

Small ruminant breeding programs focusing on centralized nucleus and crossbreeding have failed in Ethiopia and need re-think

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31st Annual ESAP conference
27-30 October 2023
Jijiga, Ethiopia

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- Context
- Small ruminant genetic improvement
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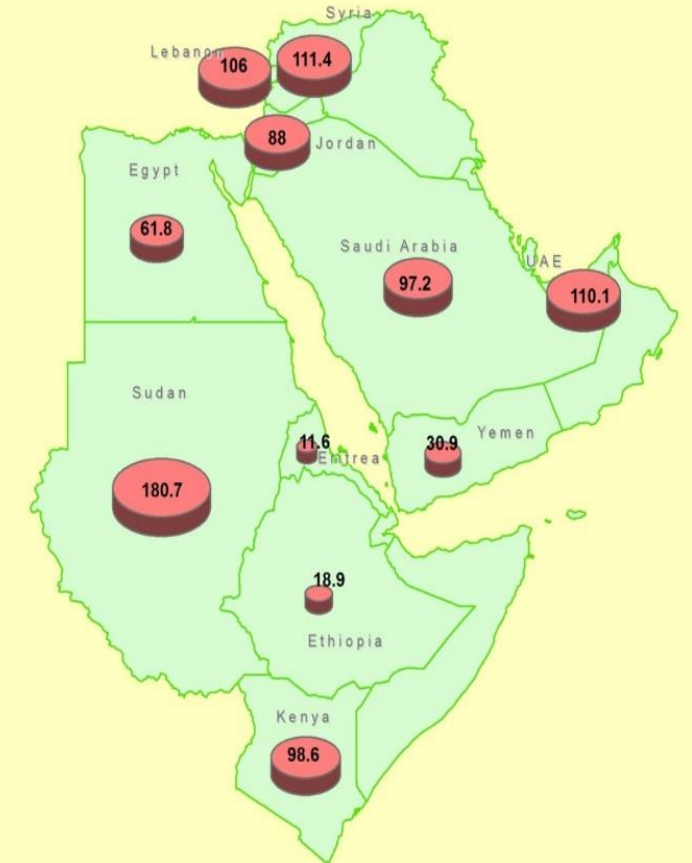
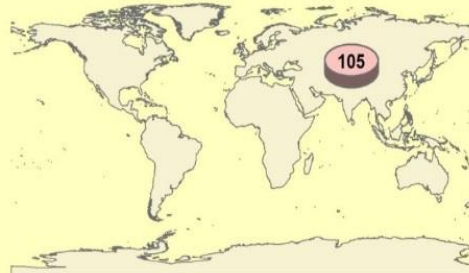
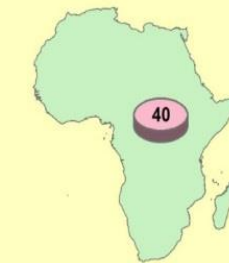
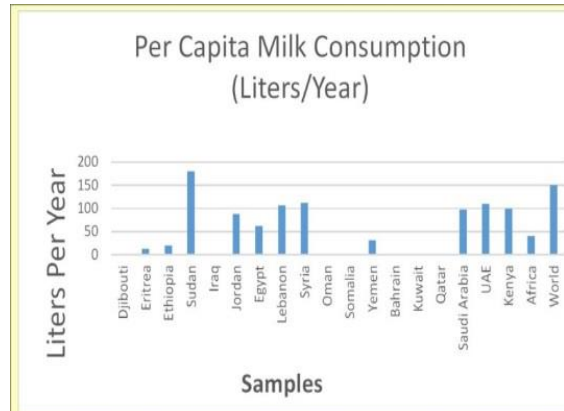


Livestock contribution

- Sheep and goat populations 30.7 and 30.2 million, respectively (CSA, 2017)
- Agriculture provides sustenance for more than 80% of the population and accounts for 34.9% of GDP and 83.9% of total exports (NBE, 2018)
- Livestock sector contributes up to 25.6% of agricultural GDP and 10.5% of total Ethiopian foreign exchange earnings (NBE, 2018)
- Ethiopia's annual exports of cattle and sheep meat were valued at USD 79.13 million in 2012, while Botswana with a much lower stock number was able to reach USD 150 million export earnings from beef alone
- Lower export level attributed to stronger local demand leading to higher prices, lower meat output and differences in efficiency of meat production systems

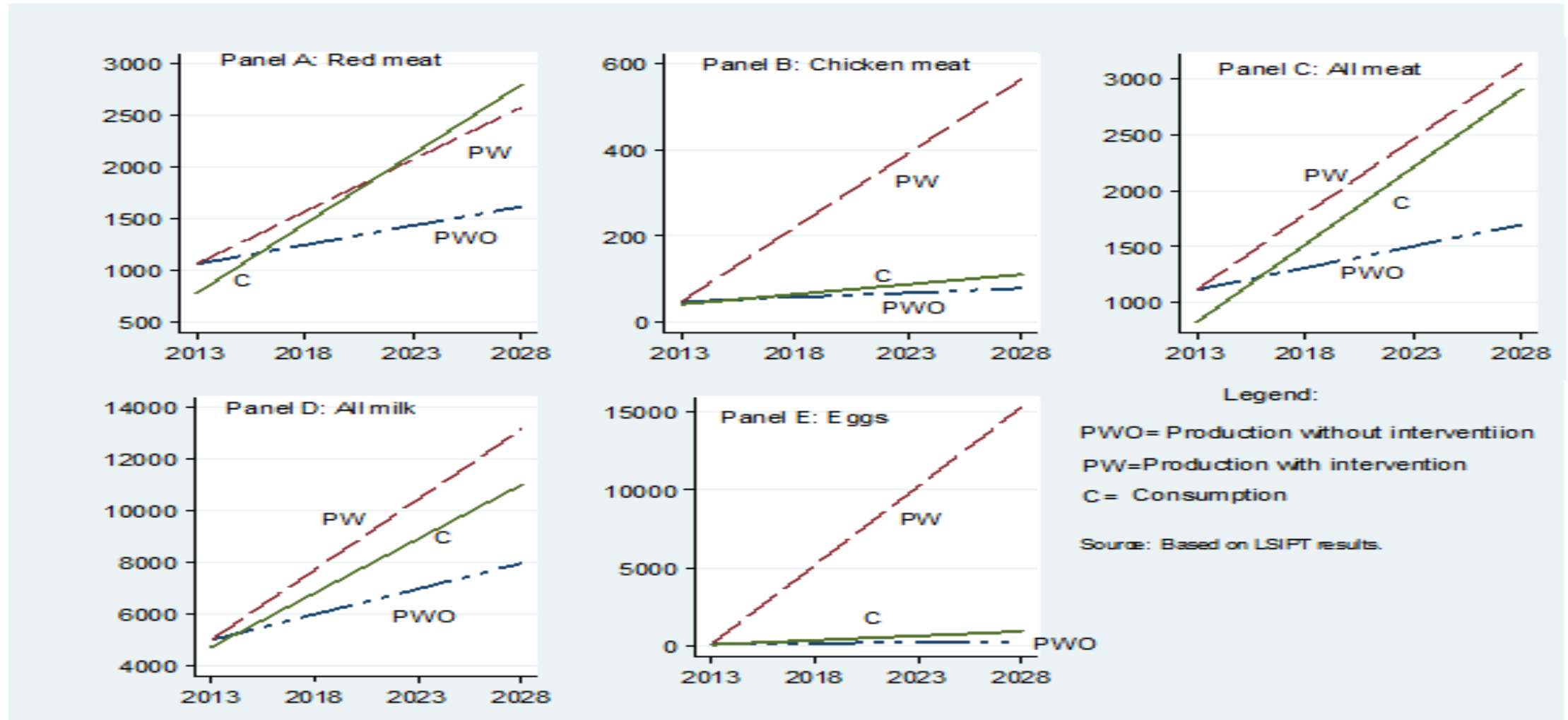
Per capita milk and meat consumption (kg/year))

Country	Milk	Meat
Developed countries	217.0	95.7
• Finland	361.2	67.4
• Sweden	355.9	76.1
• Netherlands	320.2	89.3
Developing countries	55.0	31.6
Sudan	180.7	21.0
Kenya	120.0	14.3
Tanzania	42.0	10.0
SS Africa	31.0	10.9
Ethiopia	19.0	7.9



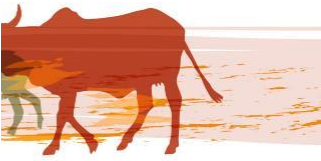
Source: FAOSTAT

Demand and supply projections for red meat, chicken meat, milk and eggs from 2013 to 2028, with and without investment interventions



