TECHNICAL BULLETIN No.42

A practical guide on village-based sheep and goat cooperative breeding schemes

ESGPIP

ETHIOPIA SHEEP AND GOAT PRODUCTIVITY IMPROVEMENT PROGRAM

FORWORD

This Technical Bulletin titled "*A practical guide on village-based sheep and goat cooperative breeding schemes*" is the 42nd produced by the Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP). The ESGPIP is a USAID funded Project with the objective of improving the productivity of Ethiopia's sheep and goats.

Village based selective breeding is one of the mechanisms for improving the productivity of local sheep and goats. This technical bulletin provides guidelines useful in the organization and implementation of selective breeding activities. It is believed that kebele development agents use these guidelines to bring about genetic improvement at village level.

At this juncture, I would like to thank all those involved in the preparation and review of this technical bulletin.

Desta Hamito (Prof.),
Chief of Party,
ESGPIP
January 2011

TABLE OF CONTENTS

A practical guide on village-based sheep and goat cooperative breeding schemes

Prepared by: Solomon Gizaw, Kassahun Awigchew and Alemu Yami
Edited by: R.Merkel and T.Gipson

1.   Introduction

Livestock productivity in developing countries is generally low due to a variety of factors. Improvement in productivity can be effected through genetic improvement and/or improvement of the production environment (improved feeding and disease control). Genetic improvement can be brought about through selective breeding within the indigenous population or crossbreeding. The purpose of this bulletin is to provide practical guidelines on village-based participatory sheep and goat selective breeding programs. The guidelines focus on operational aspects and are targeted primarily for use by kebele agricultural development agents to implement selective breeding activities in their own villages. The breeding scheme presented here can also be used by livestock research and development experts for developing breed-level village sheep and goat breeding programs. The guidelines are structured into three phases: 1) preliminary assessment and planning; 2) designing a genetic improvement program; and 3) implementing village- (or community-) based breeding activities.

2.   What is a village-based breeding program?

Figure 1. Consultation with the villagers throughout the process is important

Livestock breeding programs are broadly divided into centralized nucleus breeding programs and village- (community-) based programs. The reader is referred to ESGPIP Technical Bulletin No. 14 Genetic Improvement of Sheep and Goats at Village Level for the basic principles of animal breeding, description of breeding programs and definition of technical terms. A village-based breeding program refers to breeding activities planned, designed and implemented by smallholder farmers individually or in cooperation to effect genetic improvement within their flocks. The process could be facilitated, coordinated and assisted by outsiders like development and research experts of governmental and non-governmental organizations (Figure 1).

3.   PHASE I   Assessment and pre-planning

Village-based breeding programs should preferably be initiated by the cooperating sheep/goat keepers themselves. However, other stakeholders in the livestock development sector could initiate and facilitate cooperative breeding. The most ideal initiator from this latter group could be the *kebele* development agents (KDA).

The following are indicative guidelines for assessing the feasibility of initiating a village sheep/goat breeding program and initial planning by KDAs:

- First of all, evaluate the present animal production system and the interest and motivation of the sheep/goat keepers in the target village(s) towards genetic improvement. Genetic improvement is more likely to be acceptable by communities in areas where sheep/goats serve as a major source of livelihoods (e.g., subalpine Menz region, pastoral and agro-pastoral areas). On the other hand, farmers' interest may be low in perennial crop areas with very few animals and where cash crops play a major role in livelihoods of the communities.

- Assess the history of genetic improvement in the target area. For instance, if crossbreeding has been going on in the area, selective breeding may not be acceptable by the sheep/goat keepers

- If the assessment is positive, proceed to planning the program with farmers

  o Hold planning meetings with the sheep/goat keepers to design the breeding program (see section 4).

  o Estimate the costs involved in running the program. Costs may include ear tags, ear tag applicator, animal scales, construction of a holding yard, etc..

  o Plan alternative funding schemes for the program – raising funds from within the village or external sources (NGOs, Government, etc.)

  o Explore the possibility of acquiring improved animals or breeding services from external institutions. Genetically superior males from research centers or breeding ranches could help jumpstart the breeding program and speed up genetic improvement (Figure 2)

Figure 2. One-year old Menz sheep improved by selection at Debre Birhan Research Centre. Genetic merits of indigenous breeds can be improved by selective breeding.

  o Identify institutions that could provide technical support (district livestock experts, research centers, universities, and NGOs.)

