From the multipurpose breed, the focus is now on breeding Sunandini solely for milk and the present policy is to have exotic inheritance around 50 percent from Friesian/Brown Swiss.

The average adult Sunandini cow at 48 mth weighs around 375 kg while Sunandini bull weighs 574 kg. Averages for age at first calving, service period and calving interval in Sunandini cows in the nucleus breeding stock were 32.2 + 0.19 months, 148.2 + 3.08 days and 424.5 + 3.32 days. There is scope for reducing the service period. The first laction milk yield was 1 914 + 27.8 kg with fat percent being 3.97 + 0.02. The milk yield increased over the lactations and was 3 024 + 68.8 kg in the fourth lactation. Average age at first calving in recorded cows was 42.17 + 0.07 months. First standard lactation in recorded Sunandini cows increased from 1 480 kg in 1983 to 1 830 kg in 1991. The average annual increase is 2.9 percent which is both genetic and due to improved management.

The progeny testing programme to estimate the breeding value of cross-bred bulls based on milk recording of farmers' cows was started in 1977 and proven bulls are being used to produce young sires for extensive use through AI. The project has a well established field performance recording system and excellent bull rearing and semen freezing facilities. Some of the problems facing the progeny testing programmes are:

i) long generation interval (around nine years);
ii) poor reproductive performance of cross-bred bulls, only 27 percent of bull calves contributed to semen production;
iii) large variation in management practices;

iv) tracing accuracy of parentage of calves born; and
v) difficulties in performance recording because herds are small and scattered. The data revealed that only 14 percent of the progeny of AI resulted in completed first lactation.

It is important to mention that between 45 and 73 percent of the cross-bred bulls up to six years of age were culled on account of poor individual semen mortality, poor or no libido, aspermia / oligospermia while those between four and 19 percent were culled due to other reasons. These data suggest that a much larger number of cross-bred males need to be produced to select the required numbers to be put to the progeny test so as to have reasonable intensity of selection. Herd size with farmers varied from one to three cows. Milk recording was done once a month and records used for predicting 300 day milk yield. A genetic model with effects like AI centre, sire of cow, type of dam, month and year of calving, age of cow and sex of calf explained only 21 percent of the variation in milk yield. Lower variability accounted for due to the model was attributed to small herd size. It was suggested that animals should be grouped into herds according to feeding / production level, which is impractical.

The major problem is that there is no selection intensity on the male side as the number of bulls tested is hardly sufficient for semen production required by the State. There is no improver herd which is well defined. The only selection intensity available is through selection of young bulls who are progeny of proven bulls. The progeny testing programmes in this situation have little relevance.

All India Coordinated Research Project (AICRP) on cattle cross-breeding

The Indian Council for Agricultural Research (ICAR) initiated a large cross-breeding project on five locations, for example, HAU, Hisar, IVRI, Izatnagar, JNKVV, Jabalpur, MPKVV, Rahuri and APAU, Lam using Jersey (J), Brown Swiss (B) and Holstein-Friesian (F) as exotic breeds and Hariana, Gir and Ongole as indigenous (L) breeds. The objective was to produce halfbreds (FL, BL, JL) and 3/4 grades with two exotic breeds and test them for growth, production and reproductive efficiency with the possibility of developing them into breeds suitable for specialised dairy farming. The Hariana breed at Hissar and Izatnagar and Ongole at Lam were crossed with all three exotic breeds while Gir units at Jabalpur and Rahuri used two exotic breeds, for example, Friesian and Jersey. Breeding of Brown Swiss to Jersey halfbreds and Jersey to Brown Swiss halfbreds was later discontinued. Accordingly, the number of 3/4 genetic groups was reduced from six to four at Izatnagar, Hissar and Lam and from four to three at other units. It was also decided that halfbred females should be disposed of as soon as the targetted number of 3/4 grades was produced. This was done to accommodate the required number of 3/4 genetic groups as the carrying capacity of each unit was not more than 400 adults and followers.

