AICCRA
Accelerating Impacts of CGIAR Climate Research for Africa

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Science for resilient livelihoods in dry areas

Optimizing for a variety of issues can advance genetic gain and lower emission intensity in the community-based breeding programs

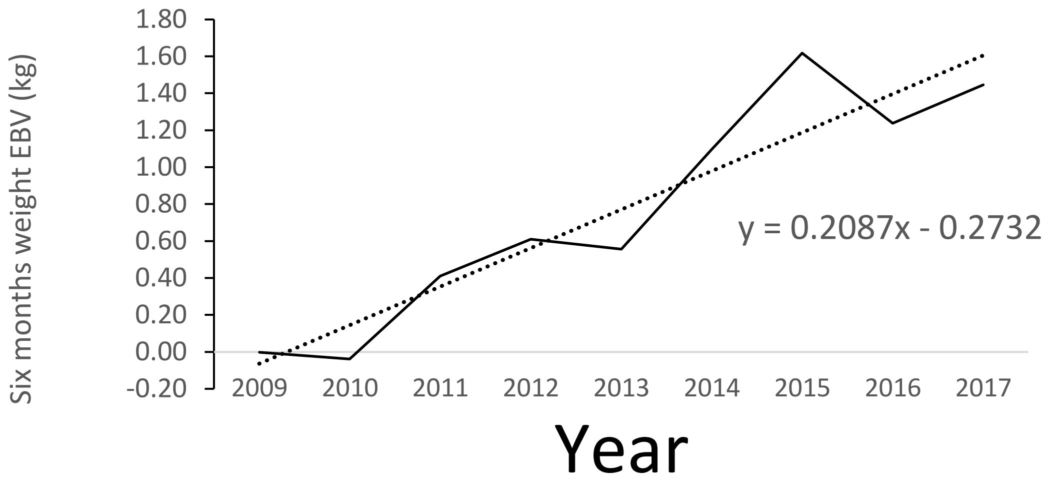
T. Getachew, J. Mueller, M. Rekik, B. Rischkowsky, D. Solomon, B. Belay, A. Haile

All Africa Congress, 26 to 29 Sep 2023, Travelodge, Gaborone, Botswana

Community-based breeding program

Community-based breeding programs (CBBPs) for sheep and goats

Started in 2009



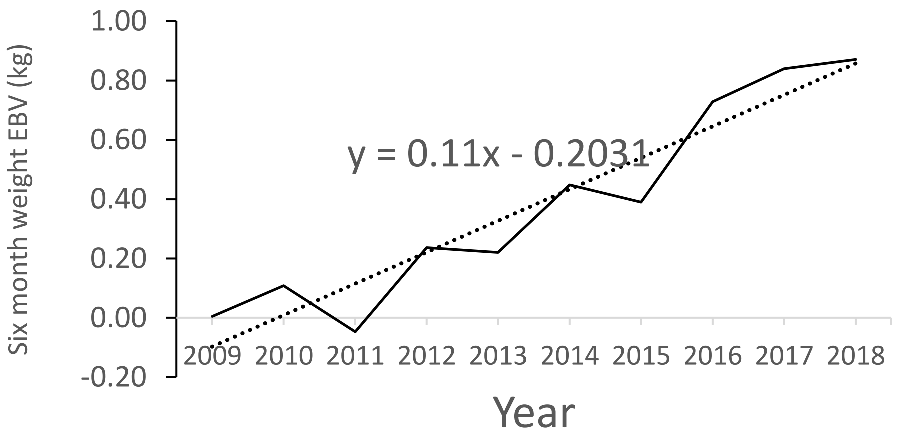
Impacts

genetic gain

Sale volume and income

consumption

Farmers participat ion



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doi:10.1017/S1751731120000269
animal

Community-based sheep breeding programs generated substantial genetic gains and socioeconomic benefits

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frontiers in Veterinary Science
ORIGINAL RESEARCH
published: 29 July 2021
doi: 10.3389/fvets.2021.610610

