Sheep crossbreeding in Ethiopia

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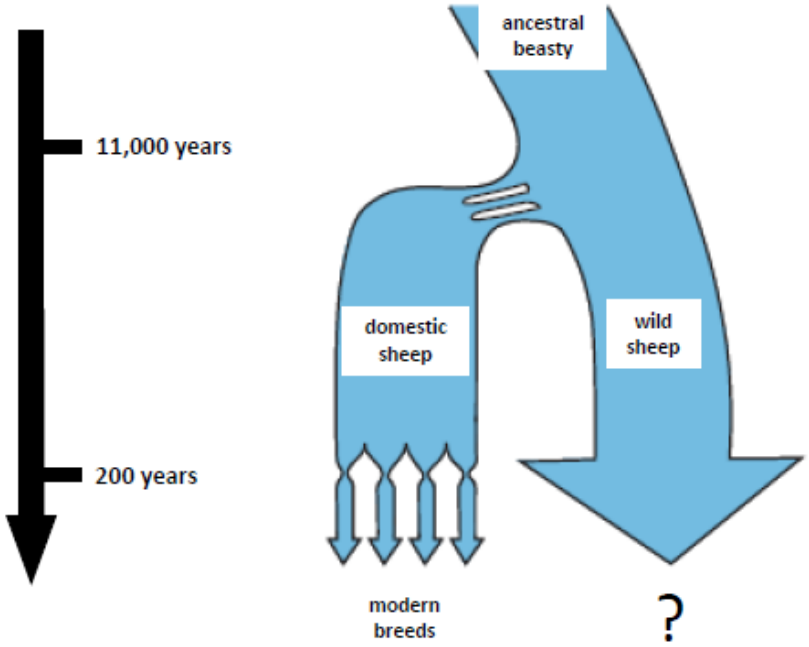
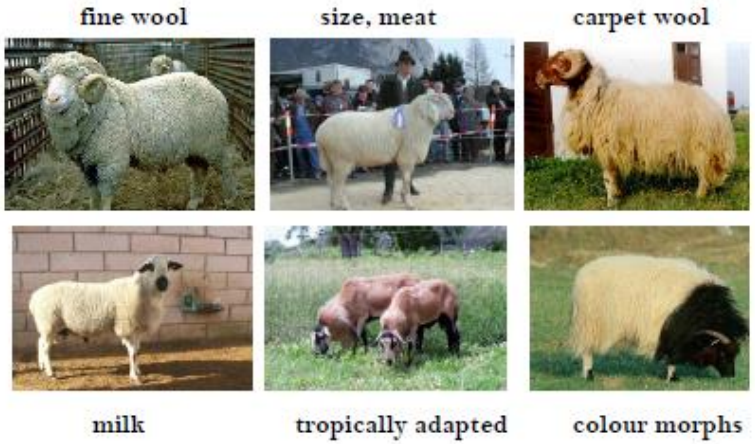
Sheep domestication and breed formation





Source: Kijas et al (ISGC)

Crossbreeding helps to re-combine different merits

History of exotic breed introduction in to Ethiopia

In 1947

Merino from Italy (NGO)

In 1967

Corriedale, Hampshire, Romney _Kenya

Targeting blanket factory established in 1967

Wool and meat

In 1980….recently 2011

Awassi _Israel

Menz sheep

Late 1980s, 2006, 2011

- Dorper sheep were introduced into the Jijiga area (Somali Region) in the late 1980s
- There was no on-farm evaluation during that time
- All sheep were looted from the ranch during the political instability in 1991
- Dorper sheep again introduced in 2006 and 2011

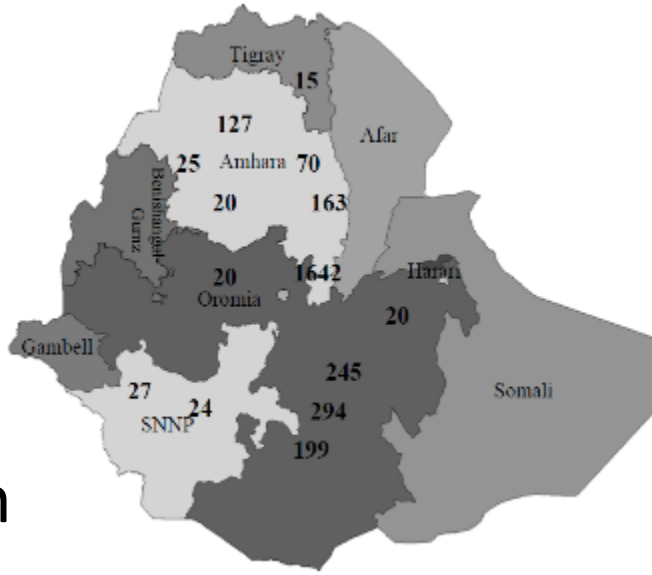
Evaluation of crossbreeding program (Awassi and Dorper)

Breeding program has three main components (Awassi)

1. **Breeding and multiplication unit**
   - Include breeding, evaluation and multiplication of pure and crossbreds
   - 2 ranches in Amhara region, 1 in Oromiya and DBARC
2. **Dissemination unit**
   - Agricultural extension, livestock agency
3. **Production unit (Farmer)**
   - Controled by agricultural extension

Strategy

- At the beginning approach was to sell to **individual farmers**
- Focus shifted to farmers organized in co-opratives (1979 to 89)
- Animals were looted during the government change in 1991
- Back to **individual farmers**
- Results were discouraging (proportion crossbred is only 0.2%)
- Important to identify where the problem is?