4. PHASE II   Designing village-based breeding programs

The following guiding principles can be followed for designing a village-based breeding activity:

- Ensure full involvement of participants

- Design a program that is simple and practical under village conditions

- The design should ensure genetic progress but not be overwhelmed with genetic theories

- Adopt tactical optimization, which means finding the best practical solution at each step of the program

The steps for designing a village-based breeding program include:

i. ***Defining the breeding goals:*** Breeding goal definition is the first step to be made in designing animal breeding schemes. It defines what the 'ideal' animal is. It defines what animal traits farmers/pastoralists would like to have improved.

ii. ***Devising a genetic evaluation mechanism:*** This step involves implementing a recording system to identify those animals that have the highest genetic merit (breeding value) for traits determined by the breeding goal.

iii. ***Defining the breeding structure:*** Defining the breeding structure is an important element in designing a breeding program. The term breeding structure refers to the arrangements regarding how and where recording and genetic improvement takes place, how the selected animals are used and how genetic improvement is transferred to the whole animal population.

4.1   How to identify the traits farmers want to improve

Breeding goals can be defined in 2 ways:

- Bio-economic modeling: This is a conventional way used by animal breeding experts with little or no consultation with farmers. The approach helps to identify traits that influence profitability of a sheep/goat farm.

- Participatory approach: Alternatively, breeding goals can be defined by directly asking farmers which traits they would like to see improved or maintained at the current level. This is a recommended approach under traditional sheep/goat farming systems in Ethiopia.

The following steps can be followed by KDAs to identify breeding goal traits:

- Look for published breeding goal traits for the target sheep/goat breed and production system. Breeding goals have been defined for a number of breeds by researchers. For instance, the breeding goals for Menz, Afar, Blackhead Somali, Bonga and Horro sheep have been defined following participatory approaches (Table 1).

- Verify the published breeding goals with the sheep/goat keepers in the target villages and get their consensus

- If published breeding goals are not available for the breed and production system, follow the steps below to identify the breeding goal traits:

  - Seek assistance of experts (researchers, development experts);

  - Hold field workshop with the sheep/goat keepers to discuss their sheep/goat production and breeding objectives;

  - Ask the sheep/goat keepers to list the traits they would like to see improved;

  - Ask the sheep/goat keepers to rank the traits according to their preferences. The sheep/goat keepers can rank the traits by allocating a bunch of pebbles (say 100 pebbles) to the traits according to their preferences for the traits;

  - Rank the traits according to their weights, i.e., the number of pebbles allocated to each trait;

  - Make sure the traits are measurable so that they can be used as selection criteria. See ESGPIP Technical Bulletin No. 4 Selecting Breeding Stock for Sheep Production; and

  - This is a simple practical method that can be used by KDAs at the village level. There are advanced methods to define breeding goals. Assistance of experts may be sought.

Table 1. Example breeding goals for some sheep breeds in Ethiopia

Menz	Black head Somali	Afar	Bonga	Horro
Growth, survival, fleece weight	Adaptation (resistance to diseases), reproduction (number of lambs weaned), growth	Milk, growth, twinning, litter size	Growth, twinning, litter size	Growth, twinning, survival

Source: Gizaw et al. (2010), Getachew (2008); Zewdu (2008)

4.2   How to identify superior animals under village conditions

After identifying farmers' breeding-goal traits, the next step is to devise a means of identifying the 'best' animals to be parents of the next generation. To do this:

- Decide on the evaluation approach
  - Subjective assessment by the sheep/goat keepers only
  - Objective measurement based on performance records, or
  - A combination of subjective and objective measurements (Figure 3). This is a recommended approach as it accommodates farmers' preferences. See Section 5.2.2 for details.