Evaluation of results revealed that there were significant differences among the three halfbred groups and that FL were superior to BL and JL halfbreds. The best genetic group at all the locations was the FL. There were little or no significant genetic group differences among the 3/4 grades for important economic parameters. It was thus suggested that FJL and JFL and FBL and BFL should be merged and FJL and FBL sires be used to breed the merged groups. FL and 3/4 merged groups after interbreeding should form the foundation herd for developing new strains of cross-breed dairy cattle. Furthermore, interbreeding among halfbred and 3/4 grades would provide answers to one of the major questions regarding breeding of cross-bred populations. It was also decided that genetic evaluation of FL and 3/4 grades should be made on the basis of overall economic efficiency. The project was wound up in 1986. The knowledge gained from this experiment was used for synthesis of cross-bred dairy strain using Friesian x Sahiwal cross-breds (around 24 000 breedable females) available at military dairy farms. At the end of the experiment around 547 breedable females in FL, 971 in FJL + JFL and 702 in FBL + BFL groups were available in the project. These populations were large enough for synthesis of cross-bred strains. Unfortunately, this option was not pursued.

The technical programme of the project has undergone frequent changes. The production of a target number of halfbreds in a given time frame was seriously affected due to poor reproductive efficiency of indigenous breeds used. Against the assumption of 30 female calves from 100 indigenous cows, only 15 were produced in the project. The halfbreds and 3/4 grades were produced at different times and were not contemporaries. Three-quarters were produced at a time when there were more constraints both in terms of physical facilities and inputs and this also affected their performance. The comparison between 1/2 and 3/4 grades needs to be made with caution. The decision to remove the halfbreds after producing requisite number of 3/4 grades eliminated the possibility of contemporary comparison of 1/2 and 3/4 groups.

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Cross-breeding of Sahiwal and Red Sindhi with Brown Swiss was initiated in 1963 to evolve a new dairy breed Brown-Swiss breed famous for its high milk yield, better heat tolerance and draught capacity was chosen. Semen of bulls with a progeny test index between 6 000 and 7 000 kg of milk was used. The interse mating in these crosses was practised for three generations and cross-breds were named as ‘Karan Swiss’. Cross-breds were about 5-6 kg heavier at birth and had higher growth rate than Sahiwal/Red Sindhi. The age at first calving, service period and calving interval were much lower and milk yield higher in Karan Swiss than Sahiwal/Red Sindhi. The 305 day first lactation yield was higher in F_1 (2 859 + 34 kg) than in F_2 (2 183 + 84 kg) and F_3 (2 296 + 46 kg) crosses. The large decline in F_2 crosses was mainly due to non-selection of F_1 cross-bred sires. About five to six sires per set were tested. Each set of bulls was used over three to five years which is too long a period. The breeding cycle should have been restricted to 18 months even if it meant reducing the number of bulls to be tested. Analysis of sire indices indicated that genetic superiority of bulls ranged from –22.1 percent to 13 percent, -9.1 percent to 20.9 percent and –23.2 percent to 8.7 percent in sets 1, 2 and 3, respectively. The 305 day first lactation milk yield in Karan Swiss cows in general showed an increase from 2 427 kg in 1981 to 3 312 kg in 1993 while thereafter a large decline was noted. A large decline in milk yield between 1992 and 1997 was due to the fact that 80 percent sires used in the third set were below the herd average. Deterioration in management during this period was also responsible for the decline. Only 31 percent of the cross-bred bulls donated good quality semen. Apparently 69 percent of the selected bulls did not even enter the test. This would call for the numbers to be raised at least three times, to achieve the required selection intensity.

A large reduction in number of cows (adults) has taken place over the years (207 in 1981 to 59 in 1998). This was due to higher annual culling rates in heifers / adults due to poor reproduction (18.2 percent) and low milk yield (7.4 percent). The conception rate in Karan Swiss cows was also low being 39.4 percent. Heavy mortality (47 percent) up to six months during 1992 and 1998 also led to depletion of the herd.

The semen of Karan Swiss breed was used in cross-breds in the ORP area of NDRI, Karnal. The institute neither developed a performance recording system nor extended a sire testing programme in the field. The field testing programme should have in fact been started after F_3 generations were produced at the institute. Such an approach was the only viable alternative to enlarge the base of the Karan Swiss breed and their further improvement through selection.

