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Design and implementation of community-based sheep and goat crossbreeding schemes

ESGPIP

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FORWORD

This Technical Bulletin titled "*Design and implementation of community-based sheep and goat crossbreeding schemes*" is the 43rd 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.

Cross breeding is one of the genetic improvement tools used to improve productivity of sheep and goats. One of the strategies followed by the ESGPIP to bring about improvement in productivity is through multiplication of imported genotypes namely Dorper sheep and Boer goats to producers for crossing with local breeds. Currently, these genotypes are being distributed to producers at the village level.

This technical bulletin provides guidelines useful in the implementation of cross breeding activities to bring about optimum benefit from the exercise. The underlying principles apply to all animal enterprises even though the presentation in the bulletin makes reference to sheep and goats.

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

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Design and implementation of community-based sheep and goat crossbreeding schemes

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1. Introduction

Crossbreeding of indigenous livestock breeds with improved exotic or local breeds is a usually quick means of genetic improvement. Importation and multiplication of exotic breeds in nucleus centers has largely been a successful activity in Ethiopia. However, disseminating improved breeds to village flocks, and designing, organizing and implementing crossbreeding activities at the village level has been a challenge. The purpose of this technical bulletin is to present practical guidelines on the design and implementation of crossbreeding activities at the village level. The primary target of this bulletin is the Kebele Agricultural Development Agent.

2. Community-based crossbreeding

A community-based (or village-based) sheep/goat crossbreeding scheme refers to crossbreeding activities planned, designed and implemented by smallholder farmers except for a one-time provision of breeding rams/bucks from centrally organized crossbreeding centers to start the village-based crossbreeding activities. The reader is referred to ESGPIP Bulletin No. 14 Genetic Improvement of Sheep and Goats at Village Level for the basic principles of crossbreeding and definition of technical terms.

Three basic steps can be followed:

1. Identify farmers'/pastoralists' breeding goals and choose the improver breed
2. Choose the crossbreeding scheme suited to the farmers' breeding practices and preferences
3. Organize and implement the crossbreeding activity

3. Guidelines on choice of sire breeds

The first decision to be made in genetic improvement through crossbreeding is the choice of appropriate improver breeds. Crossbreeding is a mating between two or more different breeds. Commonly, the mating is between improved males (the sire breed) from an external source and the local females. The source of the sire breed can be from outside or inside the country. The following guidelines can be used to choose the sire breed and acquire breeding stock:

- Identify which traits the goat/sheep keepers want to improve, i.e., define the breeding goals. The reader is referred to ESGPIP Technical Bulletin 'A practical guide on village-based sheep/goat cooperative breeding scheme' for steps to define breeding goals.
- Describe the local production environment, particularly the climate. This helps in considering the appropriate sire breeds that will perform under local conditions.
- Obtain the goat/sheep keepers' preferences for the sire breeds available in the country. This can be done by describing the performance characteristics and physical appearances of the breeds to the goat/sheep keepers. Physical appearance is very important in traditional livestock production systems. Some sire breeds imported into the country have been rejected by goat/sheep keepers. Description of the breeds can be supported by visit to farms or ranches where the sire breeds are located or through photographs if travel to the locations is not possible.
- Choose the appropriate sire breed considering the above criteria and consulting experts' technical recommendations.
- Identify the sources of the chosen sire breed.
- Acquire bucks/rams. It is recommended that breeding males rather than breeding females of the chosen sire breed be used in village crossbreeding.

Table 1 gives helpful information on exotic (foreign) and local sire breeds available in Ethiopia. The blood levels available include pure breeds, 75% Awassi, 50% Dorper and 50% Boer crosses.