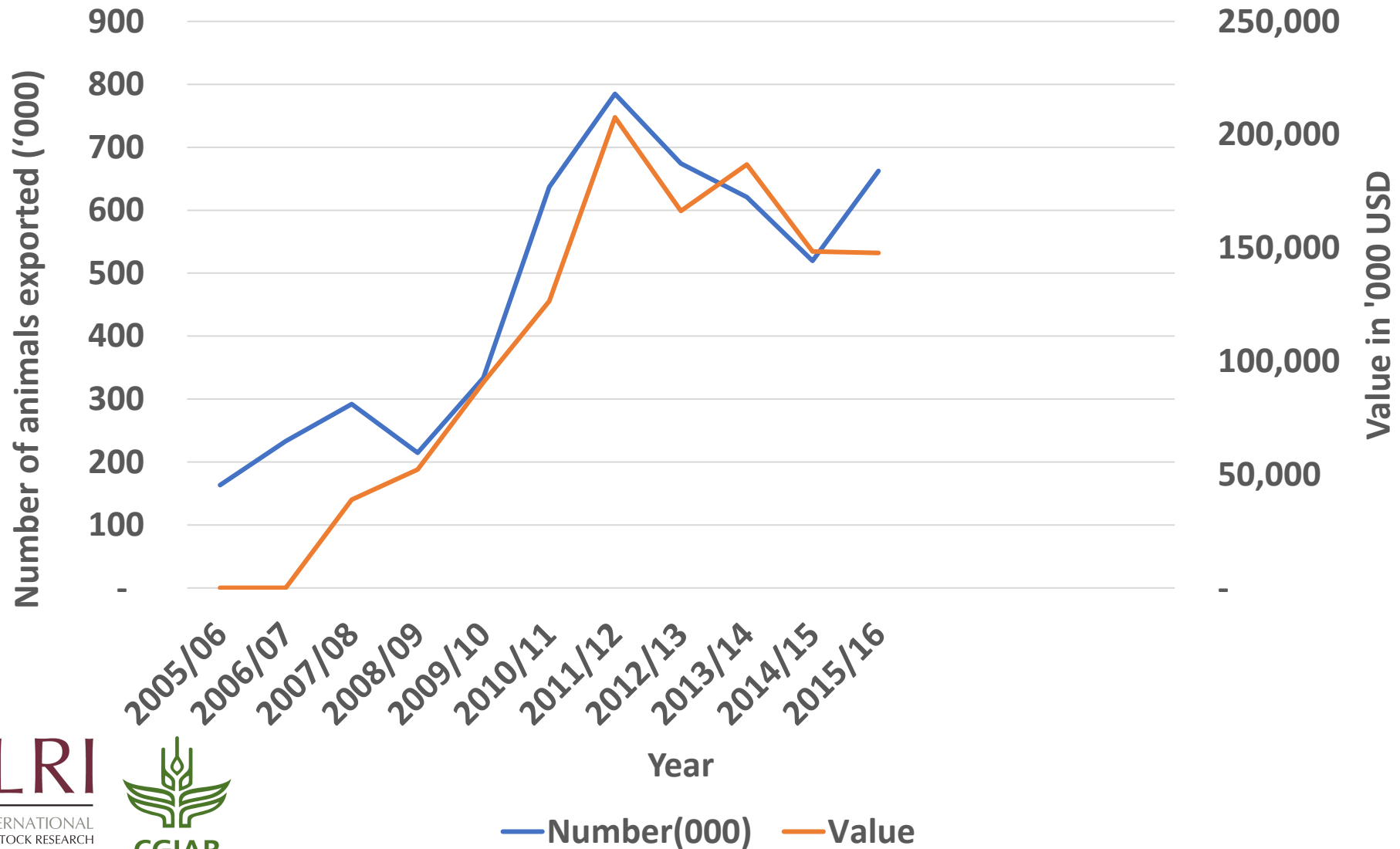
Source: LMP, 2014

Introduction (Cont'd)



eat, milk and eggs by and for the poor

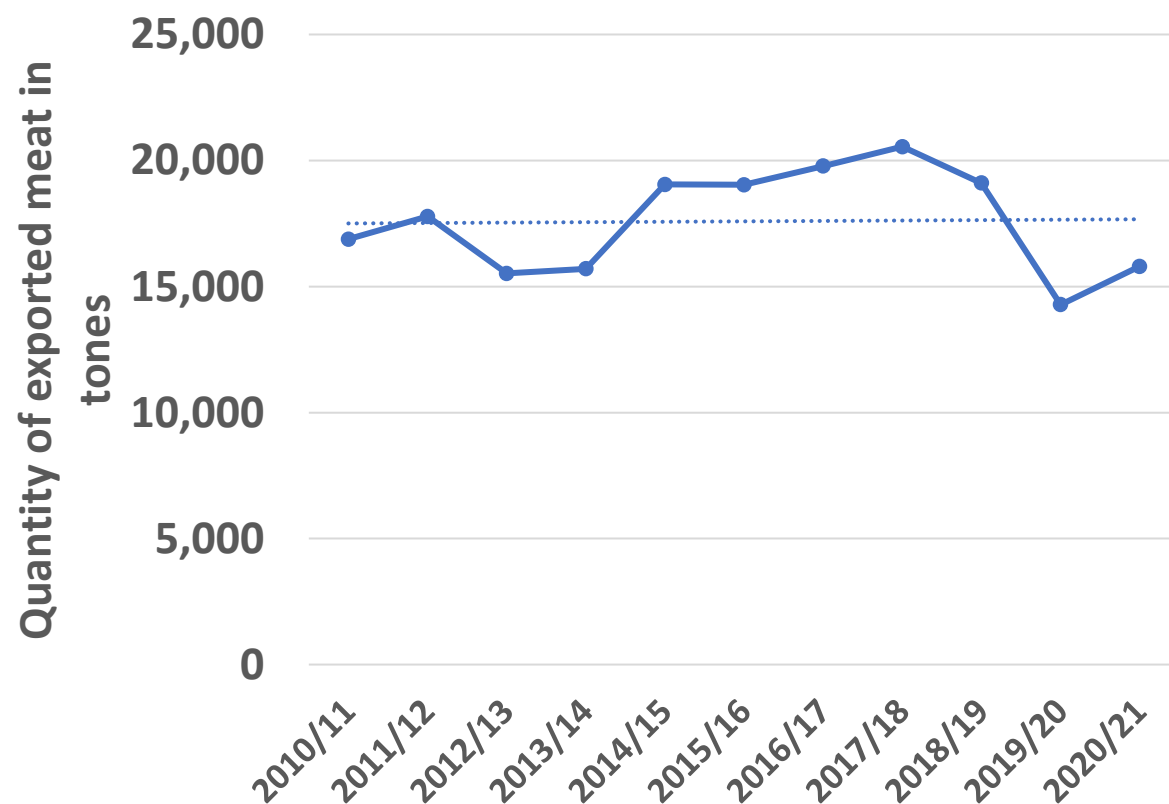
Number of live animals exported 10 years and income obtained



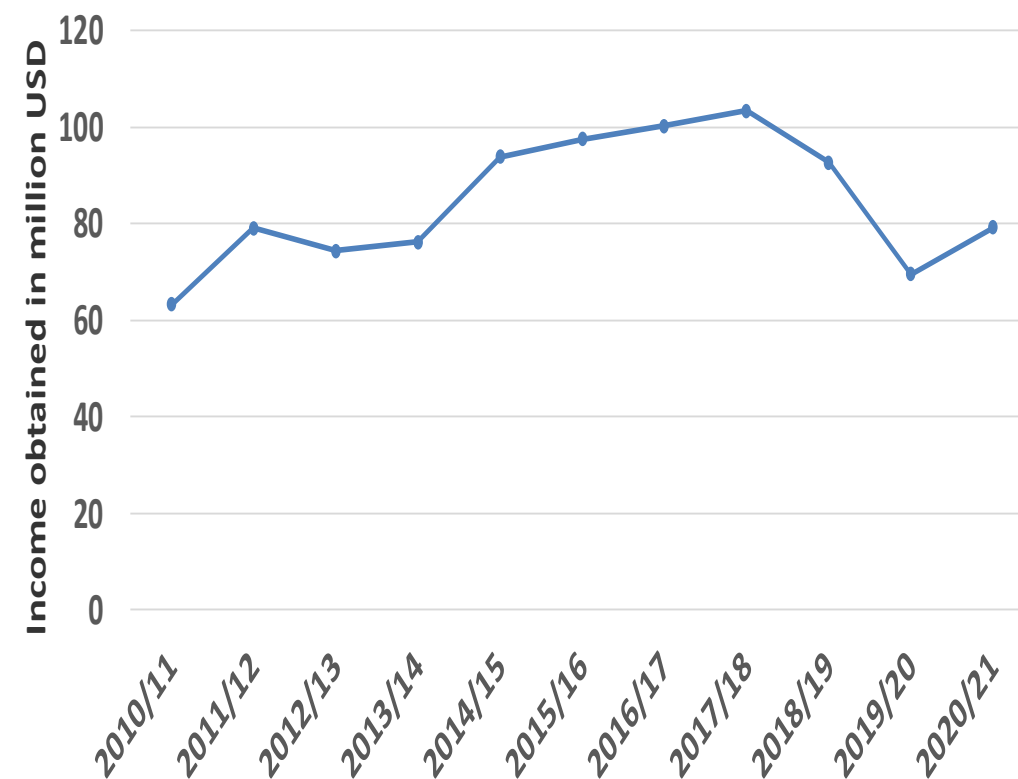
Introduction (Cont'd)