- Devise a recording scheme for objective evaluation
  - Records should include production traits identified in section 4.1.
  - All or part of the newborn animals in the village(s) should be performance recorded depending on the breeding structure adopted (see section 4.3)
  - It may also preferably include pedigree records
  - Recording should be simple
- Devise techniques for evaluating the candidate animals
  - Evaluation of animals should be participatory involving farmers and experts
  - Animals should be evaluated based on both appearance and production traits

Figure 3. Farmer participatory selection of breeding animals

  - Mass selection (i.e., comparing animals on their phenotypes) is a practical technique under village conditions for evaluating animals based on performance
  - Performance records of animals need to be adjusted for effects like season, year and age of the animal. This has to be done by experts supporting the breeding program.

4.3   How to define the breeding structure

Breeding structure involves defining roles and coordination regarding recording, selection, and provisions for desired mating. In defining breeding structures:

- Involve the sheep/goat keepers fully
- Consider flock herding and breeding practices and movement of flocks (e.g., pastorals)
- Identify the current breeding structure in the area and build on it

- Decide whether recording and selection is to be carried out across the whole or part of the population

  o Two-tiered breeding structure: Recording and selection are carried out in a breeding population (commonly known as nucleus flock) and producers obtain improved breeding animals from the breeding population. There could be a distinction between breeders and producers.

  o One-tiered breeding structure: Recording and selection takes place in the whole population. There is no distinction between the breeding population and the population kept for production.

- Decide whether selection is carried out in individual flocks or in a group of flocks in a village or villages. Individual flock size is the critical determining factor in defining breeding structures

- Adopt the breeding structure that suits the local conditions from those listed in Table 2

- Modify the structure to suit the local conditions. However, the structure should ensure appreciable genetic progress and dissemination of genetic gain