Welfare Impact of Community-Based Veterinary and Breeding Services on Small Ruminant Keepers

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Tropical Animal Health and Production (2021) 53: 42
https://doi.org/10.1007/s11250-020-02445-w
REGULAR ARTICLES

Estimates of genetic parameters and trends for reproduction traits in Bonga sheep, Ethiopia

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Optimization issues

Traditional data capture

Fixed time for sire usage

Selling of lamb/kid before selection age

Lower selection intensity

Unknown sire

Single trait selection

Practical solutions

Digitize data capture and feedback

Selection in stage

Sire age structure

Uncertain sire

Multi-trait selection

Optimized male to female ratio

Received: 29 June 2020 | Revised: 24 May 2021 | Accepted: 19 July 2021
DOI: 10.1111/jbg.12639

ORIGINAL ARTICLE

Animal Breeding and Genetics WILEY

Three easy fixes for sire use can enhance genetic progress in community-based breeding programmes

Joaquín P. Mueller[1] | Tesfaye Getachew[2] | Mourad Rekik[3] | Barbara Rischkowsky[2] | Zelalem Abate[4] | Shenkute Goshme[5] | Yeshiwas Wale[6] | Aynalem Haile[2]

Animal 15 (2021) 100198
Contents lists available at ScienceDirect
ELSEVIER
Animal
The international journal of animal biosciences

Converting multi-trait breeding objectives into operative selection indexes to ensure genetic gains in low-input sheep and goat breeding programmes

J.P. Mueller[a,*], T. Getachew[b], M. Rekik[c], B. Rischkowsky[b], Z. Abate[d], B. Wondim[e], A. Haile[b]

Livestock Science 256 (2022) 104819
Contents lists available at ScienceDirect
ELSEVIER
Livestock Science
journal homepage: www.elsevier.com/locate/livsci

Optimizing breeding structures and related management in community-based goat breeding programs in the Borana pastoral system of Ethiopia

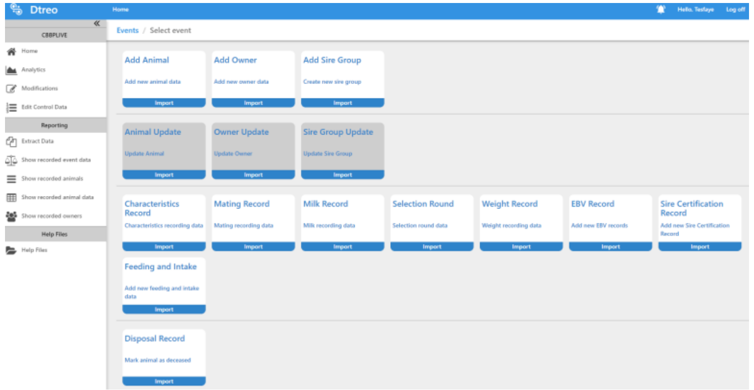
Tesfaye Getachew[a,*], Barbara Rischkowsky[a], Mourad Rekik[b], Joaquin Mueller[c],