Volume of meat exported in the last 10 years



Income Obtained from Meat Export in the Last 10 Years



Summary points

- High potential
- Huge demand
- Little consumption
- Little contribution at HH and national level
- We need to do something about it





Efforts in small ruminant breeding

- Very little work by projects, Universities, Research centers
- Most efforts focused on import of exotic and crossbreeding
- Some on-station selective breeding
- Most were expensive failures



Examples of failures



1. The Dairy Goat Development Program (FARM AFRICA)

Launched in 1989 and its implementation continued in three successive phases until June 1997

The specific components of this package:

- organization of participating women into self-help credit and extension groups,
- improved forage development, tethered management, strategic supplementation,
- indigenous goat restocking on revolving credit,
- community-based animal health services,
- training of extension staff and participating women in improved goat management,
- genetic improvement of goats through crossbreeding
- close follow up and monitoring of activities

- 
- Selected participants were first provided with indigenous goats on credit after having organised themselves into voluntary self-help groups, started developing some improved forage and participated in extension training.
 - Those who maintained continued interest in the programme then received F1 crossbred goats on credit upon repayment of at least 50% of the credit for local goats.
 - The aim of the DGDP had been to enable the farmers to maintain the crossbred (Somali x Anglo-Nubian) and indigenous (Somali, Hararghe-Highland) goats managed under improved level of care in terms of feeding, health care and housing and produce better than the local flocks in traditional management.
 - Maintain 50% exotic blood level in crossbreds for the prevailing level of management (i.e. F1 does together with F1 bucks);
 - The F1 does are distributed with 50% kid in-utero;

Major results from the evaluation

- Higher unit net benefits were obtained in both the crossbred and the indigenous goats under improved management.
- Crossbred goats did not produce higher unit net benefits than indigenous goats based on land, metabolic body weight and labour input.
- The greater weight losses of the crossbreds lead to a higher risk of reaching critically low body conditions during the dry season.
- Shortages of crossbred breeding males also led to gradual backcrossing of the does, resulting in an increasingly mosaic mix of crossbreds.
- As a result activities relating to the introduced technologies have declined after the DGDP was phased out.
- The prevailing prejudgment in Ethiopia that indigenous goats do not adequately respond to improvements in level of care compared to crossbred goats is not true.
- The case for the introduction of crossbred goats was further eroded by the practicalities of maintaining an appropriate breeding programme.



Amed Guya/Debre Berhan Ranches and other introductions through projects

Small ruminant improvement in Ethiopia - Crossbreeding



In 1947
Merino from Italy
(NGO)



In 1967
Corriedale, Hampshire,
Romney, Rambouillet _Kenya



Late 1980s, **2006, 2011 (ESGPIP)**
Dorper, Anglo-Nubian, Sanan , Boer



Awassi

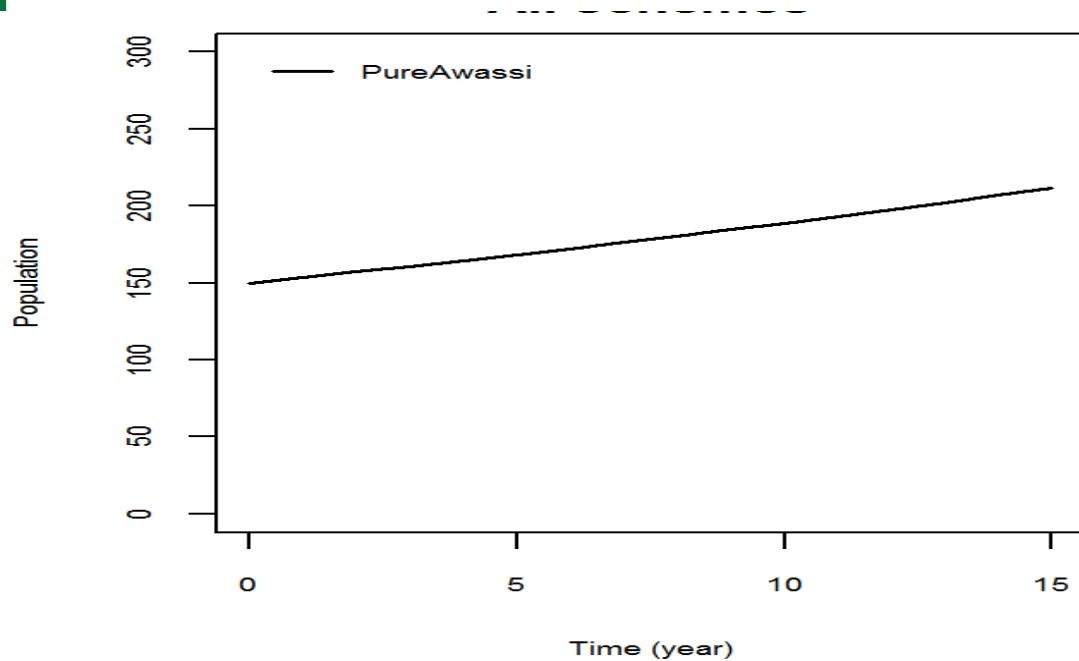
- In 1980 - 45 ram and ewe lambs
- ¹⁵ In 2011 – 170 sheep

- Inefficient multiplication and dissemination
- Maedi-Visna - dissemination was banned in the two Awassi stations between 2001 to 2009)
- Again recently, more than 80% are positive animals and were destocked
- Poor adaptation – Boer goat

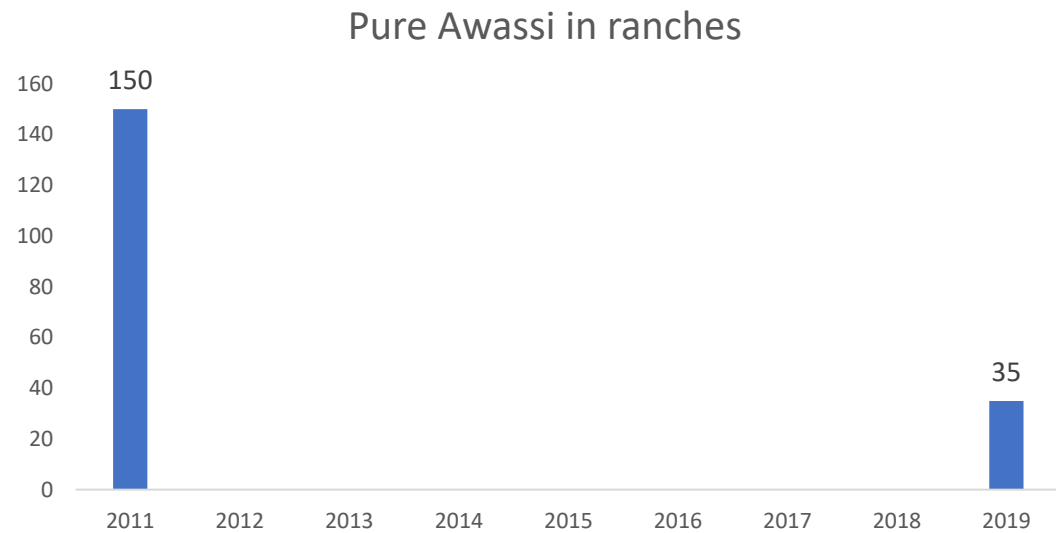


- Debre Berhan ranch – size 531 ha, 1500 animals all types
- Amed Guya – size 860 ha, 1100 sheep (most of them are local)
- Many importations of Awassi sheep from Israel for crossbreeding and distribution of rams
- Dissemination was banned between 2001 to 2008
- Again very high level of Maedi-visna reported recently in Amed Guya – Many positive animals (2300/3000) were destocked
- Sudden death – has been reported at Debre Berhan

Performance of public farms in maintaining pure exotic stock



Simulated based on existing system



realized

Indigenous stock??

Dissemination efforts

- During 1969 to 1974, a total of 96 ram lambs distributed
- During 1974 to 2001 more than 4000 disseminated from both ranches
- Both ranches disseminated a total of 3088 between the year 2008 and 2018



Crossbred sheep population in the country is less than 0.1%

Challenges

- Disease outbreak:
- Management
- Physical characteristics of animals (colour, tail, ..)
- Adaptation problem
- Lack of proper breeding program and commitment
- High importation and running cost

Alternative approach - Community-based breeding approach

- A three-year ICARDA-ILRI-BOKU project “Designing community-based breeding strategies for indigenous sheep breeds of smallholders in Ethiopia”, funded by the Austrian Development Agency, was launched on 12th March 2007
- Four sheep breeds (Menz, Afar, Bonga and Horro)



icarda.org

Aim:

Improve the livelihoods of resource-poor farmers; contribute to better market supply and food security; and provide a framework for genetic improvement that can be replicated elsewhere in and outside of Ethiopia

Community-based breeding

- Participatory breeding
- Improvement programs carried out by communities of smallholder farmers
- Considers proper farmers breeding objectives, infrastructure, participation and ownership
- Approach: Cooperative, enumerator, research/universities
- Different breeding structure depending on the scenario



Partners engagement

CGIAR – **ICARDA-ILRI**

- Design, oversee, technical support, capacity development

NARS

- Technical support: Supervise data capture and analysis, genetic evaluation and animal ranking

Universities

- Technical support: Supervise data capture and analysis, genetic evaluation and animal ranking

Breeder cooperatives

- Owner of and running the breeding program (animal identification, sire use and management, controlling finance, selection, selling and buying of sire, an so on)

Enumerators

- Assist breeder cooperatives in animal identification, data capture

Extension

- Provide extension service, organization

Cooperative office

- Cooperative formation and follow-up

Major outcomes/impact

- Ethiopia, more than 200 villagers directly benefiting
- Higher levels of household income (20% increase), meat consumption (threefold), and market participation (supplied more sheep/goat per year to the market)
- Most of the established cooperatives have been able to build capital (e.g. Bonga cooperatives has a capital of more than 501k USD)
- CBBP is strategy of choice for small ruminants in Ethiopia -
- CBBP scaled to many countries, Tanzania, Malawi, Uganda, Sudan, SA, Burkina faso, Tunisia, Egypt, Mali,...

