

Community-based breeding programs

– a sustainable way to improve small ruminant production in developing countries

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Small ruminants are an excellent livelihood option for small and marginal farmers under current unstable agricultural conditions in developing countries. Self-sustaining breeding programs to improve the productivity of diverse small-ruminant germplasm available in India is crucial to enhance farmers' income. Community-based breeding programs adopting open-nucleus breeding structure is proposed as an option for genetic improvement of small ruminants in developing countries. Ethiopia, Mexico, Bolivia and Peru obtained promising genetic improvement by adopting this approach. Understanding the set up of community based breeding program through lessons from above mentioned countries and refining the program that is suitable for each community will help in achieving a sustainable improvement in small ruminant production.

Key words: Small ruminant, Livelihood, Rural community

SMALL ruminants are reared by two-third of the rural community in India under traditional small holder and pastoral farming systems. There is a growing demand for small ruminant products like meat, milk, wool and hide with the increasing human population. In developing countries, small holder and pastoral systems contribute about 70 to 85% of small ruminant products. India has a large repository of genetically diverse small ruminant breeds adapted to varied agro-climatic conditions. Hence, small ruminant rearing provides an excellent option to enhance the livelihood security of marginal farmers for whom arable agriculture is too risky or rearing cattle is not feasible. Self-sustaining breeding programs for genetic improvement, to increase the productivity of existing diverse germplasm in their own production environment is crucial. Europe and Australia have achieved remarkable genetic improvement through national level breeding programs. With proper data collection and

sophisticated data processing center, breeding values (genetic worth) are estimated, and on their basis elite breeding males are selected. Developing countries like ours are not able to adopt the same approach due to lack of such supportive infrastructure. Some countries implemented centralized breeding schemes that were designed and monitored entirely by the government agencies but failed because of minimal or no participation of farmers in designing the program. Crossbreeding programs implemented to upgrade local indigenous breeds also proved unsustainable mainly due to poor adaptability of improved breeds to local environment and low input management. Another disadvantage of this program is the genetic erosion of local breeds that are well-adapted to the tropical climate. Alternatively, community-based breeding programs (CBBPs) adopting open-nucleus breeding structure is proposed as an option for genetic improvement of small ruminants in developing countries.

Ethiopia, Mexico, Bolivia and Peru, have tested this approach with promising results, using inputs from the International Center for Agricultural Research in the Dry Areas (ICARDA) at Beirut, *Lebanon*, the International Livestock Research Institute (ILRI) co-hosted by Kenya and Ethiopia, Austria's University of Natural Resources and Life Sciences and Ethiopian National Agricultural Research System. Currently there are 23 CBBPs (15 sheep and 8 goat sites) successfully operating in Ethiopia. In this article, let us understand the setting up of CBBPs for sustainable small ruminant production with guidelines from ICARDA.

Genetic improvement

Genetic improvement is average yield of any trait (say market weight) in the offspring generation depends mainly on (i) how accurately the genetic worth of the parents are determined and ranked, (ii) how much fraction of top ranked animals are selected as parents to produce next generation (for example genetic

gain will be more if we select top 10% of superior animals than top 30%), and (iii) genetic variation in the population.

Genetic improvement through breeding program is achieved in two phases. First phase involves selecting animals with best genetic potential. This is achieved by (i) individual animal identification, (ii) performance recording, (iii) analysis of performance records to select genetically superior animal, and (iv) planned mating of selected animals.

The second phase involves dissemination of improved animals/germplasm from improved animals obtained in the first phase for breeding, to a larger target population (where performance recording is difficult).

Constraints of small ruminant genetic improvement in tropics

Breeding of small ruminants in tropical developing countries faces following major constraints:

(i) *Lack of systemic animal identification and performance recording:* Identifying an animal with a unique number specific to the animal, will help in knowing and recording the productivity of the animal. It will also help in recording its relatives (pedigree and sibs) and their productivities. This performance record can help identify the superior animal in terms of genetic worth and genetically superior animals could be used as parents for next generation. However, such systemic maintenance of records is absent in India.