Onstation evaluation

- Birth weight, growth, carcass and wool were incresed as exotic level increased **(Lemma et al 1989, Olsson and Beyene 1990, Hassen et al 2004, Tibbo 2006)**
- Comparable ewe reproductive performance observed **(Olsson and Beyene, 1990, Demeke et al 1995)**
- Weaning weight of lambs produced per ewe lambed were increased as exotic level increased **(Olsson and Beyene, 1990)**

Response to supplement feed

Traits	Grazing	Supplemented 400 g con	Supplemented 600g con
Initial weight (kg)	**27.19^{a}**	**27.13^{a}**	**26.84^{a}**
Final weight (kg)	32.76^{a}	39.55^{b}	41.91^{b}
Average daily gain (g)	**54.39^{a}**	**119.01^{b}**	**141.47^{b}**
Carcass weight (kg)	14.2^{a}	18.2^{b}	19.4^{b}
Dressing percentage (%)	43.4^{a}	45.9^{b}	46.3^{b}
Fat thickness (mm)	4.0^{a}	9.1^{b}	8.8^{b}
Rib eye muscle area (cm^2)	14.3^{a}	17.7^{b}	18.0^{b}

- Under similar management the two indigenous pure Menz and pure Washera gained **67.6 g** and **87.04** g per day, respectively
- Comparable skin quality at least up to 50 % Awassi **(Getachew et al., 2014)**

Breeding and multiplication unit

- Ram mutiplication in the breeding unit is less efficient (quality and quantity)
  - Technical and infrastructural limitations
- Higher level of mortality associated with station confinement (medi-visna, liver fluke, feed shortage)
  - For both local and crossbreds
- Two ranches were closed for long time due to Maedi-Visna

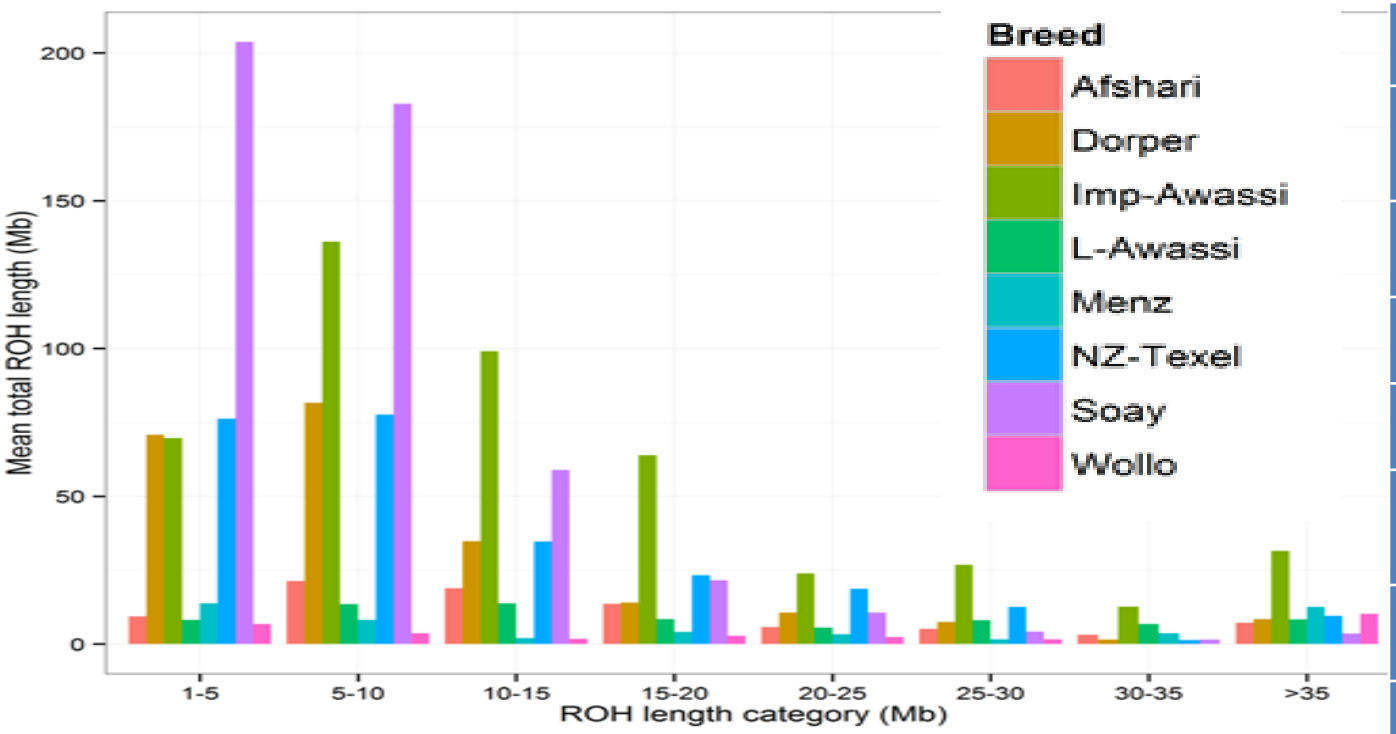
❑ Low fertility at DB ranch

$$F_{ROH} = \frac{L_{ROH>1\,Mb}}{L_{AUTO}}$$

– Based on the data collected from 25 Awassi rams and 92 different mating, EL/EM was 37 % with a range of 10 to 77.5%

- **Reasons need to be investigated**

Mean sum of runs of homozygosity



Breed	$F_{ROH\ >1\ Mb}$ (%)
Afshari	3.51
Dorper	**8.65**
IAwassi	**16.98**
LAwassi	2.65
Menz	3.67
NTexel	**9.23**
Soay	**17.70**
Wollo	1.06