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doi:10.1017/S1757177120000269



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

A. Haile¹, T. Getachew¹, T. Mirkena², G. Duguma³, S. Gizaw⁴, M. Wurzinger⁵, J. Soelkner⁵, O. Mwai⁶, T. Dessie⁴, A. Abebe⁷, Z. Abate⁸, T. Jembere⁹, M. Reki¹, R. N. B. Lobo¹⁰, J. M. Mwacharo¹, Z. G. Terfa¹, G. T. Kassie¹, J. P. Mueller¹¹ and B. Rischkowsky¹

frontiers
in Veterinary Science

ORIGINAL RESEARCH
published: 20 Aug 2021
doi: 10.3389/fvets.2021.610610

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

Girma Tesfahun Kassie¹, Wolisshet Asnake², Aynalem Haile³, Tesfaye Getachew Mengistu⁴, Solomon Gizaw⁵, and Barbara Rischkowsky¹

Received: 14 December 2018 | Revised: 29 March 2019 | Accepted: 1 April 2019
DOI: 10.1111/psp.12401

ORIGINAL ARTICLE

Animal Breeding and Genetics | WILEY

Community-based breeding programmes are a viable solution for Ethiopian small ruminant genetic improvement but require public and private investments

Aynalem Haile¹, Solomon Gizaw², Tesfaye Getachew¹, Joaquin P. Mueller³, Peter Amer⁴, Mourad Reki⁵, Barbara Rischkowsky¹

Animal 15 (2021) 10002



Contents lists available at ScienceDirect
Animal
The international journal of animal biosciences



Estimation of (co)variance components, genetic parameters, and genetic trends of growth traits in community-based breeding programs of Bonga sheep

E. Areb^{1,2}, T. Getachew³, M.A. Kirmani⁴, Z. Abate⁵, A. Haile⁶

ACTA AGRICULTURAE SCANDINAVICA, SECTION A — ANIMAL SCIENCE
<https://doi.org/10.1080/0964702.2022.2067599>



Genetic parameters and trends of growth traits in community-based breeding programs of Aberra sheep in Ethiopia

Amelmal Alemayehu¹, Tadele Mirkena², Aberra Melesse³, Tesfaye Getachew⁴ and Aynalem Haile⁵

Heliyon 6 (2022) e09749
Contents lists available at ScienceDirect
Heliyon
journal homepage: www.elsevier.com/locate/heliyon

Research article

Analysis of genetic parameters and genetic trends for early growth and reproductive traits of Doyogena sheep managed under community-based breeding program

Kebede Habtegiorgis^{1,2}, Aynalem Haile³, Tesfaye Getachew⁴, Manzoor Ahmed Kirmani⁵, Deribe Gemeyo⁶

Received: 30 October 2019 | Revised: 25 January 2020 | Accepted: 6 February 2020
DOI: 10.1016/j.heliyon.2020.13384

ORIGINAL ARTICLE

Animal Science Journal | WILEY

Increased number of large non-atretic follicles and co-dominance effects account for high litter sizes in Bonga sheep

Asrat Tera Dolebo¹, Aberra Melesse², Cristian Porcu³, Tesfaye Getachew³, Aynalem Haile³, Mariem Rouatbi⁴, Zelalem Abate⁵, Mulken Zeleke⁵, Barbara Rischkowsky³, Joram M. Mwacharo³, Mourad Reki⁶

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

Asrat Tera¹, Tesfaye Getachew², Aberra Melesse³, Mourad Reki², Barbara Rischkowsky², Joram M. Mwacharo², Zelalem Abate⁴, Aynalem Haile⁵

Open Access

Anim Biosci
Vol. 34, No. 9:1451-1459 September 2021
<https://doi.org/10.5713/ajas.20.0413>
pISSN 2765-0189 eISSN 2765-0235

AB ANIMAL BIOSCIENCE

Estimation of co-variance components, genetic parameters, and genetic trends of reproductive traits in community-based breeding program of Bonga sheep in Ethiopia

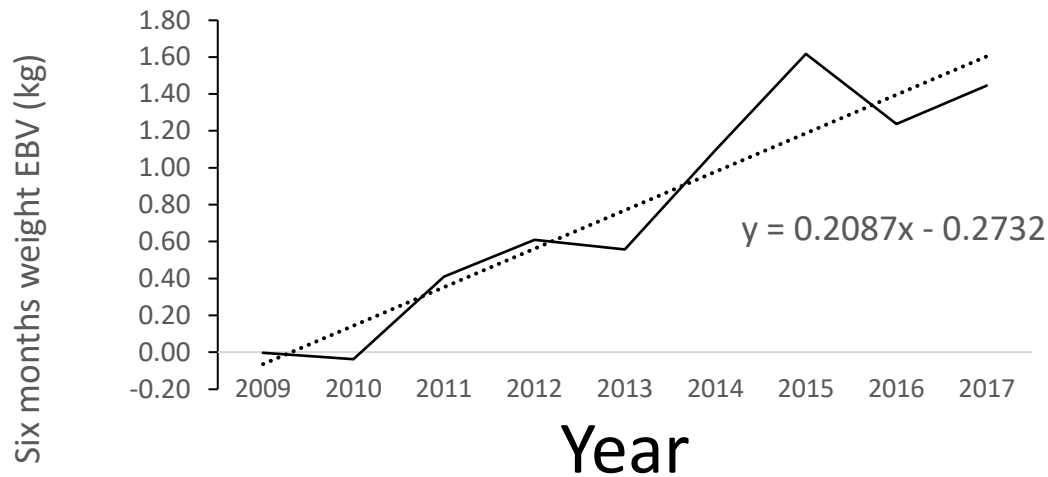
Ebadu Areb^{1,2}, Tesfaye Getachew³, MA Kirmani⁴, Tegbaru G. Silase¹, and Aynalem Haile⁵

Mammalian Genome (2019) 30:339–352
<https://doi.org/10.1007/s00335-019-09820-5>

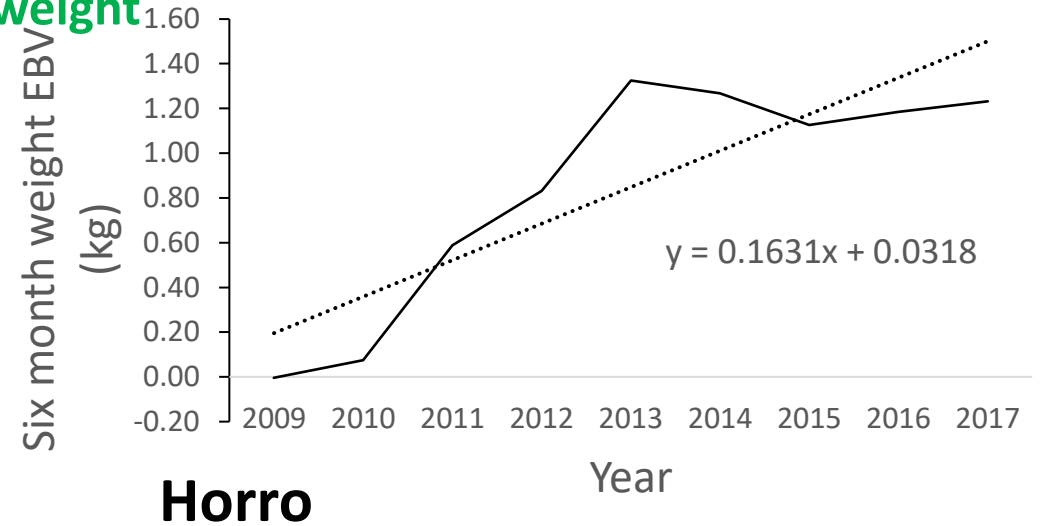
Genome-wide scans identify known and novel regions associated with prolificacy and reproduction traits in a sub-Saharan African indigenous sheep (*Ovis aries*)

Asrat Tera Dolebo^{1,2}, Negar Khayatadeh³, Aberra Melesse², David Wragg⁴, Mourad Reki⁵, Aynalem Haile⁵, Barbara Rischkowsky⁵, Max F. Rothschild⁶, Joram M. Mwacharo⁵