(ii) *Small herd size:* In India, flock size of small ruminants maintained by small and medium farmer ranges from 30 to 150. This affects the fraction of top ranked animals selected as parents for the next generation. For example, one may be able to appreciate that top 10% animals selected out of 100 animals will be better than the top 10% selected from 25 animals. Small herd size also leads to inbreeding.

Other constraints include simplistic breeding objectives, lack of organizational setup for monitoring

and evaluation, single sire flocks and pastoral flocks (problem of mobility). Lack of knowledge on genetic improvement among farmers.

Community-based breeding programs

Most of the above constraints can be overcome by a community-based breeding setup. The main aim is to make sure that the community is able to handle all activities of the breeding program from inception to implementation by itself. The success of this program depends on proper consideration of farmers' breeding objectives, infrastructure, participation, and ownership.

The important outputs highlighted by CBBPs in Ethiopia were increased market outlet through more births of lambs, bigger lambs at birth and weaning, reduced mortality rates, practice of retaining fast growing lambs for breeding instead of selling and availability of quality breeding rams.

Elements of community based breeding program

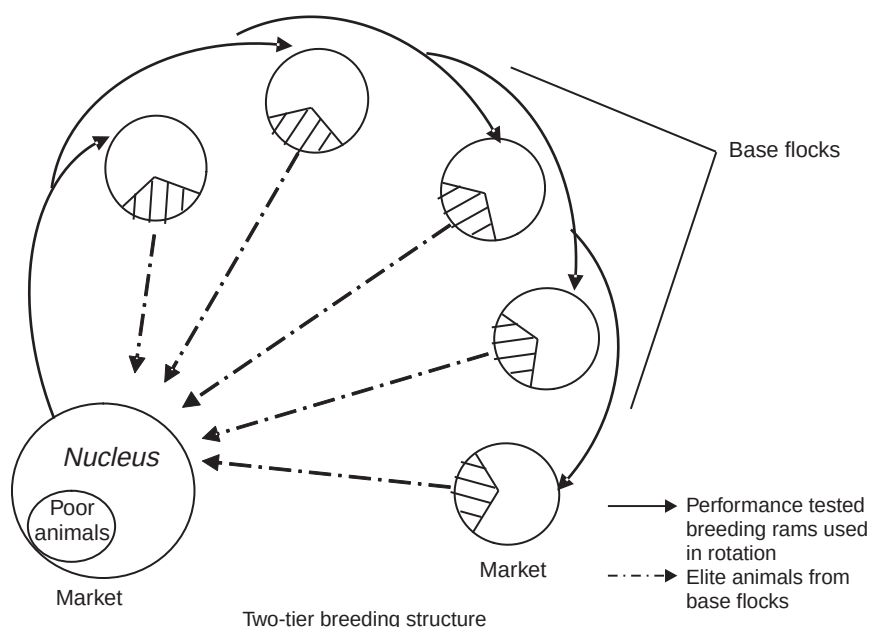
Some of the important components of CBBP are discussed here.

Basic structure of breeding program: In a community-based breeding program, several farmers with small and medium herd size are grouped into two sets (levels/tiers), the nucleus farmers and the base farmers. This design is called nucleus system. Nucleus farmers maintain best animals. Best males and females

are mated at nucleus to produce best young breeding males, which could be sold to the community, for use by the base farmers. Nucleus farmers should concentrate on maximizing genetic gain, whereas base farmers can concentrate on production. Base farmers can sell their superior rams to nucleus farmers (open nucleus system) and remaining stock to market.

Alternatively, production of breeding males can be entrusted to a centralized test station (maintained by a government agency or an NGO). Roles of the external agencies like the government, non-government or research organizations are to provide technical knowledge, conduct training, periodical monitoring and, evaluation.