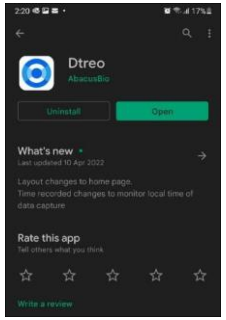
Digital genetic database - DTREO

Online https://dtreo.io/ **Username:** **Password:**

abacusbio.
BRIDGING SCIENCE & BUSINESS

Dtreo events – for data capture



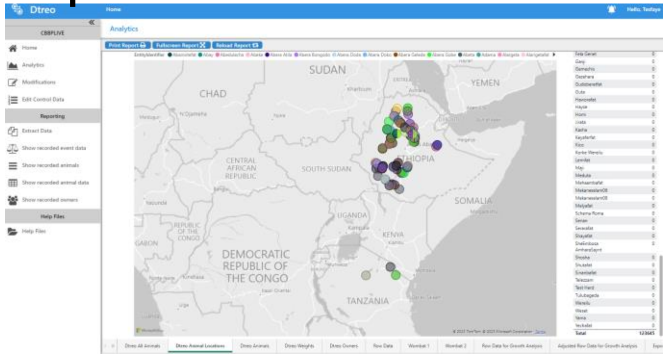


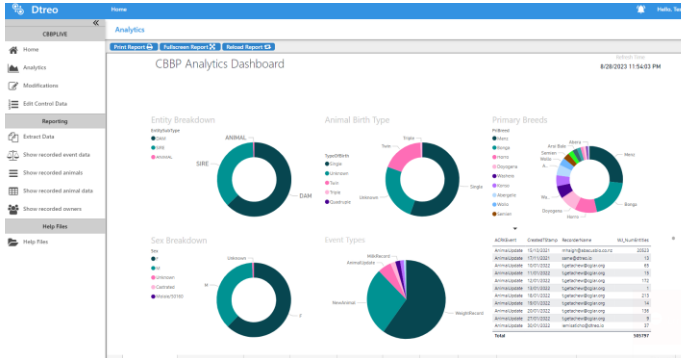
124K lambing/kidding, **200K** live weight, from **69** CBBPs

Also captures feed intake and performance

Data can be accessible for genetic evaluation

Analytic tab – Graphical and spreadsheet reports





- Input files for other programs like WOMBAT
- Ultimate goal - Calculating EBV with just one click

Selection in stages

- Two CBBPs in Menz (Molale and Sinamba) were considered
- Two-stage selection at 3 months and 6 months
- 600 lamb produced annually and 200 left for final selection at six months and 60 required for breeding
- q1 (200 = **0.33**) = proportion of lambs left for breeding at stage 1 - after 400 which is 1-q1 sold
- Among q1 second selection approved 60 (q2 = **0.3**) proportion for breeding at stage 2
- Final proportion required for breeding is q1 * q2 = 0.33 * 0.3 = **0.1**
- Actual selection pressure is 0.3 while the potential is 60/600 = 0.1
- Different q1 were tested to identify designs which achieves 80% of genetic selection differential for males (**Ḡs - Ḡp**)

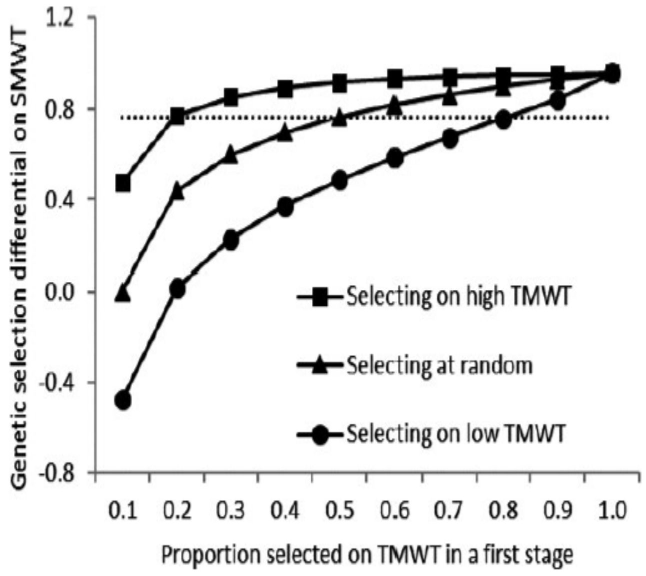
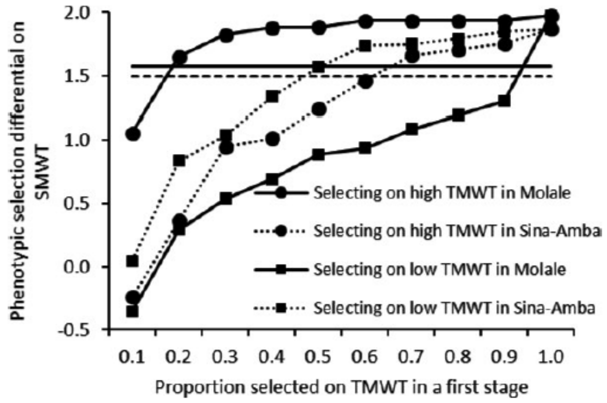