Source: Tesfaye Getachew 2015, PhD thesis

Dissemination unit

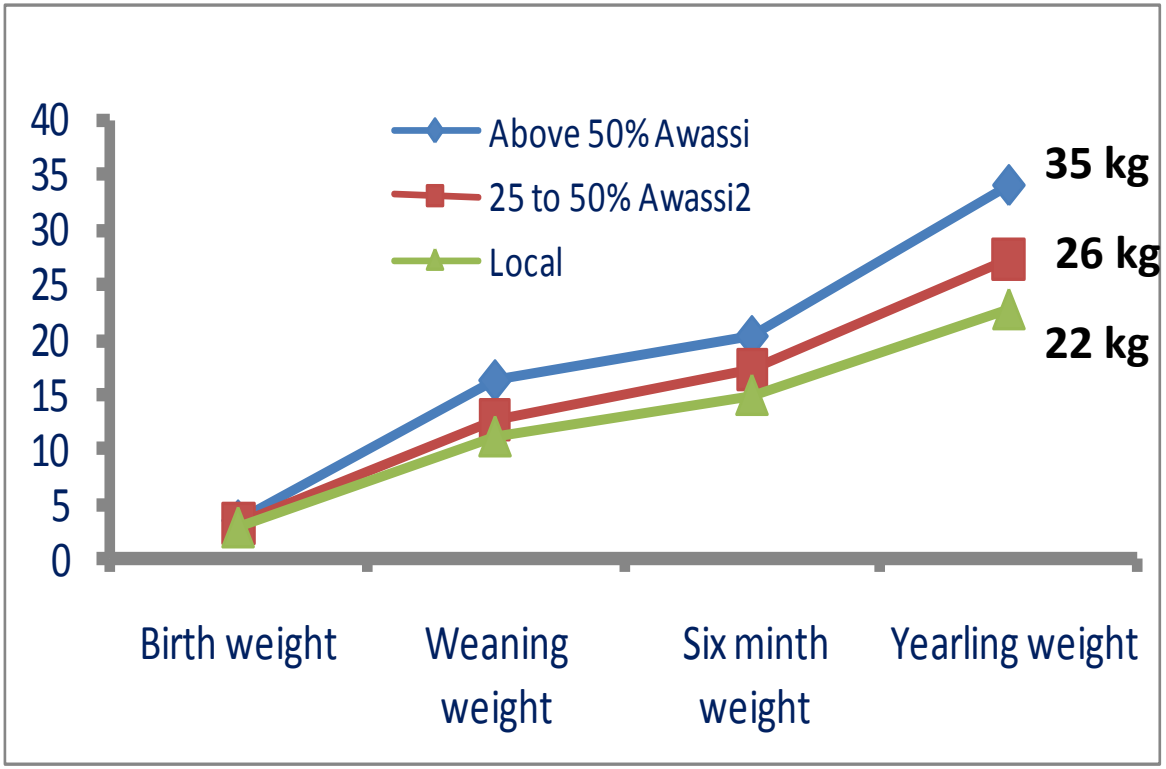
- A survey to assess the status of disseminated ram in 1997 exposed that this unit is totaly failed
  - No apparent breeding ram engaged in breeding
    - Rams were either sold or castrated
  - No preparation in site/area and farmer selection
    - Rams were sold for the non-real farmer
  - Lack of awarenes
  - Selling ram to individual farmer
    - Under utilize the genetic potential
    - Appealing famres to sell for short term benefit

Production unit

- What was the fate of disseminated rams in production unit?
- As explained before difficult to evaluate this unit before 1997
- Considering the above limitations an on-farm evaluation of crossbreeding has started in three villages (Menz, Chacha and Wollo) in 1997
  - A ram sharing scheme (rams were disseminated to groups of organized farmers based on their neighborhood and joint use of communal grazing land)
  - Better monitoring system were adopted

Since then a lot of results are comming out

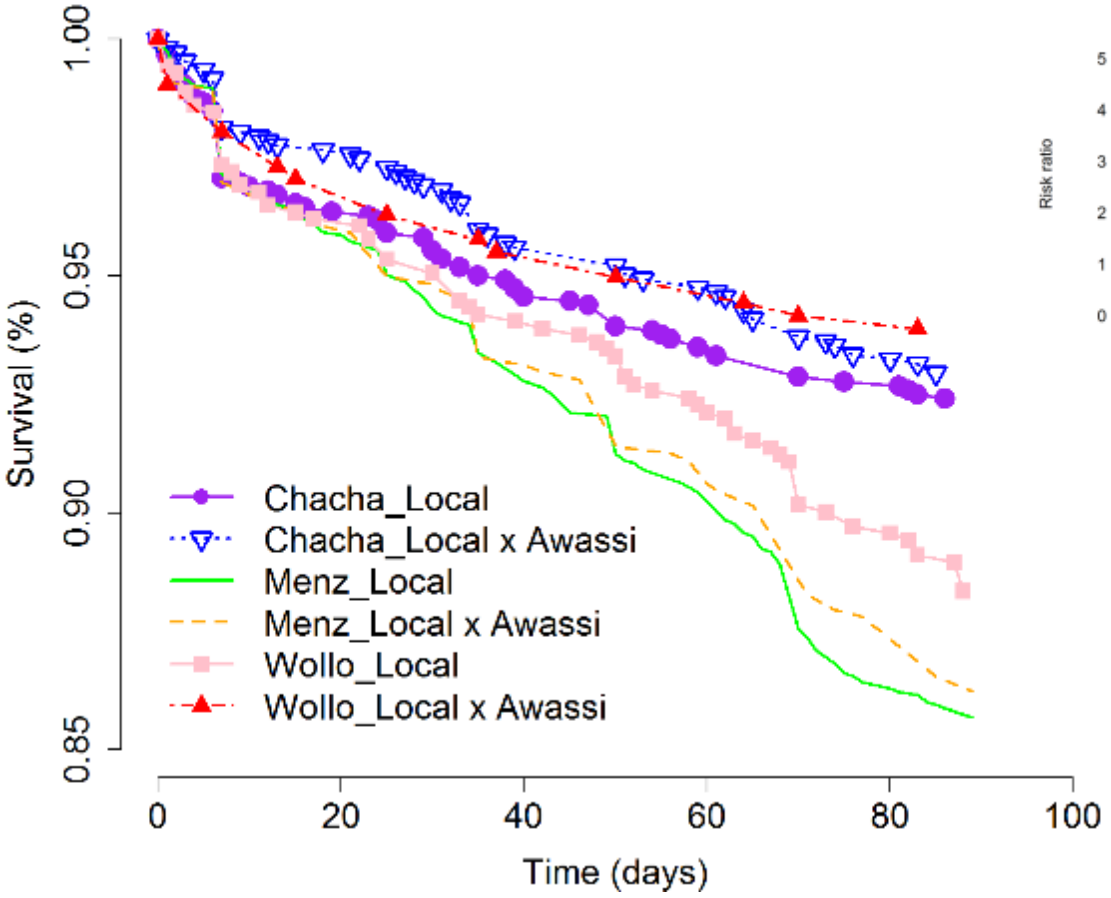
- The first report tried to compare 37.5% Awassi crossbreds and local breeds in one of the crossbreeding villages called Chacha **(Hassen et al., 2002)**
- Live weights were recorded at birth and then monthly until 210 days
- In all the measurements, crossbreds performed better than local breed except for weight on 90 days where both were not significantly different