Table 1. Characteristics of exotic and local goat/sheep sire breeds available in Ethiopia

Breed	Origin	Goat/ sheep	Genetic merits	Environmental adaptation	Sources in Ethiopia
Boer	South Africa	Goat	Meat production	Lowlands	ESGPIP Nucleus and BED sites: • Hawassa University • Haramaya University • Adami Tulu Research Center • Sirinka Research Center • Abergelle Research Center • Yabello Research Center Debre Birhan Research center Private commercial purebred and crossbred producers Smallholder producers
Dorper	South Africa	Sheep	Meat production	Lowland and highland	ESGPIP Nucleus and BED sites: • Fafen Integrated Livestock Research Centre • Werer Research Centre • Sirinka Research Centre • Haramaya University • Hawassa University • Areka Agricultural Research Center • Yabello Agricultural Research Center Debre Birhan Research Center Private purebred and crossbred producers Smallholder producers
Awassi	Middle East	Sheep	Coarse wool Milk Meat production	Lowland and highland	Amed Guya sheep breeding ranch Debre Birhan sheep breeding ranch Farmers in Gubalafto and AngolelaTera woredas Guguftu sheep ranch Debre Birhan Research Centre
Corriedale		Sheep	Fine wool Meat production	Highlands	Farmers in Chiro kebele, Gubalafto woreda
Rutana	Sudan	Sheep	Meat production	Lowlands	Farmers in Metema woreda Sheep ranch in Metema woreda
Bonga	Ethiopia	Sheep	Meat production	Highland	Bonga farmers Bonga sheep ranch

Figure 1. Purebred Dorper ram (left) and 50% crossbred Dorper lambs (right)

Figure 2. Pure Boer buck

Figure 3. Pure Awassi ram

Figure 4. High grade Corriedale sheep

Figure 5. Rutana sheep

Figure 6. Bonga ram

Figure 7. 50% crossbred Bonga x Menz ram

4 Guidelines on design of village crossbreeding schemes

Crossbreeding necessarily involves a two or three tier breeding structure (for definition of breeding structures sees ESGPIP Technical Bulletin 'A practical guide on village-based sheep/goat cooperative breeding scheme'). For instance, a three tier breeding structure has been adopted by ESGPIP for the Dorper sheep and Boer goat crossbreeding programs in Ethiopia. The first tier (nucleus centers) maintains and multiplies purebred Dorpers and Boers. The second tier (Breed Evaluation and Distribution or BED centers) produces and supplies crossbred Dorper/Boer males to the third tier (villages). The following sections describe crossbreeding at the village level.

4.1 Village crossbreeding schemes

Three crossbreeding schemes can be followed at the village level: 1) upgrading, 2) first-cross scheme and 3) terminal crossing (Figure 8). Procedures on how these breeding activities are implemented are presented in section 5.3.2.

4.1.1 Upgrading scheme

Upgrading denotes the crossing of females of a local breed (dam breed) to males of a sire breed and repeated backcrossing of the resulting crossbred female progeny to males of the sire breed. The ultimate objective is to create a high grade crossbred flock with a high percentage of the genetics of the sire breed. The optimal level of the genetics of the exotic sire breed should not exceed 50% under village conditions.

4.1.2 First-cross scheme

The term first-cross scheme is adopted for this bulletin to indicate crossing of females of a local breed to males of a sire breed and interbreeding of the crossbred male and female progeny to maintain a self-replacing crossbred flock. It does not involve back crossings but results in animals with a low proportion of the sire breed genetics, usually 25% if a 50% crossbred male is mated to local females. This type of breeding scheme requires at least three generations of selection and mating to produce a genetically stable population for consistent animal productivity.

4.1.3 Terminal crossing scheme

Terminal crossing is the production of crossbred fat lambs/kids for market. All of the crossbred offspring produced are sold. No crossbred animals, except for the breeding males, are maintained on the farm.

4.2 Guidelines for choosing village crossbreeding schemes

- Assess the sheep/goat keepers' characteristics and preferences. Upgrading and first-cross schemes are more acceptable to producers with breeding skills and higher economic status. There can also be farmers who may want to keep crossbred flocks. Terminal crossing is suitable to resource-poor farmers with the objective of earning quick cash and who are unable to buildup and maintain crossbred flocks for various reasons.

- Assess the production system and sheep/goat keepers' breeding practices. Upgrading is more feasible in areas with extensive sheep/goat production systems with large breeding flocks. Terminal crossing is more suited to intensive, market-oriented production systems with small breeding flocks.