FIGURE 1 Genetic selection differential on six-month weight (SMWT) in units of σ_A obtained in two selection stages with different proportions of candidates selected in a first stage (q_1) on three-month weight (TMWT) of a reference sheep community-based breeding programme described in the text. For example, farmers selling 80% of their lambs on high TMWT in a first stage (equivalent of leaving for final selection a proportion $q_1 = 0.2$) would impede genetic improvement on SMWT, whereas farmers retaining 20% of their heavier lambs can obtain 80% of maximum selection differential (indicated with the broken line) when selecting on high SMWT in a second stage

FIGURE 2 Phenotypic selection differential on six-month weight (SMWT) in units of σ_P after simulating different proportions selected in a first stage (q_1) on high three-month weight (TMWT) or low TMWT in two community-based breeding programme data sets: Molale (full lines) and Sina-Amba (broken lines). Parallel lines indicate 80% of maximum phenotypic selection differential



Sire age structure

- Aim: to calculate optimum age structure
- Annual response to selection $R = (SM + SF)/(LM + LF)$ was evaluated with different age structure
- The above reference system ($nM = 60$, $n = 200$, $s = 0.8$)
- Larger number of selection candidates ($n = 600$) and higher survival ($s = 1.0$), representing breeds and locations with higher reproduction rate and/or with improved management.
- Two methods: **Method A** indicates an optimum structure by selecting 20 sires to remain for 3 years whereas **Method B** indicates an optimum by selecting 29 sires to serve one year and retaining the top 17, 9 and 5 sires for 2, 3 and 4 years, respectively

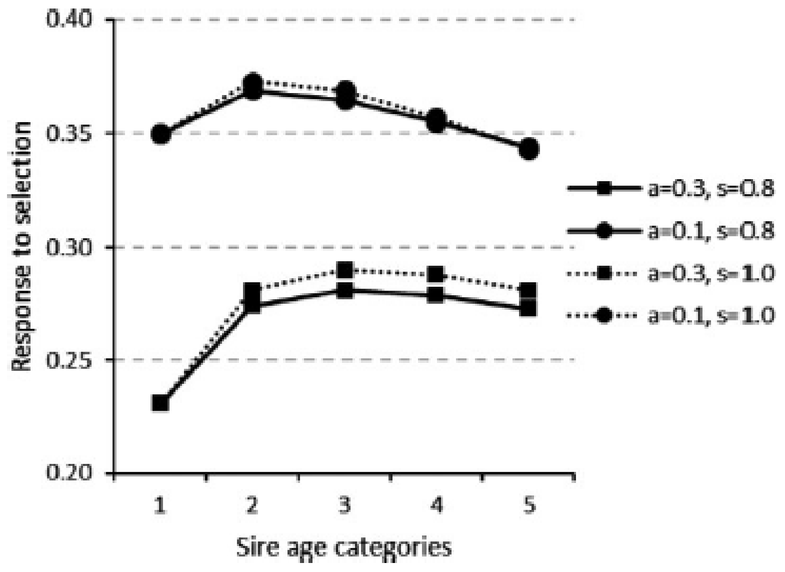


FIGURE 4 Response to selection in units of $h^2 \times \sigma_P$ / *year* with different number of sire age groups for given sire selection pressures ($a = nM/n$) and sire adult survival rates (s)

TABLE 1 Optimum number of sires per age group (n_j) in programmes with different selection pressures on males and females calculated with two methods: Method A equal n_j per age group; Method B flexible n_j per age group. Response to selection (R) in units of $r_{IA}\sigma_A/year$. Assumptions: no mortality ($s = 1.0$), average age of females 3.5 years ($L_F = 3.5$), age at first progeny 1.5 years ($afp = 1.5$)