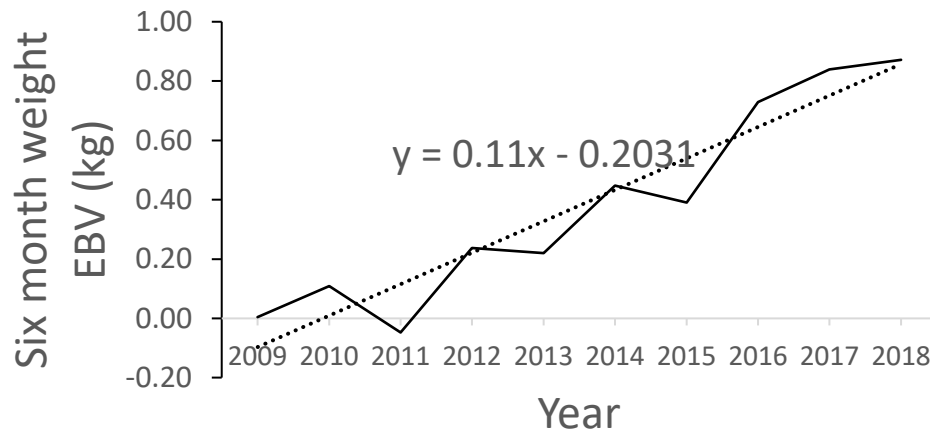
Substantial genetic progress: six months weight



Bonga



Horro



Menz

Financial performance

- The total amount of existing capital in the Bonga cooperatives: **28,073,914 = 501KUSD**
- Shared dividend: **4,356,374 ETB**
- For different community service **518,676 ETB**

Scaling framework

Strategies were

1. Replicate existing CBBPs
2. Increase the number of breeding males produced and disseminated per CBBP
3. More intense use of CBBP sires in nucleus and base

Genetic progress and economic benefit of community-based breeding programs for sheep out- and upscaling options in Ethiopia

J.P. Mueller^{a,*}, A. Haile^b, T. Getachew^b, M. Rekik^c, B. Rischkowsky^b

frontiers | Frontiers in Genetics

TYPE Original Research
PUBLISHED 17 March 2023
DOI 10.3389/fgene.2023.1114381

Check for updates

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to
Livestock Genomics,
a section of the journal
Frontiers in Genetics

RECEIVED 02 December 2022
ACCEPTED 06 March 2023
PUBLISHED 17 March 2023

CITATION

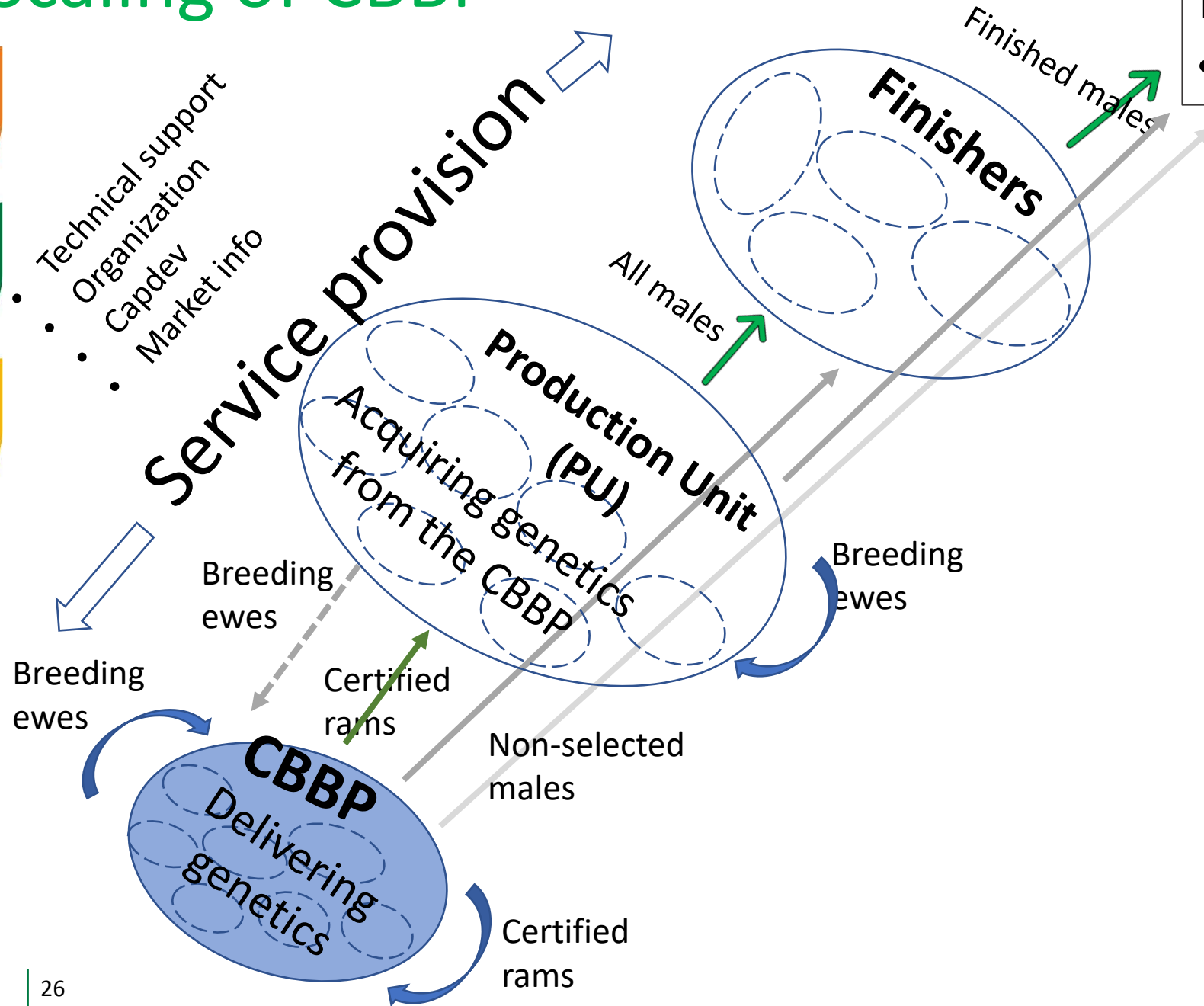
Going to scale—From community-based to population-wide genetic improvement and commercialized sheep meat supply in Ethiopia

Joaquin Mueller¹, Aynalem Haile^{2*}, Tesfaye Getachew²,
Bruno Santos³, Mourad Rekik⁴, Berhanu Belay²,
Dawit Solomon⁵, Likawent Yeheyis⁶ and Barbara Rischkowsky²

¹National Institute for Agricultural Technology (INTA), Bariloche, Argentina, ²International Center for Agricultural Research in the Dry Areas (ICARDA), Addis Ababa, Ethiopia, ³AbacusBio Limited, Dunedin, New Zealand, ⁴International Center for Agricultural Research in the Dry Areas (ICARDA), Tunis, Tunisia, ⁵International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia, ⁶Amhara Regional Research Institute (ARARI), Bahir Dar, Ethiopia

Scaling of CBBP

- Technical support
- Organization
- Capdev
- Market info

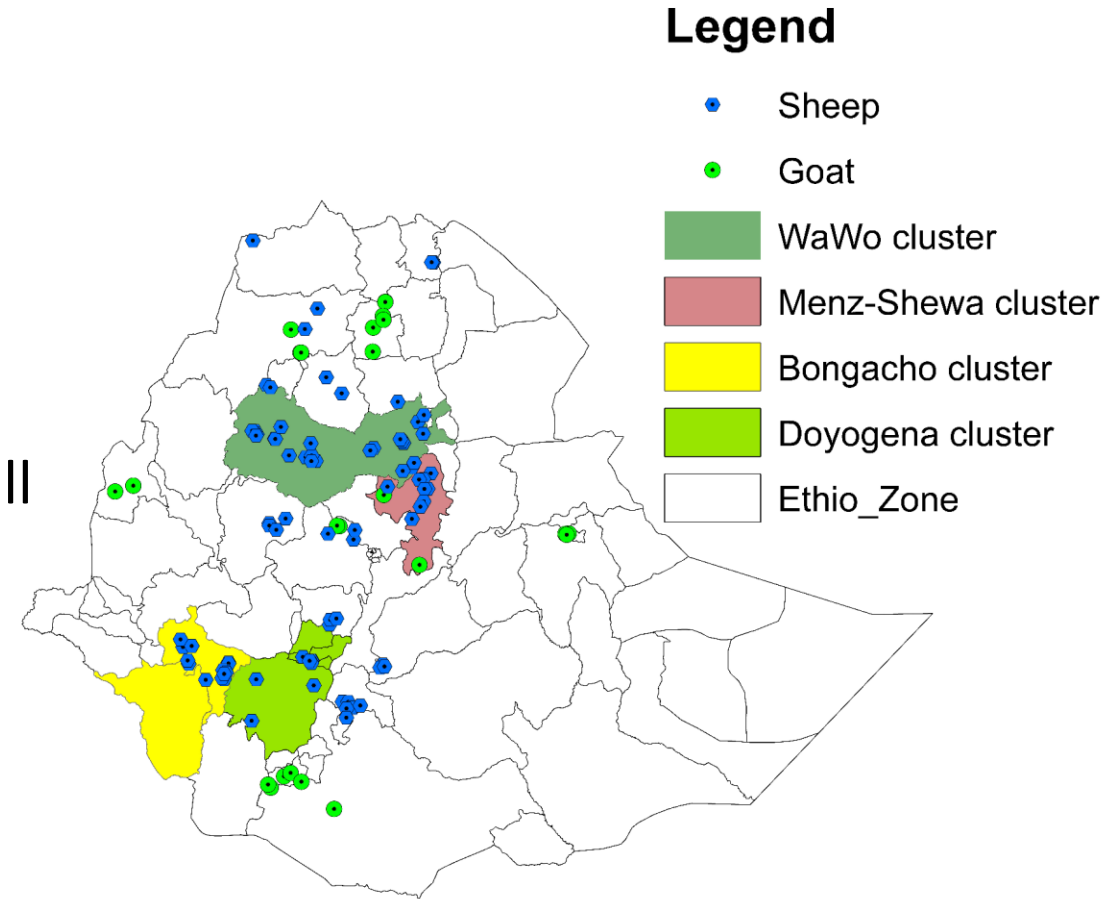


Components

- Input/ service provision
- Feed intervention
- Health interventions
- Market linkage
- Genetic improvement
- Genetic dissemination