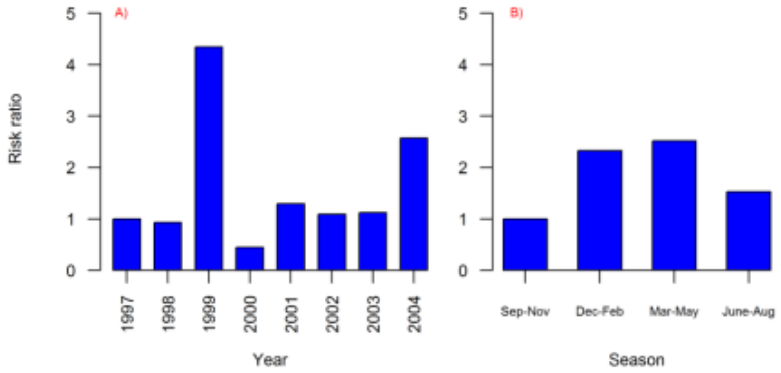


Source: Gizaw and Getachew 2009

- Based on the combined analysis of the three villages 37.5 % Awassi were recommended **(Gizaw et al 2014)**

Lamb survival by genotype and location (left) and risk for death by year and season (right)





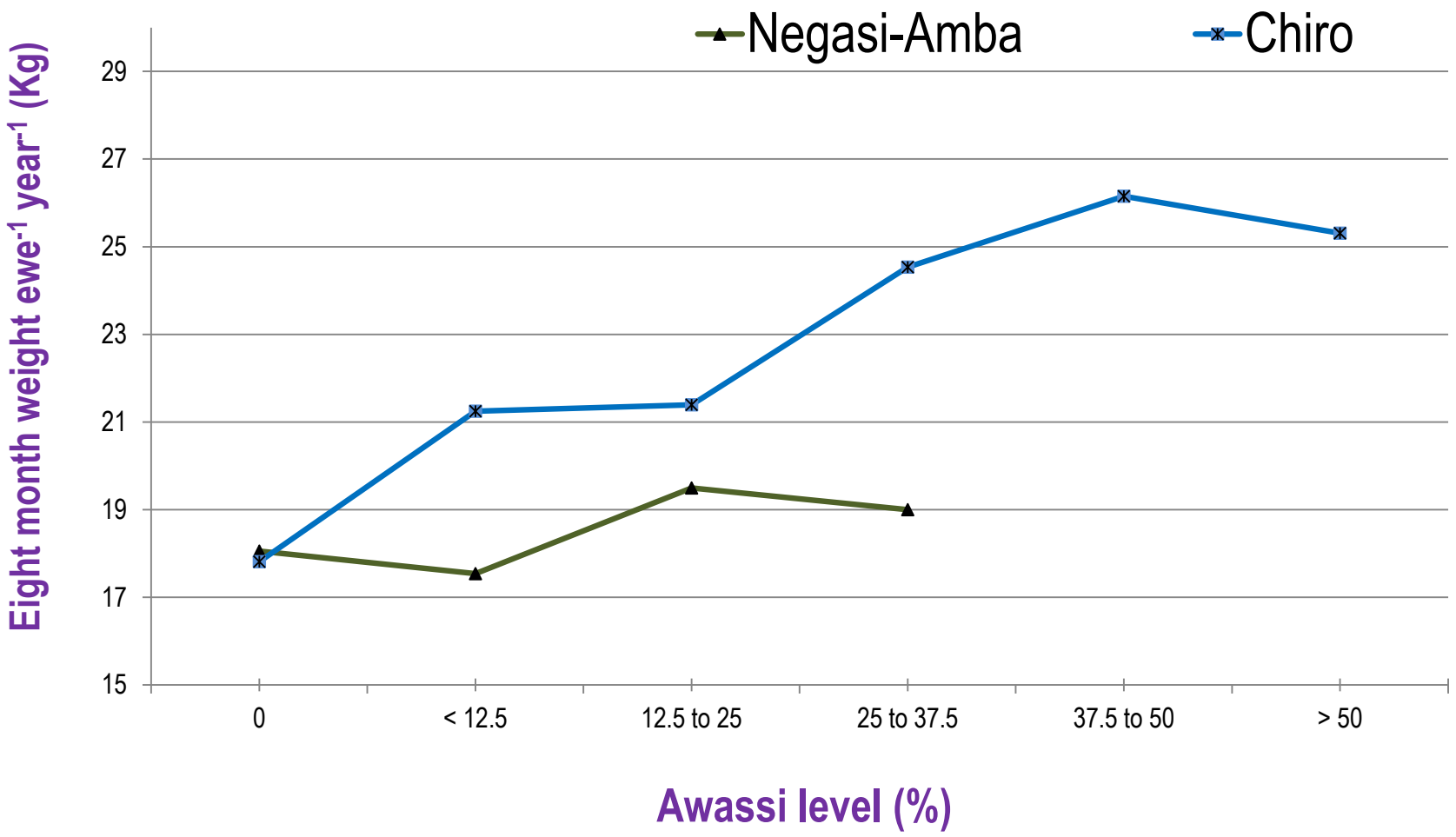
Source: Getachew et al., 2015

Reproductive performance of Ewes

Location/Awassi level	LI	LWEY	BC
Negasi-Amba	*	ns	ns
0	262±9.7[a]	1.25±0.06	2.5±0.12
<12.5 %	290±12.5[a,b]	1.10±0.07	2.6±0.15
12.5 to 25	298±10.2[b]	1.20±0.06	2.4±0.13
25 to 37.5	303±20.9[a,b]	1.18±0.11	2.6±0.18
37.5 to 50	-	-	-
Chiro	*	ns	ns
0	283±13.7[a]	1.24±0.07	2.9±0.15
<12.5 %	280±16.0[a]	1.26±0.09	2.4±0.16
12.5 to 25	297±11.6[a,b]	1.18±0.07	2.4±0.10
25 to 37.5	305±11.9[a,b]	1.19±0.07	2.4±0.10
37.5 to 50	334±16.8[b]	1.11±0.09	2.9±0.15