- Consider ease of application. Terminal crossing is simple to implement. Upgrading requires breeding skills, controlled mating and recording of flocks or animals having differing levels of exotic genes. It requires long generations of crossing and backcrossing to achieve the desired genetic level. For instance, it requires about 6 generations of mating 50% crossbred males to local females and subsequent offspring to build a population having approximately 50% Dorper blood. It is also difficult to establish a population with uniform exotic blood level. First-cross schemes are easier with regard to uniformity since they do not involve repeated backcrossing which results in different blood levels in the population. However, such schemes require stabilizing the population through selection and mating for at least three generations for a consistent animal productivity.

- Consider conserving the adapted local breed. Terminal crossing allows maintaining the local breed since all the crossbred progeny are sold and the local females are maintained for crossbreeding.

- Consider linking upgrading and terminal crossing villages. Depending on producer preferences, both schemes could be implemented in neighboring villages where a KDA is operating.

4.3 Guidelines on exotic blood levels

- Exotic blood level refers to the proportion of the genes in the crossbred progeny which have been inherited from the sire breed. Expected blood levels under the different crossbreeding schemes, for example, the Dorper crossbreeding program mentioned above, are presented in Section 5.3.2.

- Decide on the exotic blood level suitable to the production system, the production environment, the farmers' socio-economic conditions and the market demands in the locality. For instance, consider the case of first-cross and upgrading schemes as described in Section 4.1.

- Increase the exotic blood to the desired level by backcrossing the first-cross to the sire breed. Exotic blood levels of first crosses produced in villages depend on the exotic blood levels of the sire breed rams provided from multiplication centers. For instance, Dorper and Awassi breeding programs provide rams with 50% Dorper blood (produced after one crossing) and 75% Awassi blood (produced after two crossings), respectively. The first crosses produced in villages by using 50% Dorper rams and 75% Awassi rams have 25% and 37.5% exotic blood, respectively. However, the sheep population in the Dorper program can be upgraded to 37.5% exotic blood just by one backcrossing to the 50% Dorper crossbred males. Thus, the overall outcome and number of generations required to reach a certain exotic blood level, in this case 37.5%, in both programs is the same when the crossings in BED centers are considered.

4.4 Breeding stock exchange scheme

A breeding stock exchange scheme has two components: sire exchange and breeding female exchange. The sire exchange scheme is more effective in imparting a greater impact. A sire exchange scheme is a controlled mating program using rams/bucks in different flocks or villages in rotation among cooperating breeders. Breeding stock exchange schemes between producers are required to avoid inbreeding and to speed up dissemination of breeding stock since supply from BED centers is limited. Terminology used to describe crossbred animals includes half-bred and quarter-bred. Half-bred means that the animal's genetic make-up is composed of half from its sire (e.g., purebred Dorper male) and half from its dam (purebred local female). Quarter-bred means that the animal's genetic make-up is composed of ¼ (25%) of exotic genes (e.g., Dorper) and ¾ (75%) of the local dam breed's genes.

The following guidelines can be adopted:

- Under upgrading schemes (Figure 8), crossbred female progeny should be backcrossed to half-bred sires from other cooperating flocks or ram groups (See Section 5.2 for the definition of ram groups). If an individual producer has only one half-bred ram/buck (which is likely the case given the limited supply and cost of half-bred males from BED centers), the producer should try to trade services of his male with a neighboring half-bred male to avoid inbreeding (mating of daughter and father).

- Under the first-cross scheme, crossbred female progeny should be mated to crossbred males from other cooperating flocks or ram groups.
- Devise a circular ram/buck exchange arrangement between cooperating flocks or ram groups, e.g., females born in flock/ram group A will be mated to males born in flock/ram group B, females born in flock/ram group B will be mated to males born in flock/ram group C, and so on.
- Evolve upgrading villages to ram/buck sources. After some generations of upgrading, high grade rams/bucks will be available to villages practicing terminal crossing (Figure 8).
- Crossbred females from terminal crossing villages can be transferred to upgrading villages to accelerate the build-up of crossbred populations
- Exchanges between ram/buck groups within cooperative villages is through shared or communal use of rams/bucks, whereas between upgrading and terminal crossing villages exchanges could be through arranged sales