Scaling potential for Washera, Wollo, Bonga and Menz sheep

- Partner institutions involved= 27 partners (8 universities, 6 research, 6 NGOs, 1 private, 3 extension, 3 cooperative)
- Total existing dispersed CBBPs: **92 CBBPs**
- Additional CBBPs required to cover 3.8 million ewes: **111 CBBP**
- Production capacity of exiting sires at CBBPs in all the initiatives: **17,336**
- Sires that could be disseminated to PU: **16,736**
- Potential lambs produced for the market from existing CBBPs: 1.13 Million/year
- When the scaling is fully functional, number of lambs produced: **2.7** million/year
- Sires disseminated by ICARDA and partners: **7800**



WaWo Scaling initiative

Wahera
(584392
HH)

28 CBBPs with 10,000
ewes

4500 breeding
sires/Anum

266k ewes in the PU

187k lambs/year for market

Full potential: 1,373,123 lambs/ year



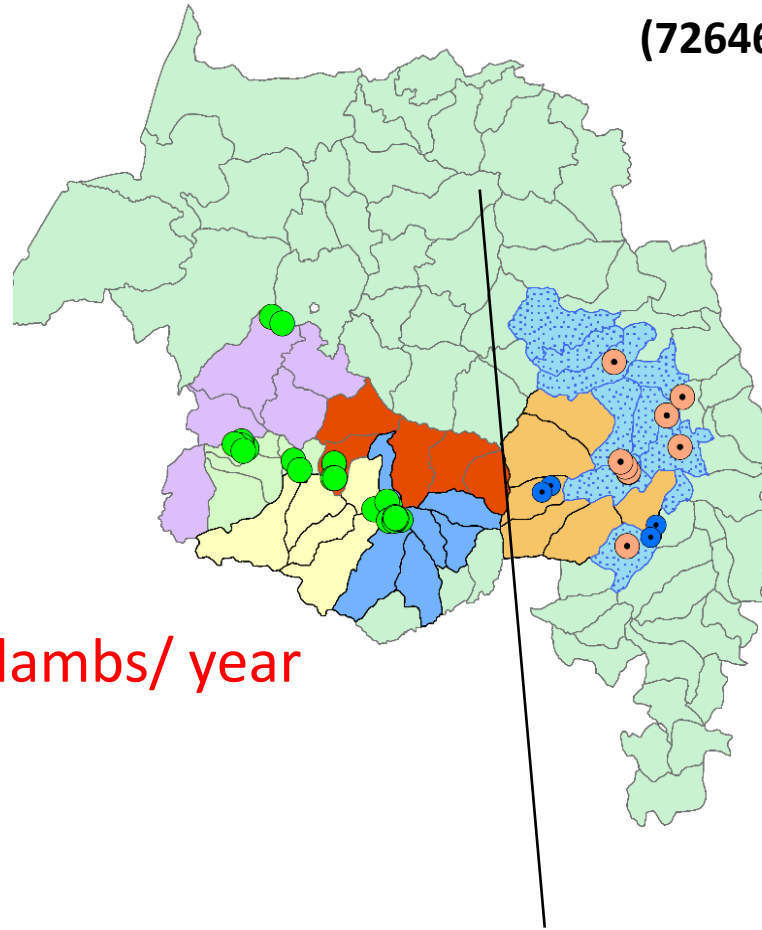
Wollo
(72646HH)

5 CBBPs with 5,500 ewes

1971 breeding
sires/Anum

169K ewes in the PU

101K lambs/year for
market



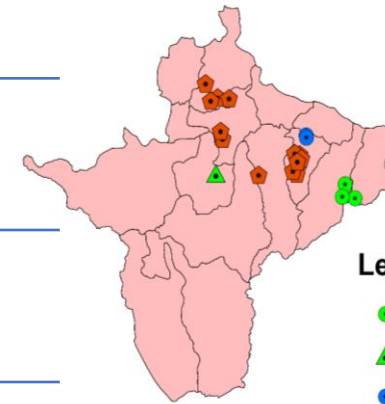
Bongacho Scaling program

22 CBBPs with 11,000 ewes

6,443 breeding sires annually

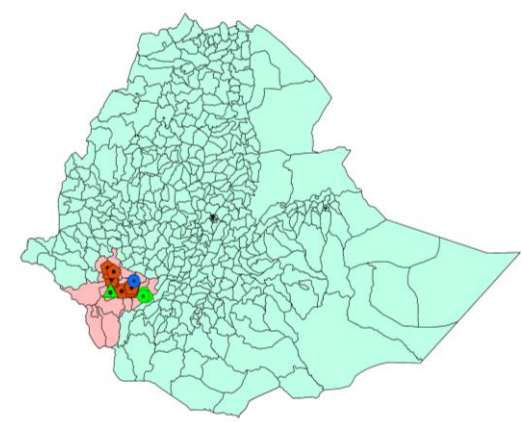
373,377 ewes in the production unit

332,012 lambs are produced annually for the market



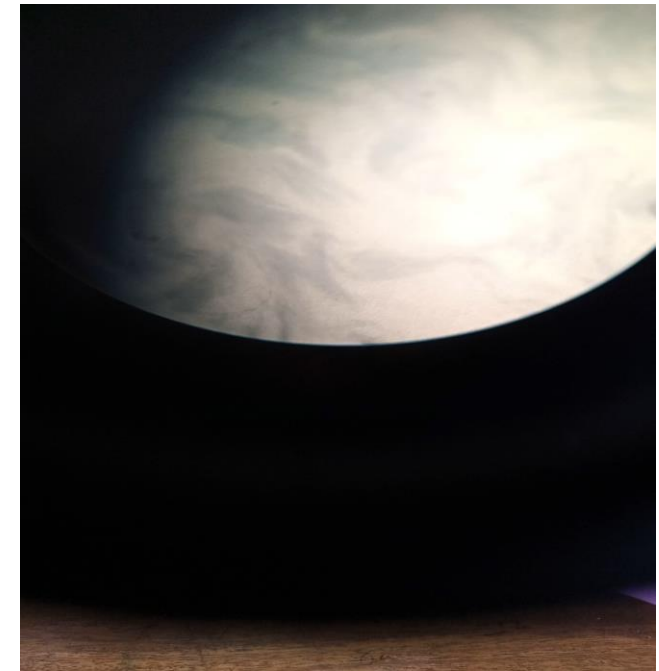
Legend

- Dawro
- ▲ MTU_Psite
- Older CBBPs
- ⬠ Out scaled CBBPs
- SW Ethiopia target area





- Each rams have been examined for their EBV, breeding soundness and certified before dissemination



Ram Pre-Breeding Examination Certificate (Bonga CBBP)