Source: Tesfaye Getachew 2015, PhD thesis

Mean eight months weight produced ewe^{-1} year^{-1}



Source: Tesfaye Getachew 2015, PhD thesis

Additional output: Milk

Model crossbreeding village created

- Farmers awareness improved
- Farmer able to improve their income and livelihood

- Proportion of crossbreds increased over time (with different levels of Awassi)
- Good entry point for research
  - Government budget constraint and ram shortage

Dorper crossbreeding

- The ESGPIP were started Dorper-based sheep crossbreeding operation in 2006
- Nucleus and breed evaluation and distribution (BED)sites were established in many areas
- Evaluation of crossbreds under station and farmers village has been implemented

Results

- Dorper crossed with Hararghe Highland (HH) showed performed better in growth than Dorper crossed with Black Head Ogaden
- The two indigenious breeds were performed less compared to the crossbreds ***(Tsegay et al., 2013)***
- No significant loss in skin quality observed in Dorper crossbreds ***(Tsegaye et al 2014)***

- Dorper crossbreeding with lowland Wollo sheep ***(Lakew al., 2014)***
  - Weaning, six months and yearling weights of 50 % Dorper crossbreds were **14.95, 20.43 and 31.37** kg, respectively
  - The corresponding values for local breed in North Wollo lowland area were **8.53, 11.92 and 22.38** kg, respectively
- Study on response to feeding ***(Tilahu et al., 2014)***
  - Initial weight for local, 25 % Dorper and 50 % Dorper at about 7 months were **14.8, 20.3 and 17.9**, respectively
  - Final weight after 90 days were **22.8, 32.2 and 29.3** kg, respectively

Growth performance in the highland

Location and breed	Birth weight (kg)	3 months weight (kg)	6 months weight (kg)	Yearling weight (Kg)
On-station				
Dorper	3.7	16.4	26.1	35.0
50 % Dorper	3.0	12.7	19.2	31.3
On-farm				
50 % Dorper	3.3	16.5	25.6	33.4
25 % Dorper	3.1	12.3	17.6	27.5

Source: Ayele Abebe: unpublished data DBARC

Crossbreeding among indigenous breeds

- Washera and Bonga with Menz
- Better survival of 50 % crossbreds observed, however birth weight and lamb growth were not improved except Bonga crosses were heavier at yearling (21.7 vs 20 kg)
- 75 % Bonga crossbreds were heavier at birth and grow faster comapared to Menz and 75 % Washera crosses
- Washera sired crossbreds adapeted and has been produced well in N Gondar

- **No difference in reproductive performance**

Conclusion and recommendations

- Both Awassi and Dorper sired crossbreds have been performed well under low-input station as well as farmers management
- Identifying causes of low fertility and devising mechanism to solve the problem is important
  - Selection in the breeding unit considering risk of inbreeding
- Village based crossbreedíng program is successful
- Involving farmers in breeding ram multiplication
- Location/management specific dicision required

- Crossbreeding is attractive for most users
- Integrated effort in implementation of sheep crossbreeding is lacking
  - Threaten the indigenous AnGR
  - Less benefit from the sector
- Important to focus in developing synthetic breed combining adaptation and production traits
  - Strengethen phenotype and pedigree recording
  - Marker assisted selection

THANK YOU

Results

- Improved Menz ewes were produced crossbred lambs at birth and weaning weight (3.15 and 15.35 kg), which was higher than Local Menz produced(2.87 and 13.86 kg) **(Goshme et al., 2014)**

Awassi level for top ranked and poor performing lambs

Performance	Negasi-Amba			Chiro		
	N	8 months weight (kg)	Awassi level (%)	N	8 months weight (kg)	Awassi level (%)
		***	ns		***	***
Top	22	22.7±0.37[a]	10.1±1.50	19	30.6±0.84a	37.1±3.51[a]
Medium	121	16.1±0.16[b]	8.3±0.63	98	19.8±0.35b	25.2±1.54[b]
Poor	21	11.7±0.37[c]	6.8±1.47	25	13.9±0.78c	17.7±3.00[c]
Overall	164	**16.8±0.18**	8.4±0.73	142	**20.7±0.38**	26.7±1.62

Source: Tesfaye Getachew 2015, PhD thesis

- Continuous monitoring and modification of the breeding program is required
- Farmers witness
- Working based on farmers interest is very importan for our success
  - Legambo
  - Chacha
  - Even Menz
  - Around DB
  - Meket, N Wollo
- Trethened indigenous genetic resource:
- Yes we need to protect them..but should not be under the expense of farmers
- Conserving breed and conserving poverty
  - Existing breed best fit to its environment
  - But did not fit with the current demand
  - We need to change the enviriónment and genetic makeup for current and future use

- Giving genetoype and use approach struggle to survive them
  - Best way when the area/farmers/users has potential

- eases (e.g. maedi-visna) associated with confinement. In addition, low fertility with natural mating in the farms, lack of infrastructure and logistics (e.g. shortage of mating pens) restricted efficiency of the government farms.

- Use of local breeds to produce crossbred lamb for sale is suggested as this helps to exploit the reproductive performance ability of local breeds and fast growing potential of crossbreds
- Crossbreeding might focus on sheep populations along the roads, near towns and cities, near market places and buffer zones between two geographically separated areas as those populations are mixed and un-described.