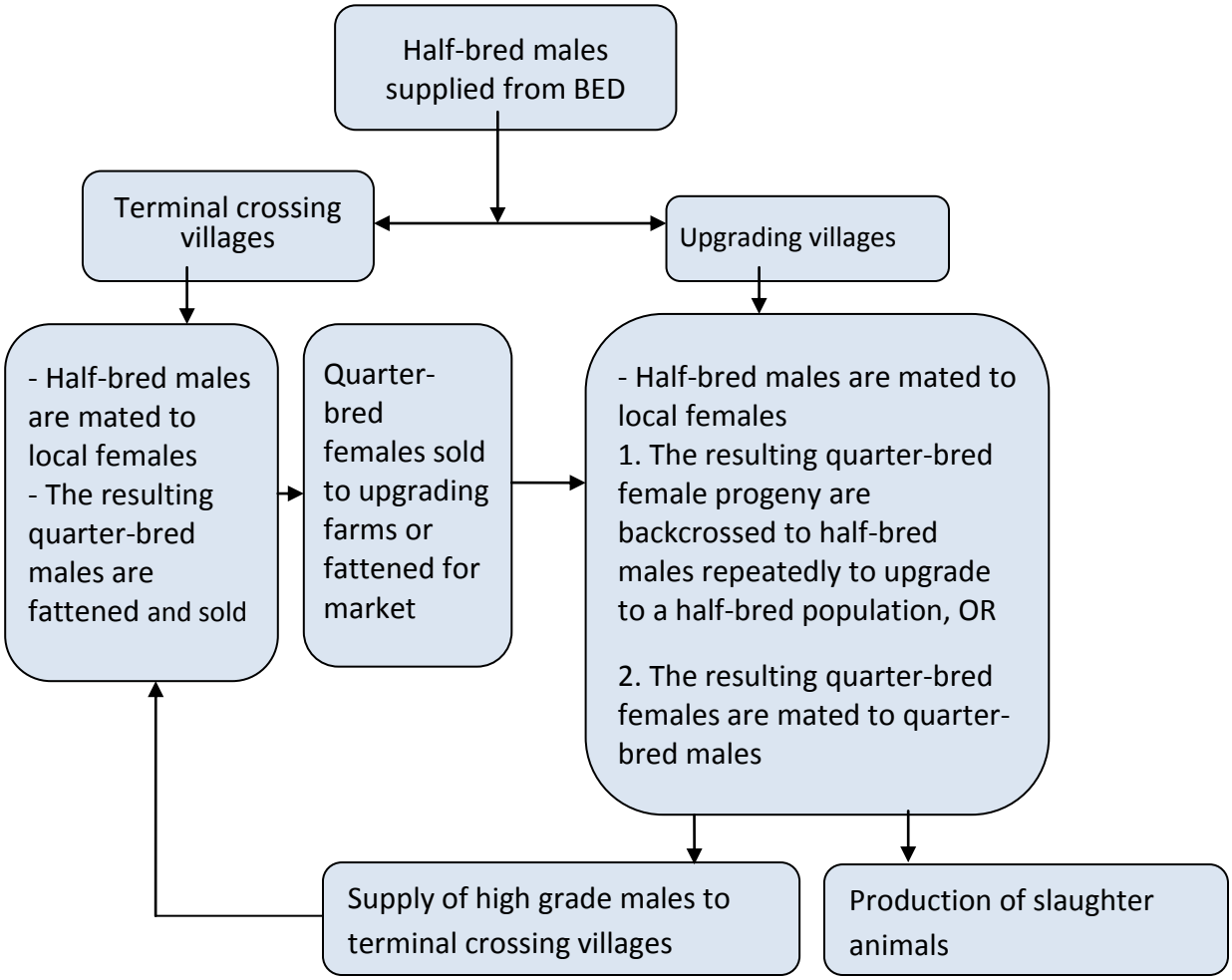

Figure 8. Village crossbreeding scheme

5 Guidelines on organization and operation

5.1 Identifying cooperating villagers and pre-planning

- Orient and train all prospective cooperating sheep/goat keepers in the locality on principles of crossbreeding and cooperative breeding schemes
- The sheep/goat keepers select cooperating villages and sheep/goat keepers
- Consult with the producers on resource requirements and project funding
- Estimate costs involved in running the breeding activity. The cost items may include ram/buck purchase, ear tags, and ear tag applicators.
- Plan alternative funding schemes and technical support
    - Raise funds from within the village, or
    - Seek external technical assistance and/or collaboration and financial support from institutions involved in crossbreeding and other livestock development programs (district livestock experts, research centers, universities, NGOs, etc.)

5.2 Organizing crossbreeding activity

- Organize the sheep/goat keepers into cooperative breeding group
- The cooperation could be an informal breeders association or a registered cooperative.
- *Devise ram/buck use arrangements*. Breeding ram/bucks supplied from BED centers is limited and costly. Ram use can be arranged by organizing the cooperating sheep/goat keepers into *ram/buck groups*. Each group will share a ram/buck for breeding. Each group may include one or more members depending on the size of the female breeding flock.

5.3 Implementing crossbreeding activities

5.3.1 Identification and recording

- Identify breeding animals using ear tags and introduce pedigree recording if an upgrading scheme is adopted.
- Identification may not be necessary under terminal crossing and first-cross schemes. However, pedigree identification and recording in first-cross scheme to avoid inbreeding and recording on other farm activities in all schemes is recommended.

- Castrate or sell all local breeding males if an upgrading scheme is to be adopted
- Acquire bucks/rams from sources identified in Section 3.
- The number of bucks/rams to be acquired depends on the number of buck/ram groups
- Follow the procedures in Section 5.3.2 below to implement the different breeding activities

5.3.2 Crossbreeding procedures

5.3.2.1 How to implement an upgrading scheme

As an example, the Dorper sheep upgrading scheme presented in Figure 8 is used to describe the steps in upgrading.