WONDIMU ABETO
Boka
BQ 00 60919
Estimated breeding value 5.7

Date of Examination: _____

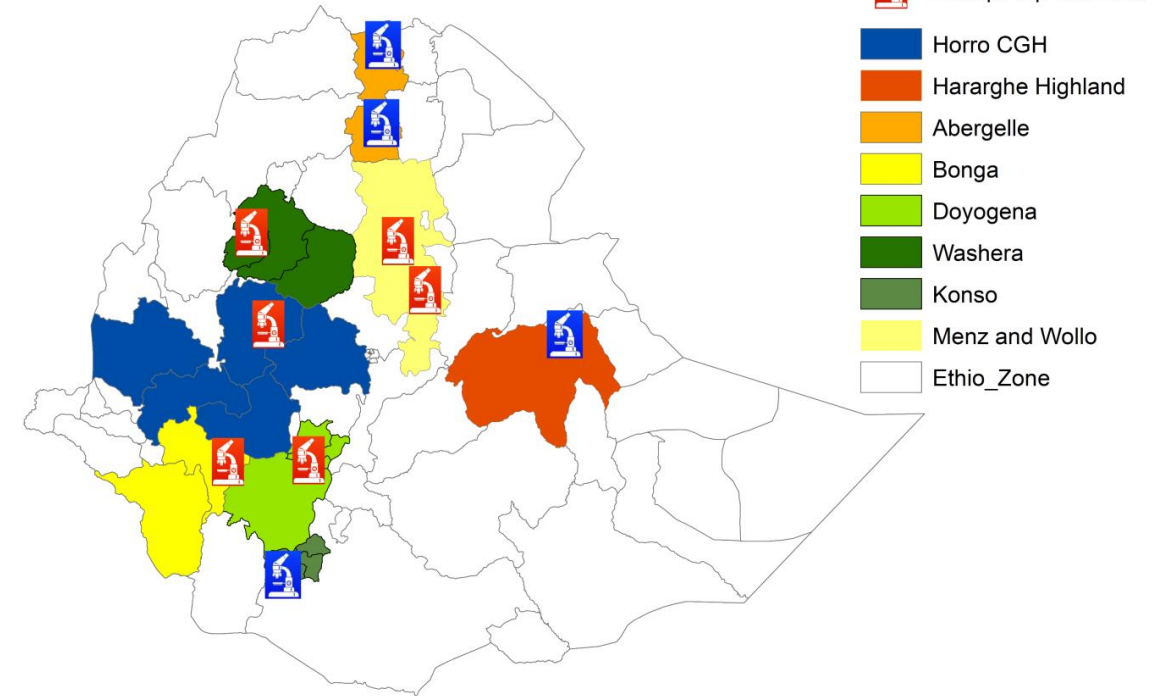
1. Physical examination			2. Semen examination			3. Assessment of mating ability and libido	
Body condition score (1-5)	4	NAD	Abnormal	Collection method	AV*	EEJ**	☒ This ram has been observed exhibiting normal service behavior and mating ability ☐ his ram has not been observed exhibiting normal service behavior and mating ability
Eyes, nose and mouth	✓			Appearance/density	4	15	
Conformation and limb soundness	✓			Gross motility	5	15	☐ his ram has not been observed exhibiting normal service behavior and mating ability
Feet	✓			Overall results: SATISFACTORY* / UNSATISFACTORY*			
External genitalia	✓			*AV: Artificial vagina; ** EEJ: Electro-ejaculator			Tick as appropriate
Scrotal circumference	31	cm		4. Classification			
Overall results: SATISFACTORY* / UNSATISFACTORY*				☒ SUITABLE FOR BREEDING based on meeting the requirements of section 1 only ☒ SUITABLE FOR BREEDING based on meeting the requirements of section 1 and 2 only ☒ SUITABLE FOR BREEDING based on meeting the requirements of section 1, 2 and 3 ☐ UNSUITABLE FOR BREEDING			
NAD = No Abnormality detected, *delete as required Tick as appropriate			Name of District-Head Animal Production Office Date Certificate No			Signature and stamp	

Bonga

Low-cost mobile reproduction technology lab

Purpose:

- Pregnancy diagnosis service
- Breeding sire certification
- Artificial insemination



Genetic dissemination efforts

Strong CBBPs: **Data collection and recording** by enumerators using tablet as well as data analysis and using the information for selection decision by researchers is fantastic



Genetic dissemination efforts

- **About** 670 rams disseminated to the PU in Menz Gera and Menz Mama district
- Real change is visible in community flock and farmers livelihood
- The colour and physical appearance of sheep is moving towards their preference

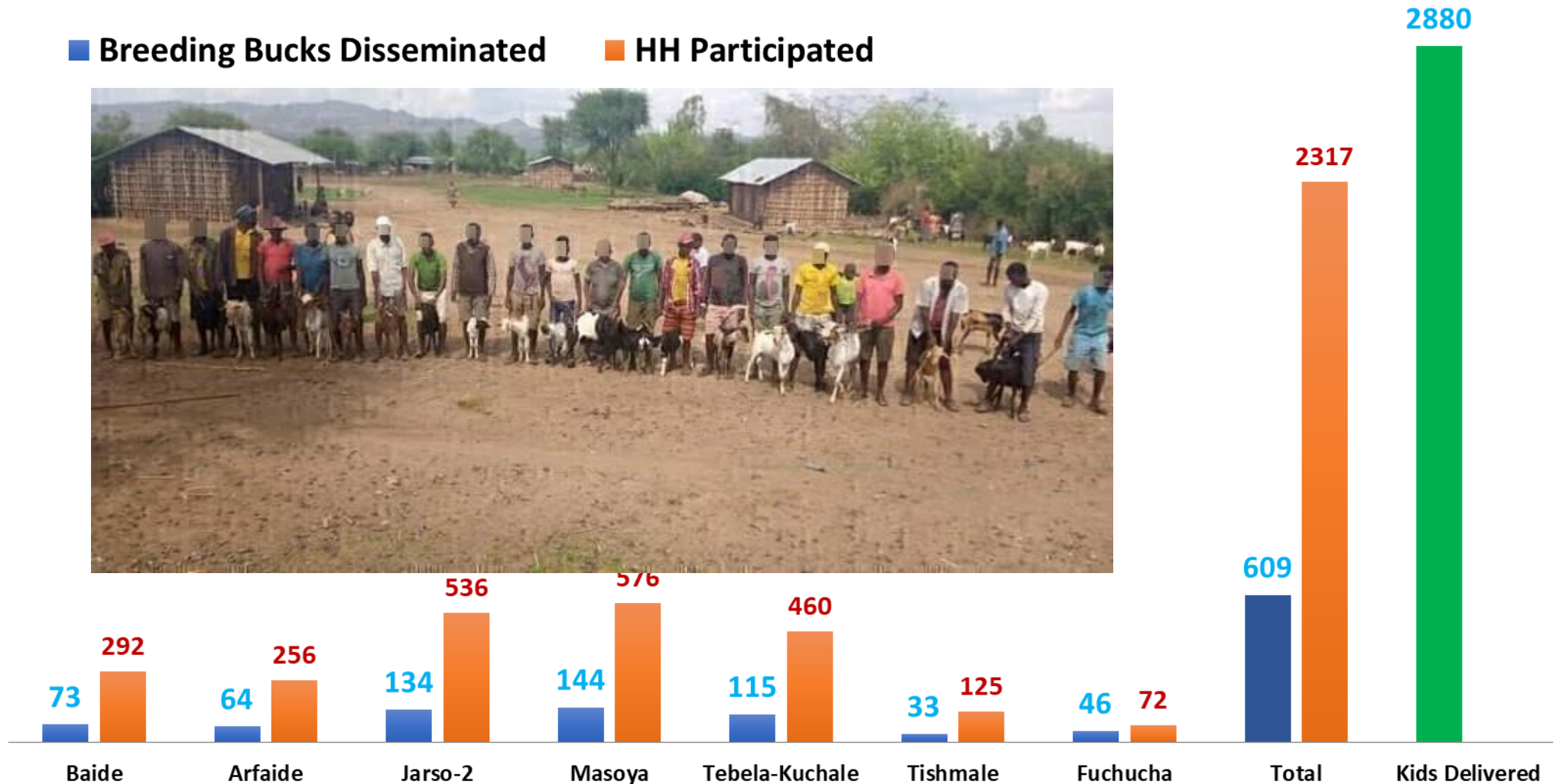


Breeding rams distribution Doyogena - (1981 rams)

Selection Year	Number of Candidates	No of rams distributed	Area of distribution
2013/2014	234	139	Kembebata Tembaro, Gurage & Wolita Zones
2015	301	168	Gurage, Wolita, Silte zones & Baseketo special district
2016	351	284	Wolita & kembata tembaro zones
2017	441	286	Kembebata Tembaro, Wolita, Silte and ,Gamgofa zones
2018	582	241	Gurage,Hydia,KT,Silte, Wolita and Gamogofa zones
2019	509	224	Kembata Tembaro, Wolita and ,Gam Gofa zones
2020	256	209	Gurage, Kembabata Tembaro, and Gamogofa zones
2021	300	200	KT, Silite, Guragae, Chenchu and Gofa zone
2022	363	230	Kembata Tembaro, Hydia, Gurage and Oromia region

Konso Bucks Disseminated for Up-Scaling to the surrounding community by ICARDA/USDA/LFDS Project