Description of production environment: Description of production environment is the first and foremost step in a breeding program. Classifying target groups within an area/region based on the existing production environment and defining breeding objectives specific to each distinct sub-categories of environment are important. There are several examples to insist the importance of defining production environment. One example is about categorizing livestock owners based on human-animal interrelationship. Pastoralist/nomads are more concerned about giving protection to the animals at night from predators and are not concerned about the feed,



water and reproduction. Whereas, a livestock keeper is more concerned about fodder production, meeting minimum standards of management and capital spent, to obtain higher yields in future. However, most national development programs consider target groups universally as livestock keepers which is not real in many cases. Failure to distinguish the marketing opportunities available for regions closer to a larger town and remote areas had been a major weakness in the project design. Sociological factors are often considered less important than they really are. Hence, the protocols to define production environment should be detailed and allow for distinction of target groups within the area/region for which the breeding program is derived.

Defining of the breeding objectives: Breeding objectives should be holistic, taking into account the antagonistic relation between production, reproduction and adaptive traits. Personal interviews or group discussion should be done to give a list of the common, most preferred trait of economic value. Garrot's ranking or RBQ analysis can help in ranking of the objectives. Livestock keepers can be asked to rank their own animals and animals not known to them to better understand their preferences. The finalized breeding objectives should be compared with the market demands to ensure the long-term economic benefits of a breeding program.

Selection traits should be – related either directly or indirectly to the breeding objectives; easy to measure under field conditions; preferably with high heritability; not too many (not more than three under small holders situations); relationships between selection traits should be understood, as antagonistic relationships (i.e. traits which are negatively genetically correlated) between two traits mean improvement in one trait will result in deterioration of the other trait.

Animal identification: Each individual animal should be uniquely identified, such that no two animals have same number. This helps in

linking performance of animals with relatives through known genetic relationship.

Combining performances of individuals with pedigree and relatives will help in accurate determination of the genetic worth of animals. Ear tags are the most commonly used, however ear tags, collars, tattoo, branding and ear notches can be used. In an extensive system of management with grazing, loss of ear tags can lead to loss of valuable data. A permanent marking system like tattoo combined with ear tags is always recommended. Animals loosing their ear tags can be retagged with the same number from tattoo.

Data recording: Data recording is recommended to be kept simple and as practical as possible for easy use and adoption by the farmers. It is better if an enumerator is employed for each community to train the livestock keepers to measure and maintain records. Recording formats—2 for ewes and 1 for lamb, were developed. One ewe format containing detailed information was maintained by the enumerators. Another simple ewe format in which basic data about the selection traits (lambling date, litter size, etc.) are to be entered, are maintained by the farmers. Providing necessary equipments (e.g. weighing scales, ear tags, and markers) ensures accurate and efficient recording. An incentive based recording system encourages farmers to do the recording with integrity in the initial phases. With mobile phones reaching every nook and corner, the idea of specialized app with area based format and language can be of help in accurate collection and easy handling of data.

Selection of candidate rams: While selecting candidate rams, traditional practices followed by the community should be taken into account to increase the acceptance from the community. Best rams should be selected by computing breeding values using the recorded data and pedigree. Breeding values if cannot be computed, candidate rams can be selected based on simple index values (designed by the farmers, with the help of researchers) computed using available data from the region. Selection is to be done at two stages:

initial screening at the age of 4–6 months and final selection for admission for breeding at 12 months of age. All young rams are collected at one central place in each community on an agreed screening date. Selection is carried out based on the data analyzed. A breeding ram selection committee composed of about 3–5 members elected by the community are involved in the selection. In here, if for example 15 rams were to be selected from a total 100 candidates, say 20 would be preselected based on their breeding value. Then, the ranking of the selected 20 rams, and culling of the last five would be made by the committee. The joint selection process strengthens the linkages between farmers and researchers at grass-roots level.

Management and use of breeding rams: A common misconception among livestock keepers is to sell the fast growing males with better market weight for slaughter, leaving the slow growing males for breeding in flocks. This is called negative selection. To prevent negative selection by retaining best young rams for breeding, the breeding rams can be purchased by the project and used by the community. Further, the community can be subdivided into ram groups. The breeding rams can then be rotated among the ram groups, after being used for a specified period (say one or two year) in a particular group. This helps us to avoid inbreeding and also maintain genetic variability.