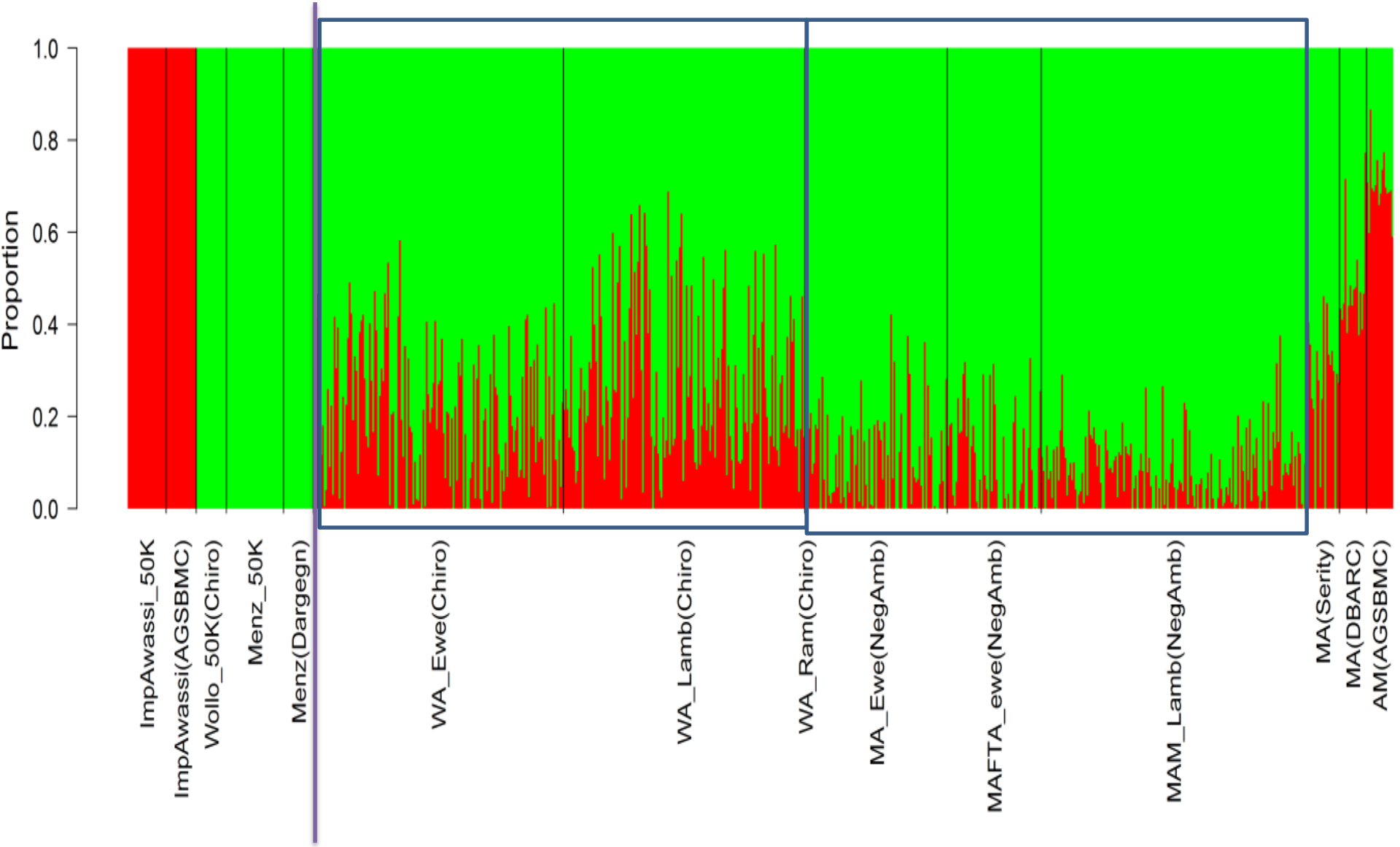
- Improvement throgh crossbreeding and selection are the same if we consider similar breeding objective
  - The difference is time
  - Genetic gain is directly proportional to the within population variation
- Selection has also power to create significant difference
  - Improved Awassi vs Local Awassi
- There is always within population variation
- This allow us to develop a breed/population based on our interest (adaptation + production)
- Looking for possibility of using genome tools to select an animal with a merit of both adaptation and production trait