Based on the facts in Table 2, a one tier cooperative breeding structure is the most feasible option under village conditions in Ethiopia. An example of the breeding structure is shown in Figure 4 (See Table 2 and Sections 5.1.2 and 5.2.3 for details). The scheme has been tested under local conditions by Debre Birhan Agricultural Research Centre. Recording and selection in the whole flock will increase selection intensity and genetic progress. The extra cost of recording the whole flocks (the only drawback of the scheme compared to the two tier scheme) can be offset by the infrastructure requirements (barn and land for separate grazing of the nucleus flock) and the management difficulties under two tier schemes.
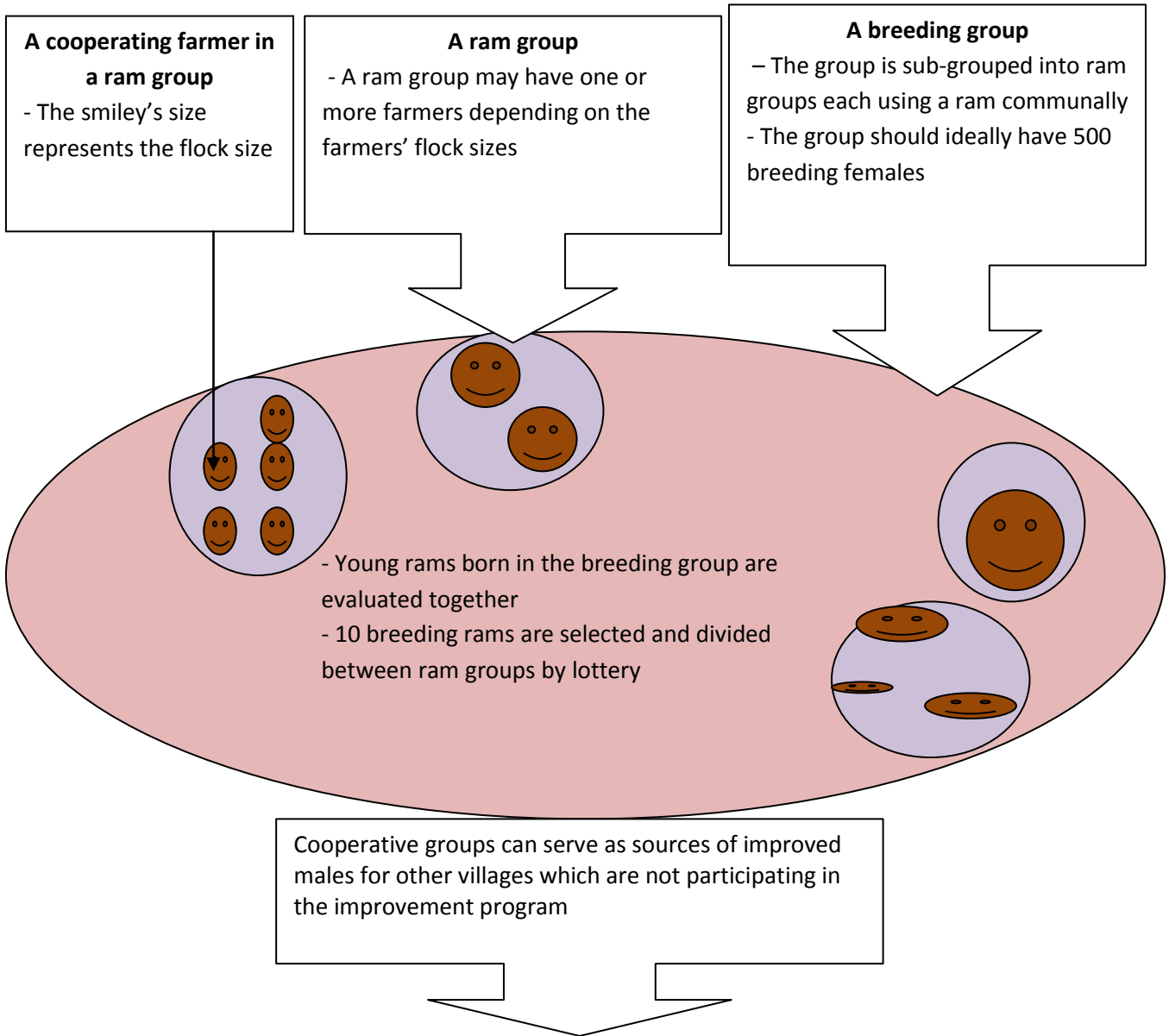
A cooperating farmer in a ram group
- The smiley's size represents the flock size

A ram group
 - A ram group may have one or more farmers depending on the farmers' flock sizes

A breeding group
 – The group is sub-grouped into ram groups each using a ram communally
- The group should ideally have 500 breeding females

- Young rams born in the breeding group are evaluated together
- 10 breeding rams are selected and divided between ram groups by lottery

Cooperative groups can serve as sources of improved males for other villages which are not participating in the improvement program

Figure 4. An example of one tier village-based cooperative sheep and goat breeding scheme

7

Table 2. Characteristics of typical village-based breeding schemes and their feasibility under village conditions in Ethiopia

Breeding scheme	Description	Applicability / feasibility
Within flock selection (Croston and Pollot, 1994)	- Program designed based on individual sheep/goat keepers - Recording and selection takes place within each sheep/goat keeper's flock - The sheep/goat keepers produce breeding nucleus animals - Provide improved stocks to producers who do not practice selection - The scheme can operate with sheep/goat keepers having at least 150 breeding females	- Suited to areas with large flocks and individual grazing - Requires that producer farmers appreciate genetic improvement and are willing to pay for breeding animals with greater genetic merit - Buying breeding stock from breeders may not be feasible for poor farmers - Returns to investment for the breeder farmers may not be attractive

Ram circles
 	
(Croston and Pollot, 1994)
	- Farmers organize themselves into ram circles
	- Each year they use a significant proportion of the young males selected from their group
	- Breeding males are moved from farm to farm on a daily basis
	– Breeding males are evaluated based on the performance of their progeny in each participating farm
		- High accuracy of selection is achieved
		- But operationally very DIFFICULT
		   - Rams have to be moved daily
		   - Difficult to identify sires of lambs as the rams move daily between farms