Analysis

The breeding objective in dairy cattle was to increase milk production through up-grading of local cows, selection within indigenous breeds and cross-breeding mostly of local cows with various European and American dairy breeds to produce cross-bred grades for commercial milk production and to evaluate them for their suitability in a tropical environment. Comparisons among various breed groups have mostly been made on the basis of individual first lactation and lifetime traits and these together have not been used to study the overall merit of a given genotype. Criteria like feed cost / unit of milk production and profit / cow / year have not been used to define breeding goals. Information on breeding and health parameters of non-descript cows, defined indigenous breeds and cross-bred cattle in field conditions is hardly available. These data need to be generated to devise breeding programmes for improving cattle productivity.

India according to the 1992 livestock census, had 63 million breedable cows, of which 6.4 million were cross-breds and 56.3 million indigenous (approximately 8 million defined breeds and 48 million non-descript cows). Apparently, a large number of quality bulls of defined indigenous breeds would be needed for breeding indigenous breeds and up-grading large proportion of local cows. Breeding programmes did not show any significant genetic improvement in cattle productivity because of non-availability of proven bulls. Programmes therefore for production and testing of bulls of indigenous breeds and cross-breds shall have to be strengthened. The emphasis should be to develop breed societies, introduce performance recording and link the existing breeding farms and farmers' animals into the breed improvement programme for milk. The cross-bred populations should be synthesised into a breed development programme with performance recording and sire testing as an integral part of it. In view of limited performance recording and long generation interval in indigenous breeds and cross-breds in field conditions, MOET should be used for production and testing of sires. The bull production programmes should be coordinated at national level.

The progeny testing programme in field conditions has its own limitations. Between 75 and 80 percent of cross-bred female calves identified and registered were lost before completing first lactation. Herd size is very small and it is not possible to produce contemporaries for accurate sire evaluation. A large number of cross-bred bulls (40 to 70 percent) are eliminated on account of poor semen quality, poor or no libido, aspermia / oligospermia and other reasons. These data suggest that a much larger number of cross-bred males need to be produced and raised to select the numbers required for progeny testing in order to have a reasonable intensity of selection. Similar data on male reproductive efficiency of indigenous breeds need to be generated. The generation interval which was eight to nine years in cross-breds and 12 to 15 years in indigenous breeds needs to be further reduced to achieve higher genetic gain per year.

Genetic models using field records explained 16 to 21 percent of variation in milk yield. Poor accuracy of sire breeding values resulted from errors due to no correction for sire's age, exotic inheritance of the cross-bred dam, large differences between herds and small herd size. Developing appropriate methodologies for standardisation of field records for sire and cow evaluation should therefore, be a priority.

Recommendations

Genetic progress in indigenous and cross-bred herds with a population size of 200-300 breedable females and eight to ten bulls is not possible even in institutional herds for reasons of high mortality, poor growth and poor reproduction, etc. The only alternative is to have large field programmes of performance recording with progeny testing as an integral part of it to support breed improvement.

Culling in cows is not possible due to economic and religious reasons. Selection pressure for increasing milk production, therefore, mainly comes from sire selection. Breeding programmes to produce quality bulls should be strengthened by networking the existing herds and involving farmers' animals in a breed improvement programme. Test and improver herds should be clearly defined.

Reproductive efficiency in indigenous breeds is rather low in a low input environment. Around 15-20 female calves are born per year per 100 cows in the field. These data should be used while developing breed improvement programmes, for indigenous breeds.

A minimum of 40 daughters per bull spread over four to six locations would be essential for evaluating a bull for milk yield with reasonable accuracy. With only around 20-25 percent of total female calves born and registered completing the first lactation in field conditions, 320-400 cows should be allotted to each bull to have around 40 recorded daughters for first lactation milk yield.

In view of limited success in performance recording and a long generation interval in indigenous breeds and cross-breds in field conditions, MOET should also be used for production and testing of sires.

Problems of culling of a large number of cross-bred bulls due to poor semen quality, libido and freezability, need to be looked into. Two to three times the number of cross-bred bulls needed should be produced to have the requisite number of bulls for semen production. The data on male reproductive efficiency of indigenous breeds, which is scanty, should also be generated immediately.

Appropriate methodologies for use of field records for sire evaluation should be standardised.