Selection pressure	Method	n_1	n_2	n_3	n_4	R	R_B/R_A
Low male selection ($n_M/n = 60/200$) and no female selection ($S_F = 0$)	A	20	20	20	0	0.290	
	B	29	17	9	5	0.317	1.093
High male selection ($n_M/n = 60/600$) and no female selection ($S_F = 0$)	A	30	30	0	0	0.373	
	B	37	17	6	2	0.393	1.054
Low male selection $n_M/n = 60/200$) and some female selection ($S_F = 0.4$)	A	20	20	20	0	0.357	
	B	32	17	8	3	0.383	1.073
High male selection ($n_M/n = 60/600$) and some female selection ($S_F = 0.4$)	A	30	30	0	0	0.446	
	B	40	15	4	1	0.465	1.043

Note: n_M: total sires, n: total selection candidates, S_F: female selection differential in $r_{IA}\sigma_A$, R_A: response to selection using Method A, R_B: response to selection using Method B.

Uncertain sire

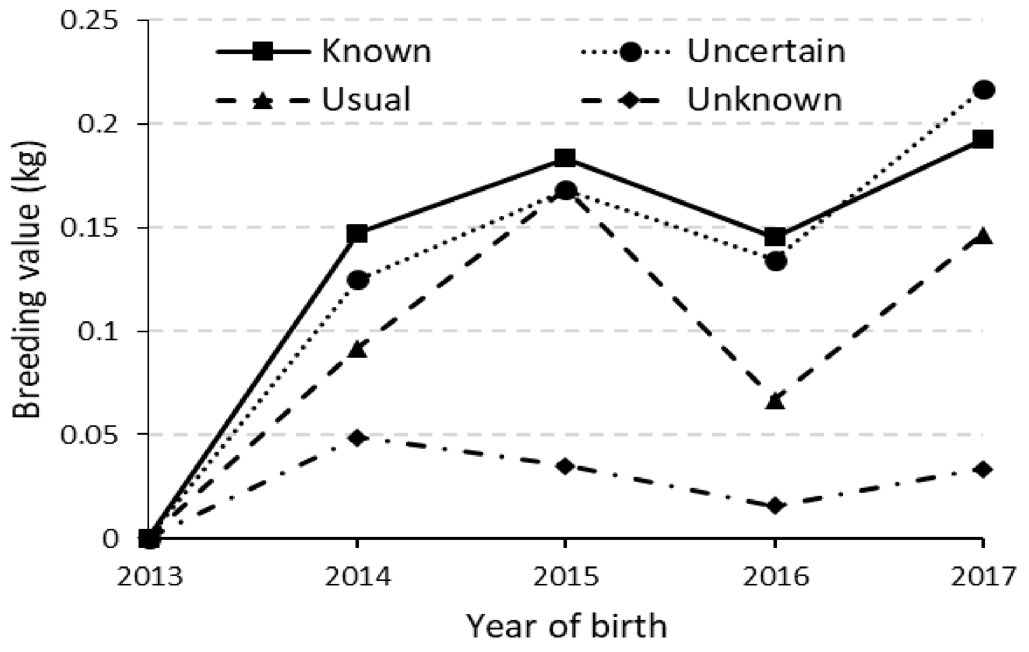
- Aim: to study the benefit from considering uncertain sires rather than unknown sires in BLUP analysis
- Data base from the Abergelle goat CBBP were used
- Four pedigree files with different sire information were prepared
  - "Known" pedigree file: one uncertain sire set as true sire
  - "Uncertain" pedigree file: up to three uncertain sires
  - "Unknown" pedigree file: all sires set to unknown
  - "Usual" pedigree file: uncertain sires set to unknown

TABLE 3 Least squares means of six months weight breeding values with their standard errors (SE) and accuracies using different sire pedigree information of the Bilaque Abergelle goat community-based breeding programme (goats born 2013–2017)

Pedigree file	No. kids with records	No. kids with known dam	No. kids with known sire	Breeding value, kg	SE of breeding value, kg	Accuracy of breeding value
Known	965	964	632	0.090 a	0.649 d	0.693 a
Uncertain	965	964	284 + 273 + 75[a]	0.086 a	0.661 c	0.678 b
Usual	965	964	284	0.051 ab	0.668 b	0.670 c
Unknown	965	964	0	0.023 b	0.683 a	0.652 d

Note: Least squares means followed by different letters are significantly different ($p < .05$).