Two tier cooperative (Croston and Pollot, 1994)	- The scheme involves co-operation among farmers - Farmers form a nucleus flock by contributing their best females - Recording and selection takes place only in the nucleus - The nucleus produces replacement rams for the co-op flocks	- Suits smallholder mixed crop-livestock systems under communal grazing - Operationally difficult, - Requires land, barn and separate herding of nucleus flock - Extra cost of nucleus maintenance
Dispersed nucleus scheme (Mueller and James, 1984)	- The scheme involves co-operation among farmers - Top females are identified within each member flock - Those females are mated to selected males - Male progeny is retained for evaluation and eventual replacement	- Requires hand mating or the best males and females in each flock have to be herded separately from other flocks
One tier cooperative (Gizaw et al, 2009; Rodríguez and Quispe, 2007)	- The scheme involves co-operation among farmers - In a one-tier structure, no nucleus flock is established - All young males of cooperating flocks are evaluated - Breeding males are selected amongst young males born in the flocks of the cooperating farmers - Males can be evaluated within the cooperating flocks or maintained and evaluated in a separate place to be redistributed amongst the farmers	- Suits smallholder mixed crop-livestock systems under communal grazing - Suits the existing breeding structures in most parts of Ethiopia, particularly in mixed crop-livestock production systems - Extra cost of recording in base flocks

Figure 5. Within flock selection is applicable in areas with large individual flocks and separate herding (left), while in areas where many small flocks are herded together in communal grazing lands a cooperative breeding is the best option (right).

5. PHASE III. Implementing cooperative breeding programs

The following guidelines for organizing and running a one-tier cooperative village-based sheep/goat selective breeding program could be followed by KDAs and progressive sheep/goat keepers in collaboration with KDAs.

5.1 Organizing a one-tier cooperative village breeding program

5.1.1 Consultation and training

- Initiate and organize the breeding program by holding consultation meetings with sheep/goat keepers in the target village(s)

- Train the sheep/goat keepers on basic principles of genetic improvement and husbandry

- Train the sheep/goat keepers on cooperative village breeding schemes

5.1.2 Identifying cooperating sheep/goat keepers

- The sheep/goat keepers that join the cooperative are those that agreed on the breeding goals, selection criteria and the breeding structure adopted (see Section 4.3)

- identifying cooperators should be done with full participation of the villagers

- Start with some progressive sheep/goat keepers and use their success to expand the number of participants

- The number of cooperating sheep/goat keepers is determined by the number of breeding females required for effective genetic improvement

- A breeding population with 500 breeding females is suggested (Gizaw et al., 2009) to set up a cooperative village breeding program with appreciable genetic improvement and acceptable inbreeding rate

- If animal numbers in one village are low, sheep/goat keepers in two or more villages could cooperate (Figure 6)

- Map the settlement patterns and the social networks (i.e., relationships, neighborhoods, social institutions, etc.) in the villages to identify villages or sheep/goat keepers that could form a workable cooperative

- Cooperation is more feasible among sheep/goat keepers that share communal grazing areas. In such cases, flocks are herded together for most of the year and rams are communally used.

Figure 6. Two villages are organized in a cooperative breeding group in Dargegne kebele of Menz region.

5.1.3 Organizing sheep/goat keepers

- Help cooperating sheep/goat keepers organize on a voluntary basis. The cooperation could be an informal breeders association or a registered cooperative.

- Set up the organizational structure and allocate responsibilities. The KDA could act as a coordinator.

- Draft bylaws for the cooperative, particularly relating to breeding activities, financial matters, and animal disbursement. Determine the timeframe for the cooperative existence and provisions for members to enter and leave as desired or if necessary.

5.2   Selection and breeding in a one-tier cooperative village breeding scheme

5.2.1   Measuring and Recording

- Decide the animal identification system to be used. Ear tagging is preferable (Figure 7).