■ Breeding Bucks Disseminated ■ HH Participated

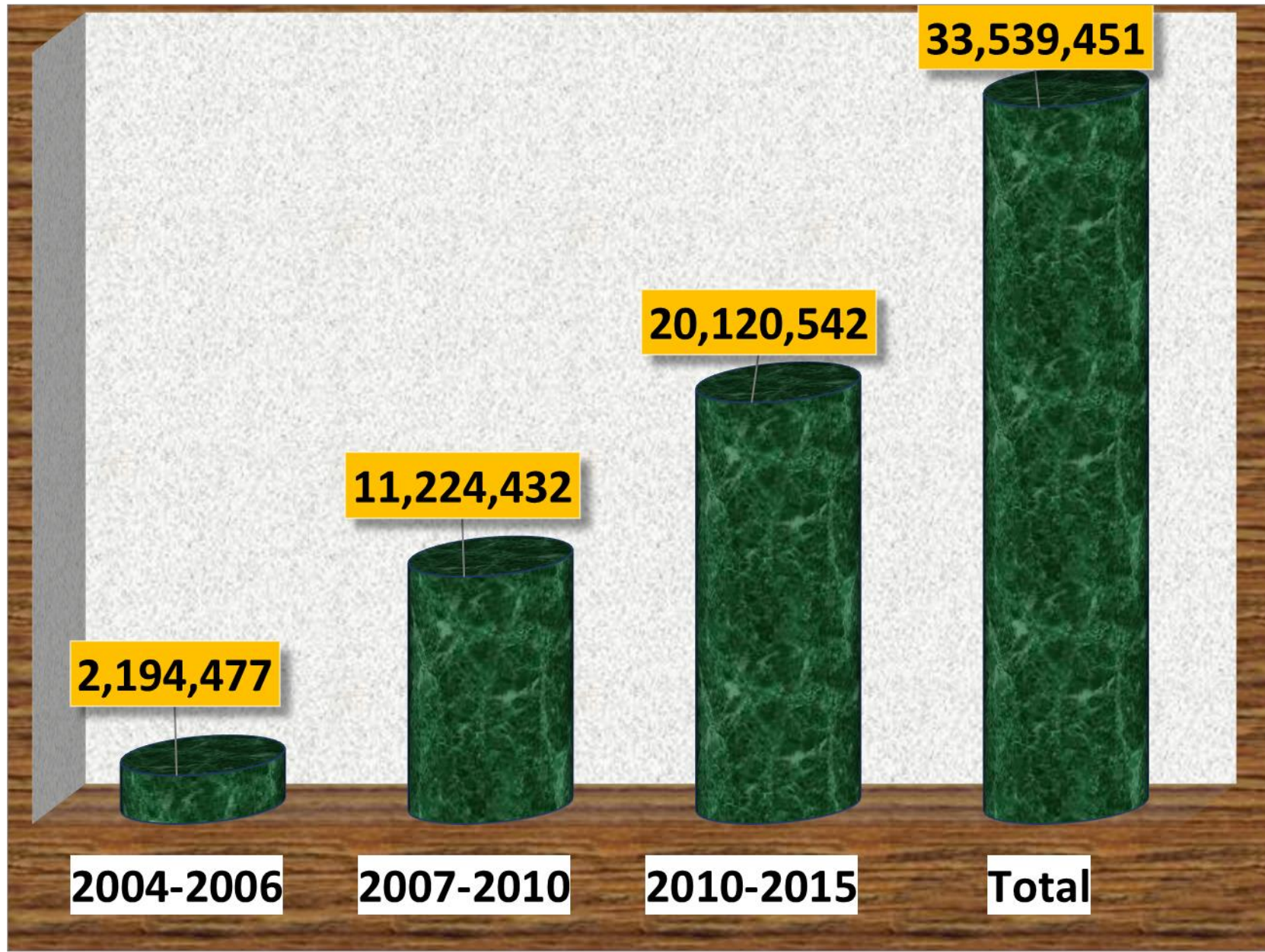


Bonga

- So far, more than 455 rams have been disseminated to different areas in Ethiopia



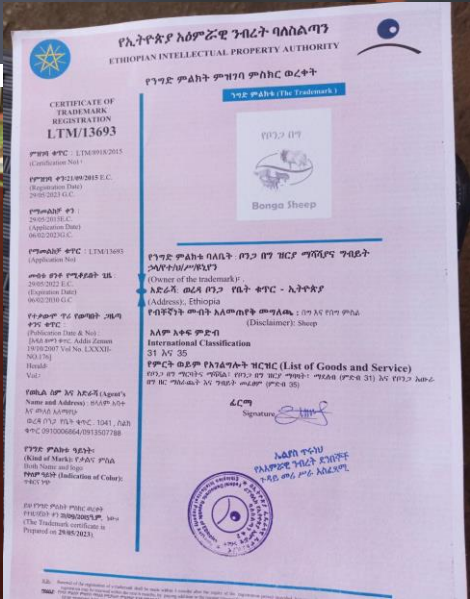
INCOME FROM SHEEP DISSEMINATION - BONGA



Commercialization in Bonga



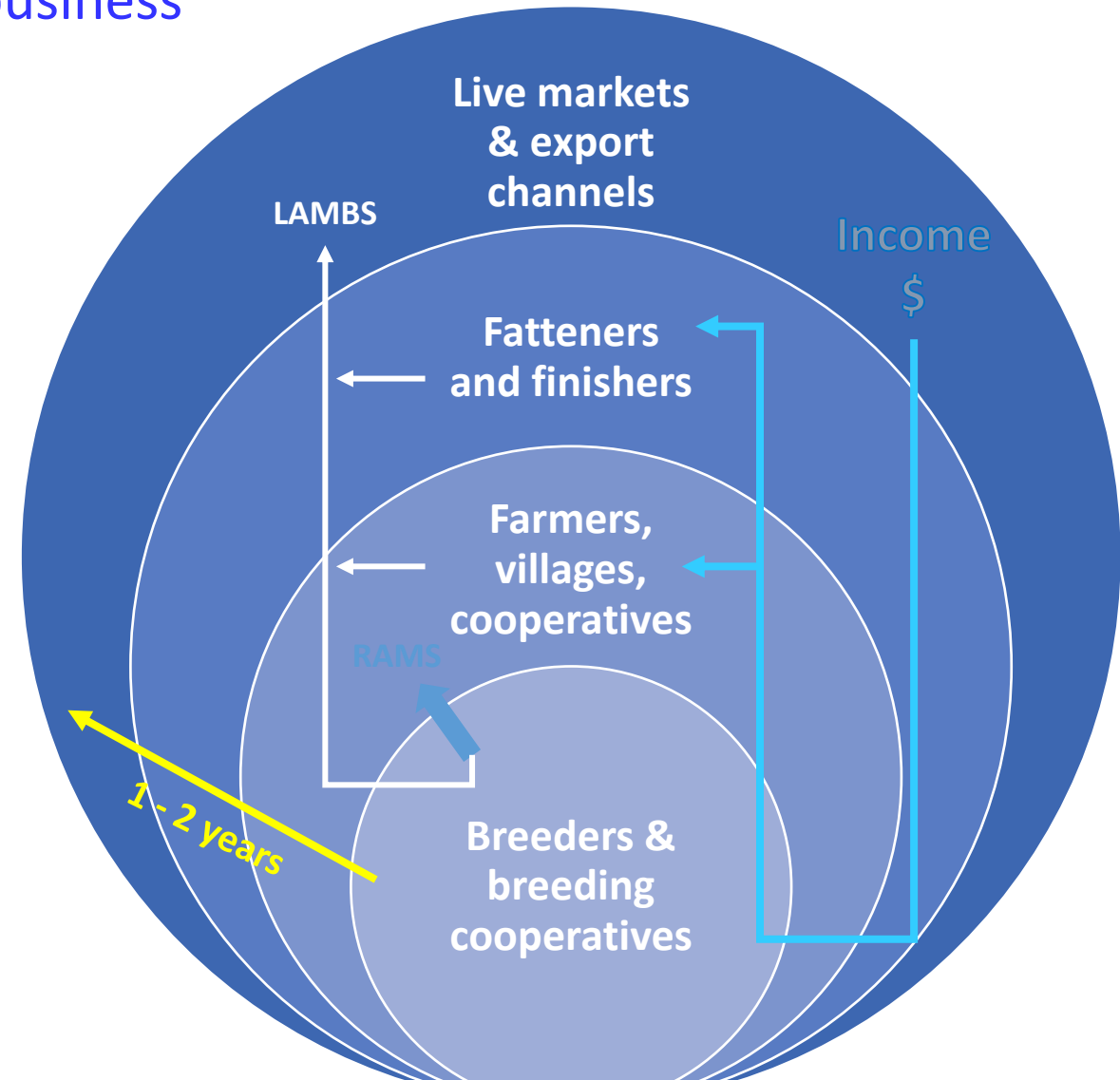
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Bonga Sheep

From subsistence to commercialization model

- Private sector involvement in small ruminant business
 - Minimal
- Our model
 - Community group
 - Legal cooperatives
 - Commercial entities
 - Our approach is based on dissemination of improved genetics produced in CBBPs through breeder cooperatives (with focus on youth and women) who will be capacitated and supported to take up the role, as a business venture.



- 
- CBBP is an alternative to often failed centralized breeding programs
 - Clear evidence that the program works
 - Relatively cheap and easy to implement
 - Pedigree and performance recording is possible
 - Results is measurable genetic gain and socio-economic benefits; inbreeding controlled
 - Works for all species, schemes could be developed for different systems
 - Good opportunity for genomics and reproductive biotechnology interventions
 - Expand and strengthen CBBPs in pastoral areas - **LRRD**

Acknowledgements



Thanks a lot!!!



Animal biotechnology lab developed

Ten low-cost mobile reproduction technology lab established

Purpose:

- Pregnancy diagnosis service
- Breeding sire certification
- Artificial insemination

Each has team of experts and equipped with ultrasound, full AI facilities, cool box, tent, generator

