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Organisation of sustainable breeding schemes for smallholder dairy farmers in the highlands of Ethiopia

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Contents

1. Introduction

Significance of smallholder dairy production

- tremendous potential for development

  → shortage of dairy products in urban centres

- avenue towards agricultural intensification

- improvement in
  - household nutrition and health
  - family income
  - food security
  - natural resource management

(Azage & Alemu, 1998)

1. Introduction

Structure of market oriented rural dairy systems

- smallholder farming (≤3-4 cows)
- mixed farming system
- feeding on agricultural residues and grazing on natural pastures
- use of crossbred dairy cattle
- sale of most of the milk for income generation
- natural bull service
- lack of breeding programmes

1. Introduction

Objective:

Suggestion of a sustainable breeding scheme based on a young sire programme to provide breeding bulls for smallholder dairy farmers in the Ethiopian highlands

- Determination of nucleus size
- Identification of factors maximising genetic response

1. Introduction

Definition: Young sire programme

Evaluation of bulls on the basis of their ancestors' performances (i.e., milk yield of dam, maternal / paternal halfsisters of sire and dam)

Features:

- short generation intervals (minimum 3-4 years)
- low accuracies
  → relatively high genetic response per year
- simple, least expensive breeding scheme

2. Study site

2.1 Highland region in Ethiopia – Selale region

- high potential cereal-livestock zones
- dairying plays a significant role
  → more than 100 000 crossbred cows
- good access to livestock development services and milk markets

2. Study site

2.2 Lowest administrative unit in rural Ethiopia – Peasant association (PA)

- comprises about 200 farmers
- formation of service co-operatives
  (e.g. purchase of agricultural inputs, marketing)
- implementation of village bull service

3. Modelling

3.1 Determination of number of replacement bulls

- Crossbred cow population in the highlands:
  ca. 100 000

- Derivation of number of bulls needed per year

  - Mating ratio: 1 : 40

    → 2500 bulls for service in total

  - Useful life of a bull: 3 years

    → **833 replacement bulls per year**

3. Modelling

3.1 Determination of number of replacement bulls

- Population size of crossbred cows in a PA

  - smallholders : 2 crossbred cows per farm

    → 400 crossbred cows

- Derivation of number of bulls needed per year

  - Mating ratio: 1 : 40

    → 10 bulls for service in total

  - Useful life of a bull: 3 years

    → **4 replacement bulls per year**

3.2 Determination of number of bull dams

Table 1: Factors affecting number of bull dams required

Factor	Factor coefficient
Number of replacement bulls per year	4* / 833**
Sex relation	2
Survival rate	2 / 1.33
Success of planned matings	1.33
Preselection for growth, frame, extremities, etc.	2
Calving interval	2
Number of calvings per cow	4 / 3

* PA, ** whole highlands

3.2 Determination of number of bull dams

Table 2: Number of bull dams required for the provision of breeding bulls in a PA and for the highlands

Scenario	Number of bull dams
Highlands, survival rate 75%, 4 calvings	2947
Highlands, survival rate 50%, 3 calvings	5909
PA, survival rate 75%, 4 calvings	14
PA, survival rate 50%, 3 calvings	28

4. Breeding bull provision

4.1 Purchase of breeding bulls from the urban / periurban areas

Urban / periurban region:

- sizable dairy cow population (17 000)
- prevalent genotypes: 75-100% Exotic
- improved management conditions:
  - zero grazing
  - feeding of wheat bran, oil seed meal and hay

4. Breeding bull provision

4.1 Purchase of breeding bulls from the urban / periurban areas

Possible impacts on rural cow population

- Low grade cows (< 50% exotic genes):

  → shift in milk production mainly through additive gene action

- Middle grade cows (50-75% exotic genes):

  → shift in milk production only under excellent management conditions

  → poorer management: performance depression

  (genotype x environment interaction)

4. Breeding bull provision

4.2 Establishment of local open nuclei based on cow performance

Identification of superior cows to breed bull calves:

- First step (no recording)

→ farmer information about cow performance (e.g., milk yield at the beginning of the lactation)

- Second step:

→ start of a recording system essentially based on owner control

4. Breeding bull provision

4.2 Establishment of local open nuclei based on cow performance

Minimum nucleus size within a PA:

- 14-28 superior cows (7-14% of cow population)

→ no scope for performance selection

4. Breeding bull provision

4.2 Establishment of local open nuclei based on cow performance

Table 3: Selection intensities for different nucleus sizes

	Nucleus size		
	50	100	150
Expected proportion of bulls selected, %	28-56	14-28	9-19
Selection intensity *i*	1.16-0.69	1.60-1.16	1.80-1.42

5. Breeding scheme optimisation

Table 4: Further strategies to improve genetic response

Strategy	Expected effects	
Management improvement	Higher survival rate Lower calving interval	*i* + *i* +
Recording quality	Systematic effects Pedigree information Recording frequency	*r* +
Optimal useful life of bulls	Replacement rate Generation interval	*i* +, *L* - *i* -, *L* +
Optimal useful life of bull dams	Number of calvings Generation interval	*i* +, *L* - *i* -, *L* +

$$\text{Genetic response} = \frac{\text{selection intensity } i * \text{ accuracy } r * \text{ genetic SD}}{\text{generation interval } (L)}$$

6. Conclusions

- Peasant associations as service co-operatives seem to be an adequate starting point for rural genetic improvement programmes
  → Extension of service activities to dairy production (health, feeding, milk processing, breeding)

- The provision of breeding bulls through purchase from the urban area seems not to be sustainable in the long run (genotype x environment interactions, costs); the establishment of local breeding programmes should rather be enhanced

7. Conclusions

- Increasing the nucleus size allows for higher selection intensities. The optimum size, however, depends also on performance level and operational costs.

- Good management plays a crucial role for achieving satisfactory genetic response through the increase of selection intensity (higher survival rate, lower calving intervals)

7. Conclusions

- An efficient recording system mainly based on farmers' own recording is essential for the success of a breeding programme;
  it presupposes the active participation of the farmers and respective vocational training, considering also the traditional role of women in dairy operation

Thank you!

3. Study site


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Beigi
Gīmbī
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Hāgere Hiywet
Addis Abeba
Ādīs Ābeba
Nāşir
Dembī Dolo
Giyon
Gorē
Butajīra
OGADEN
Jīma
Āsela
Bor
Hosa'ina
Shabaelle
Tarch'a Sodo
Gīnīr
Shewa Gīmīra
Yirga 'Alem
Goba
Omo
Wabē Gestro
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Dīla
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Ārba Minch'
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