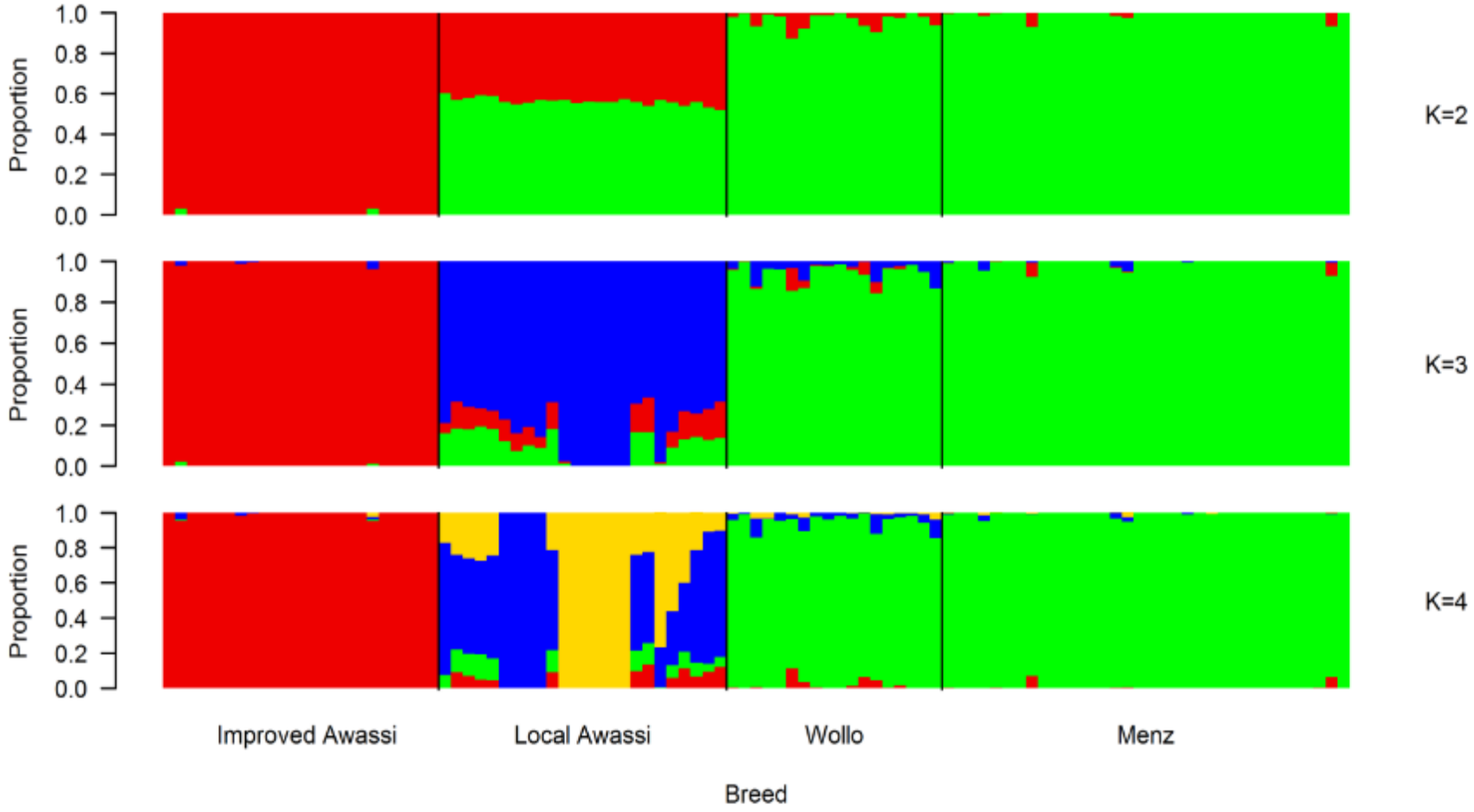
Developing Fattening Packages

Traits	Grazing	Plus supplemented 400 g con	Plus supplemented 600g con
Initial weight (kg)	19.72[a]	21.25[a]	21.25[a]
Final Weight (kg)	24.14[a]	27.97[b]	27.60[b]
Average daily gain (g)	*29.3[a]*	74.43[b]	70.84[b]
Carcass weight (kg)	10.32[a]	13.31[b]	13.34[b]
Dressing percentage (%)	44.3[a]	47.4[b]	48.2[b]
Fat thickness (mm)	3.2[a]	8.0[b]	7. 6[b]
Rib eye muscle area (cm^2)	13.0[a]	13.3[a]	13.3[a]

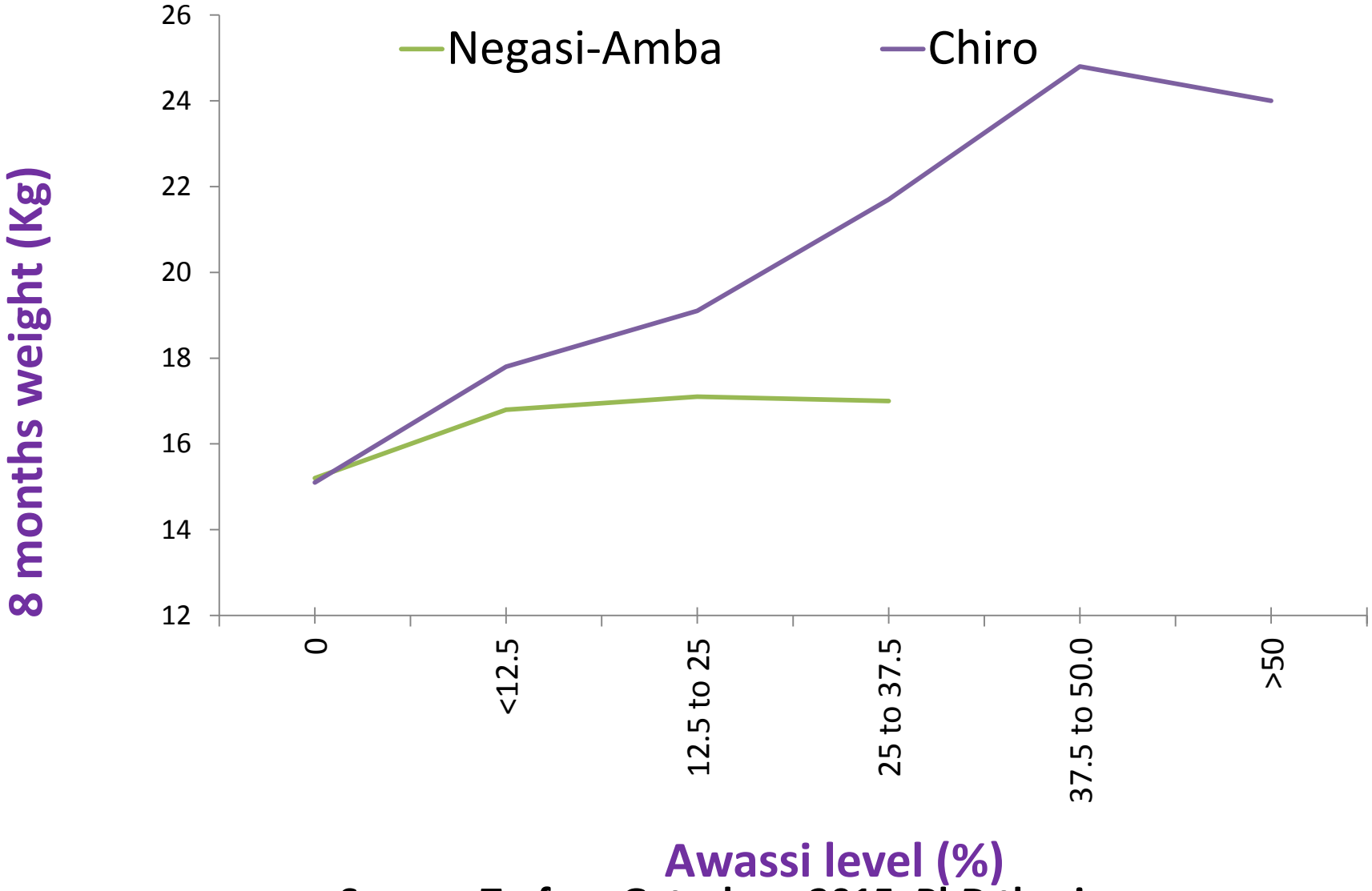
	HH	BHO	D x HH	D x BHO
In wt (7 month)	14.6	17.3	20.7	17.5
Final wt	18.1	20.9	27.0	23.3