[a]No. of kids with one, two and three possible sires.



Selection index and mating ratio

- Different systems were considered
- Alternatives were evaluated
  - Sires for meat sheep programs should be selected on own early live weight and desirably also on their dam's number of offspring born

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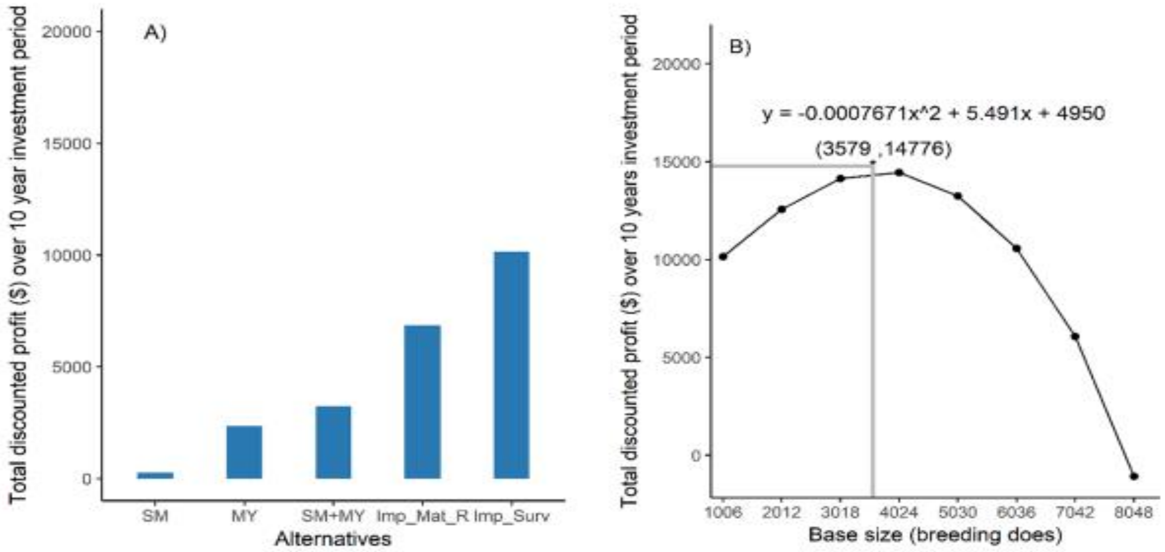

Fig. 1. Total discounted profit (US$) in the breeding program for different breeding schemes (A) and varied base population size (B). MY = lactation milk yield only included in the index, SM+MY = a combination of SM and MY included in the index. For SM, My, SM+MY traditional male to female ratio of 1:9 and kid survival of 60 percent considered. Imp_mat_*R* = improved mating ratio in which male to female ratio of 1:25 and SM and MY traits considered, and Imp_Surv = improved survival rate in which 90 percent of pre weaning kid survival considered over Imp_mat_R.

- In dual-purpose goat CBBPs, sires should be selected on indexes including at least own early live weight and their dams average milk production records

Genetic improvement and climate

- Genetic improvements can lead to healthier, more robust animals that are less susceptible to diseases and environmental stresses – **Climate smart**
  - Improved survival – less replacement and lower emission
  - Reduced time to market – reduce emission associated with breeding and feed production
  - Enhanced growth rates often correlate with improved feed efficiency – fewer resources to produce
- **Multi-Trait Selection** approaches that consider both productivity and GHG emissions

"Being "locally adapted" is not an excuse for poor performing. Go for locally adapted and well performing, by breeding."

Professor Johann (Hans) Soelkner

Thank you!!!