One practical example can be taken from the Network Project on Sheep Improvement (NWPSI)–Madras Red, an open nucleus breeding scheme involving 198 farmers' flocks of Madras Red sheep jointly supported by ICAR, Delhi and TANUVAS, Chennai. The design of this group breeding scheme is that (i) breeding rams are distributed by a ram-rearing center at TANUVAS (a government agency), (ii) the breeding rams are used in rotation (once in two years) among beneficiary flocks, (iii) performance recording of progenies, (iv) superior rams in the farmers flocks are identified and procured by the ram-rearing center to

replace 20% of its existing stock. Even after two decades of selection, there is maintenance of genetic variability in the flocks under the group breeding scheme, providing scope for sustained improvement. This is one of the main advantages when several small flocks are combined under a group breeding scheme.

After using the rams for breeding for a specified period decided by the community, they can be fattened and sold to market, the income of which can be used by the community to purchase the next set of breeding rams.

Institutional back-up

Initial support from researchers, extension personnel, government and NGOs is highly essential until the community is able to handle the

program in a routine sustainable way. A sufficient period of at least four years is recommended by the ICARDA, thereafter constant monitoring and periodic evaluation by the research community or project staff is vital to a prolonged success of the program.

SUMMARY

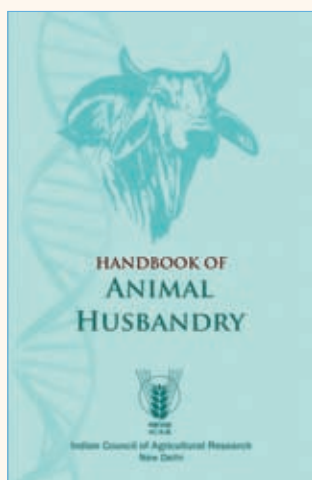
Community based breeding programs are proposed as an option for genetic improvement of livestock in developing countries. The aim is not to blindly adopt breeding programs from the temperate countries, but to ensure designing and handling of breeding program by and for the community for a sustainable development in developing countries. Understanding the community's practice and preference on selection of sheep, ram

sharing and management; and incorporating knowledge of genetic parameters (heritability and correlation) are the main determinants for design of community-based breed improvement program. This approach has been a promising model in many countries, however, the present guidelines will have to be refined according to each community and updated as experience accumulates and our tools improve.

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HANDBOOK OF ANIMAL HUSBANDRY

Livestock sector has created a significant impact on equity in terms of employment and poverty alleviation. After staple crops, livestock sector is the second most important contributor to the agricultural economy. The



producer prices of meat, eggs and milk, in India appear to be highly competitive as the domestic producer prices of these products are quite low compared to the ex-farm gate prices of major exporters in the world markets. A knowledge resource is essential to harness the potential of animal production. The Indian Council of Agricultural Research brought out first edition of *Handbook of Animal Husbandry* in 1962 for serving the end-users ranging from livestock owners to academicians. This is the Fourth revised and enlarged edition of *Handbook of Animal Husbandry* which includes 48 chapters under nine sections, such as Animal Genetics and Breeding; Animal Nutrition and Feed Technologies; Animal Management; Animal Reproduction; Animal Health Management; Animal Biotechnology; Animal Products, Technology and Machineries; Economics and Trade of Livestock and Poultry Enterprise; and Social Sciences. It has 19 new chapters like Impact of Biotechnology, Nanotechnology; Applications in Animal Sciences; Carbon Trading; Mechanisms and Opportunities in Livestock Sector; Intellectual Property Rights Regime;

Indigenous Technical Knowledge etc.; and old chapters were revised holistically. The fourth revised and enlarged edition of *Handbook of Animal Husbandry* will prove useful to the students, teachers, livestock/poultry farmers, and to especially those who visualize the economic growth of country with the support of livestock sector.

TECHNICAL SPECIFICATIONS

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