- Acquire half-bred males from BED centers (See Table 1). Mate the half-bred male to local females. The resulting offspring will be quarter-bred.
- Mate the resulting quarter-bred females back to half-bred males. This will result in a progeny with 37.5% Dorper blood. Backcrossing of the female progeny to half-bred males gives animals with 43.7% Dorper blood. A further backcrossing results in nearly half-bred animals with 46.9% Dorper blood.
- This repeated backcrossing results in a half-bred population

5.3.2.2 How to implement a first-cross scheme

- Acquire half-bred males from BED centers (See Table 1) or upgrading farms.
- Mate the half-bred male to local females. The resulting offspring will be quarter-bred.
- Interbreed the quarter-bred progeny (i.e., mate quarter-bred male to quarter-bred female every year). The resulting population will be quarter-bred.

5.3.2.3 How to implement terminal crossing

- Implementing terminal crossing is easy!!
- Acquire half-bred males from BED centers or upgrading farms.
- Mate the half-bred male to the local ewes, fatten and sell all crossbreds which are quarter-bred.
- There are two breeding options: the producer can mate all of the local ewes to the half-bred male and buy replacement local ewes when needed. Alternatively, only a portion of the ewes can be mated to the half-bred and the rest to a local ram to produce ewe replacements.

- There are also two options regarding disposal of crossbred female lambs: either sell as fattened animals if the local culture permits or sell them for breeding to other farmers. The latter is recommended.

6 Improving the production environment, value adding and marketing

- Improving genetic merit should always be complemented with improving the production environment, value adding and improved marketing. This means that crossbreeding should be implemented under high-input and market-oriented production systems.

- Introduce improved production packages: Improved production packages include introducing and developing alternative feed resources, improving the nutritional qualities of locally available feed resources, improved feeding practices and animal health packages

- Introduce value adding practices such as fattening

- Plan and advise farmers on marketing strategies. For example, upgrading villages with high grade animals may focus on the sale of genetic material (high grade rams/bucks for breeding) for premium prices, whereas terminal crossing villages will sell fattened lambs.