- Measure and record the performance of all newborn kids/lambs for the traits identified in Section 4.1

- Secure a weighing scale and measuring tape

- Construct holding yards as shown in Figure 8 for weighing animals

- Plan a schedule for members to assist in measurements (especially weighing). Weights can be recorded at birth, 3 and 6 months of age.

- The KDA will be responsible for recording. See ESGPIP Technical Bulletin No. 30 Records and Record Keeping on Sheep and Goat Farms for example recording sheets.

- Gradually introduce recording by farmers themselves

Figure 7. Ear tags for identification and ear tag application
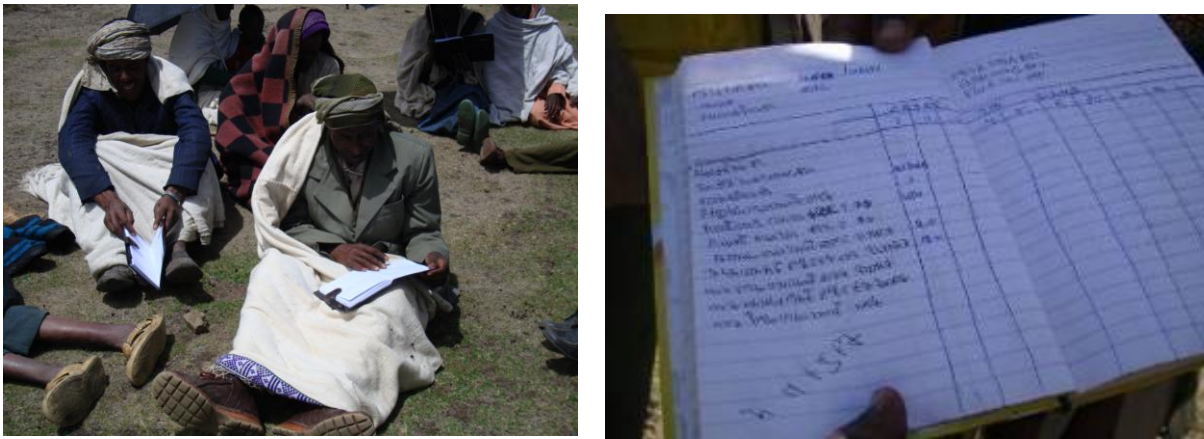
Figure 8. Weighing under village conditions

Figure 9. Recording can be done by farmers themselves.

5.2.2 How to select

- Start simple – culling inferior animals and avoiding negative selection. Negative selection is selling superior males with the intention of fetching higher market prices

- Decide how long a breeding male should be used. The common practice in some areas is castration of rams after two years of service for sale as finished animals during festivals

- Decide on age at selection. Sheep and goats commonly mate at one year of age

- Decide on the proportion of animals to be selected. If only a few of the best animals are selected, greater genetic progress can be made. But the number of animals selected will be determined by the need for breeding females in the population and the male to female mating ratio

- Select across flocks. The cooperating flocks are considered as one big breeding population and, thus, selection is done across flocks. This means all animals born in the different cooperating flocks will be compared and the best rams/bucks are selected

- Make sure that the candidate animals in the different flocks are managed similarly. This ensures a valid comparison of the merits of animals from different flocks or farms

- Adjust performance records (see Section 3.2) which requires assistance from woreda or research or university experts

- Rank the selection candidates according to their performance

- Form a ram/buck selection committee chosen by the members

- Provide the performance rankings of the animals to the selection committee

- Ask the committee members to rank the candidate animals based on their preferences (color, tail, …etc.) and the performance information provided to them

Figure 10. A ram show at Molale conducted by the Debre Birhan Research Centre.

- Get approval of the cooperative members on the ranking of the animals

- Select the top ranking animals for breeding

- Animal shows and rewards motivate village breeding (Figure 10)

5.2.3 Ram/buck use and exchange schemes

Within cooperating villages

- Form ram/buck groups. These are groups of sheep/goat keepers who would share a breeding male. The size of each ram group depends on flock sizes. Formation of ram groups would be facilitated if neighborhood and relatedness are considered.