Figure 5. Admixture plot of crossbred populations using selected AIMs



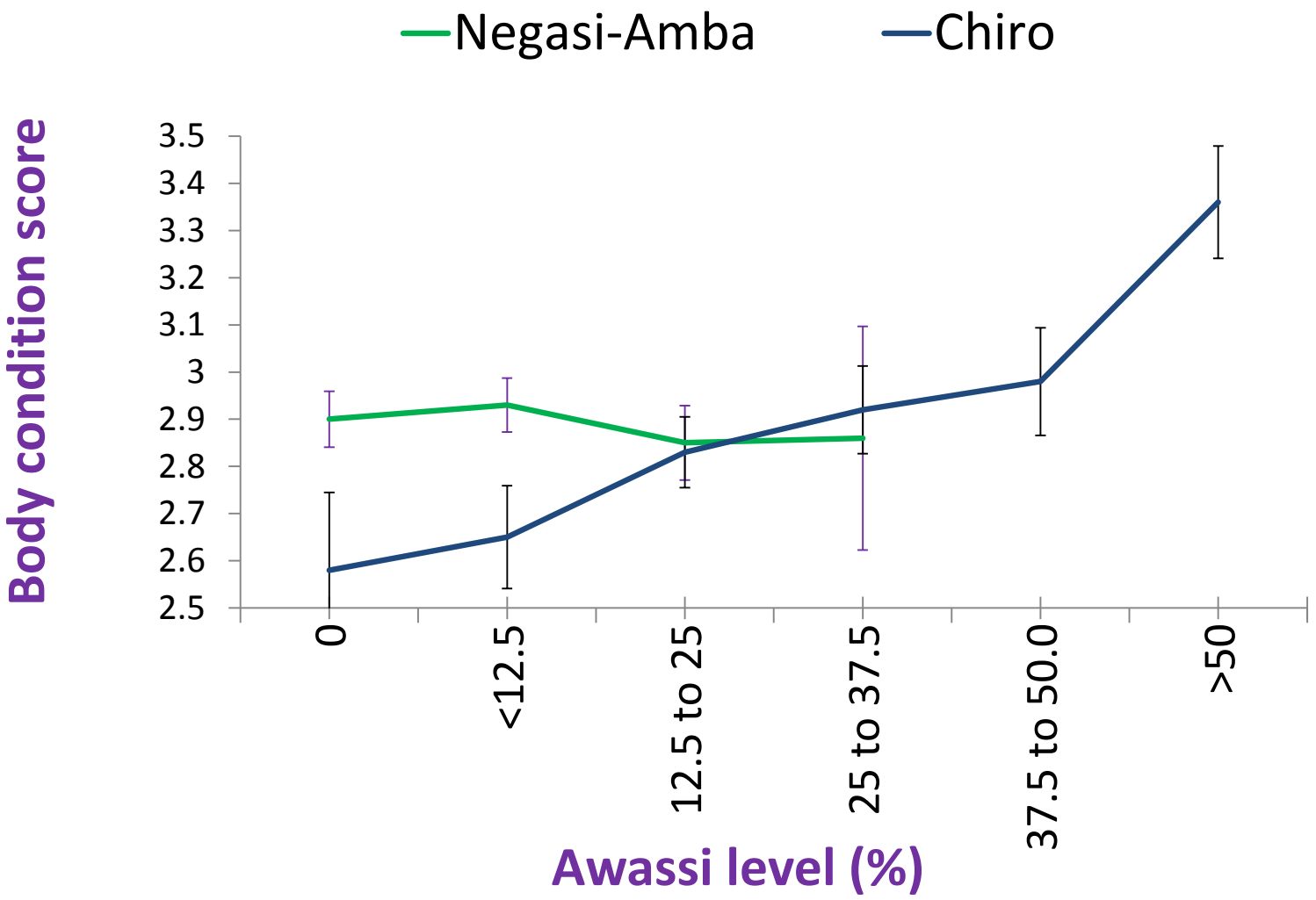

Proportion
1.0
0.8
0.6
0.4
0.2
0.0
K=2
K=3
K=4
Improved Awassi
Local Awassi
Wollo
Menz
Breed

Comparison of eight months weight by Awassi level and location



Source: Tesfaye Getachew 2015, PhD thesis

Body condition score for lambs



Source: Tesfaye Getachew 2015, PhD thesis

Least square mean±standand error of Awassi level and reproductive performances for top medium and worst performing ewes in Negassi-Amba and Chiro sites

Performance level	Negasi-Amba				Chiro			
	N	Awassi level (%)	LI	NLWEY	N	Awassi level (%)	LI	NLWEY
		ns	***	***		ns	***	***
Top	24	9.0±1.97	227±10.1[a]	1.61±0.03[a]	20	15.9±3.1	216±11.6[a]	1.89±0.041[a]
Medium	56	10.6±1.36	283±6.7[b]	1.18±0.02[b]	96	20.3±1.4	301±5.5[b]	1.19±0.020[b]
Poor	24	12.8±1.97	356±10.1[c]	0.77±0.03[c]	22	21.3±2.9	367±11.6[c]	0.69±0.041[c]
Overall	104	10.8±1.03	289±5.2	1.18±0.015	132	19.2±1.5	295±5.78	1.26±0.021

Source: Tesfaye Getachew 2015, PhD thesis