- Allocate the selected males to groups by lottery

- Adopt a family breeding plan, i.e., rams/bucks will not be allocated to ram/buck groups where they are born

- Cull or castrate all unselected males

Selected rams/bucks will necessarily be communal property since replacement rams are selected from across all cooperating flocks. Thus, ram/buck usage would be a problem unless a cooperative arrangement is made

- Secure seed money to start a revolving fund to pay for members of the cooperative whose animals were selected

- Fatten and sell culled rams in each round of selection to build up the revolving fund. The fund is expected to grow fast

Across cooperating villages

Setting up cooperative village-breeding in every village may not be feasible. The KDAs and district livestock development experts could do the following:

- Establish links and ram exchange with other cooperative breeding villages to minimize inbreeding and form breed societies;

- Promote the supply of improved rams/bucks to other villages which do not practice selection; and

- Promote the cooperating villages into nucleus breeding villages to serve the district.

This is evolving the program into district/regional level. The strategy to develop district/regional breeding programs could be to use strategically located cooperative breeding villages as a source of improved rams/bucks to other villages. This leads to a change in the breeding structure from village cooperative breeding into a two tier decentralized village-based nucleus breeding program.

5.3   Measuring genetic progress

Measuring genetic progress (i.e., how much change has occurred in the population in terms of performance such as body weight) is rather difficult under village conditions. The following can be attempted to get a rough estimation of progress:

1. Ask farmers to judge differences in productivity of their flocks across years.

2. Measure the performance of some non-cooperating nearby flocks (i.e., control flocks).

   Compare differences in performance between cooperating and non-cooperating flocks.

3. Compare performance within the cooperating flocks before and after selection.

6.   Improving the production environment and marketing

The breeding program should adopt an integrated approach, i.e., the improvement program should include improvement of the production environment, value-adding and marketing of improved products. The genetic improvement component should be considered as a part of the overall improvement program.

- Introduce improved production packages before starting breeding improvement activities

- Introduce feed resource development activities (See ESGPIP Technical Bulletins No. 17 and 25)

- Introduce improved feeding practices(See ESGPIP Technical Bulletins No. 1, 2, 5, 6, 11, 12 and 13)

- Introduce health packages (See ESGPIP Bulletin No. 3)

- Introduce community-based health services. Seek assistance from development institutes.

- Develop the cooperative beyond cooperation in breeding activities, e.g., the cooperative can become involved in input supply and marketing of products

- Assess the options for linking the village with markets

Figure 11. Look for entry points for forage development. These pictures are examples of Sesbania and Napier grass development along irrigation channels in Shoa Robit and tree Lucerne development along soil conservation structures at Dargegne cooperative breeding villages.

7.   References

Croston and Pollot, 1994. Planned sheep production. Oxford Press, London.

Getachew T 2008. Characterization of Menz and Afar Indigenous sheep breeds of smallholders and pastoralists for designing community-based breeding strategies in Ethiopia. MSc, Haramaya University.

Gizaw S, Komen H and van Arendonk JAM 2010. Participatory definition of breeding objectives and selection indexes for sheep breeding in traditional systems. Livestock Science 128, 67-74.

Gizaw S, Komen H and van Arendonk JAM 2009. Optimal village breeding schemes under smallholder sheep farming systems. Livestock Science 124, 82–88.

Mueller JP and James JW. 1984. Design and evaluation of progeny testing in open nucleus breeding systems. Anim. Prod. 38: 1-8.

Rodríguez CT and Quispe JL. 2007. Domesticated camelids, the main animal genetic resource of pastoral systems in the region of Turco, Bolivia. In Tempelman KA and Cardellino RA (Eds.) People and Animals. FAO, Rome, p. 33-45.

Zewdu 2008. Characterization of Bonga and Horro Indigenous sheep breeds of smallholders and pastoralists for designing community-based breeding strategies in Ethiopia. MSc, Haramaya University.