Sheep crossbreeding in Ethiopia

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Sheep domestication and breed formation

Crossbreeding helps to recombine different merits

Source: Kijas et al (ISGC)
History of exotic breed introduction in 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
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)
   – Controlled by agricultural extension
Strategy

- At the beginning approach was to sell to individual farmers
- Focus shifted to farmers organized in cooperatives (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 increased 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)
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)

<table>
<thead>
<tr>
<th>Traits</th>
<th>Grazing</th>
<th>Supplemented 400 g con</th>
<th>Supplemented 600 g con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (kg)</td>
<td>27.19a</td>
<td>27.13a</td>
<td>26.84a</td>
</tr>
<tr>
<td>Final weight (kg)</td>
<td>32.76a</td>
<td>39.55b</td>
<td>41.91b</td>
</tr>
<tr>
<td>Average daily gain (g)</td>
<td>54.39a</td>
<td>119.01b</td>
<td>141.47b</td>
</tr>
<tr>
<td>Carcass weight (kg)</td>
<td>14.2a</td>
<td>18.2b</td>
<td>19.4b</td>
</tr>
<tr>
<td>Dressing percentage (%)</td>
<td>43.4a</td>
<td>45.9b</td>
<td>46.3b</td>
</tr>
<tr>
<td>Fat thickness (mm)</td>
<td>4.0a</td>
<td>9.1b</td>
<td>8.8b</td>
</tr>
<tr>
<td>Rib eye muscle area (cm²)</td>
<td>14.3a</td>
<td>17.7b</td>
<td>18.0b</td>
</tr>
</tbody>
</table>
Breeding and multiplication unit

- Ram multiplication 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

- 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

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

<table>
<thead>
<tr>
<th>Breed</th>
<th>(F_{ROH &gt;1,Mb}) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afshari</td>
<td>3.51</td>
</tr>
<tr>
<td>Dorper</td>
<td>8.65</td>
</tr>
<tr>
<td>IAwassi</td>
<td>16.98</td>
</tr>
<tr>
<td>LAwassi</td>
<td>2.65</td>
</tr>
<tr>
<td>Menz</td>
<td>3.67</td>
</tr>
<tr>
<td>NTexel</td>
<td>9.23</td>
</tr>
<tr>
<td>Soay</td>
<td>17.70</td>
</tr>
<tr>
<td>Wollo</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Source: Tesfaye Getachew 2015, PhD thesis
Dissemination unit

- A survey to assess the status of disseminated ram in 1997 exposed that this unit is totally 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
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
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

<table>
<thead>
<tr>
<th>Location/Awassi level</th>
<th>LI</th>
<th>LWEY</th>
<th>BC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negasi-Amba</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>262±9.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25±0.06</td>
<td>2.5±0.12</td>
</tr>
<tr>
<td>&lt;12.5 %</td>
<td>290±12.5&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.10±0.07</td>
<td>2.6±0.15</td>
</tr>
<tr>
<td>12.5 to 25</td>
<td>298±10.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.20±0.06</td>
<td>2.4±0.13</td>
</tr>
<tr>
<td>25 to 37.5</td>
<td>303±20.9&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.18±0.11</td>
<td>2.6±0.18</td>
</tr>
<tr>
<td>37.5 to 50</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Chiro</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>283±13.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.24±0.07</td>
<td>2.9±0.15</td>
</tr>
<tr>
<td>&lt;12.5 %</td>
<td>280±16.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.26±0.09</td>
<td>2.4±0.16</td>
</tr>
<tr>
<td>12.5 to 25</td>
<td>297±11.6&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.18±0.07</td>
<td>2.4±0.10</td>
</tr>
<tr>
<td>25 to 37.5</td>
<td>305±11.9&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.19±0.07</td>
<td>2.4±0.10</td>
</tr>
<tr>
<td>37.5 to 50</td>
<td>334±16.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.11±0.09</td>
<td>2.9±0.15</td>
</tr>
</tbody>
</table>

Source: Tesfaye Getachew 2015, PhD thesis
Mean eight months weight produced ewe\(^{-1}\) year\(^{-1}\)

![Graph showing mean eight months weight produced ewe\(^{-1}\) year\(^{-1}\) for different Awassi levels.](image)

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 better in growth than Dorper crossed with Black Head Ogaden.
- The two indigenous 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

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

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 compared to Menz and 75% Washera crosses

- Washera sired crossbreds adapted 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 crossbreeding program is successful
- Involving farmers in breeding ram multiplication
- Location/management specific decision 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

- Strengthen phenotype and pedigree recording
- Marker assisted selection
THANK YOU
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

<table>
<thead>
<tr>
<th>Performance</th>
<th>Negasi-Amba</th>
<th>Chiro</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N 8 months</td>
<td>Awassi level</td>
</tr>
<tr>
<td></td>
<td>weight (kg) (%)</td>
<td>weight (kg) (%)</td>
</tr>
<tr>
<td>Top</td>
<td>22 22.7±0.37&lt;sup&gt;a&lt;/sup&gt; 10.1±1.50</td>
<td>19 30.6±0.84&lt;sup&gt;a&lt;/sup&gt; 37.1±3.51&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Medium</td>
<td>121 16.1±0.16&lt;sup&gt;b&lt;/sup&gt; 8.3±0.63</td>
<td>98 19.8±0.35&lt;sup&gt;b&lt;/sup&gt; 25.2±1.54&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Poor</td>
<td>21 11.7±0.37&lt;sup&gt;c&lt;/sup&gt; 6.8±1.47</td>
<td>25 13.9±0.78&lt;sup&gt;c&lt;/sup&gt; 17.7±3.00&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overall</td>
<td>164 16.8±0.18 8.4±0.73</td>
<td>142 20.7±0.38 26.7±1.62</td>
</tr>
</tbody>
</table>

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 important for our success

- Legambo
- Chacha
- Even Menz
- Around DB
- Meket, N Wollo

Trehened 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 environment and genetic makeup for current and future use
• Giving genetotype 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 through 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

<table>
<thead>
<tr>
<th>Traits</th>
<th>Grazing</th>
<th>Plus supplemented 400 g con</th>
<th>Plus supplemented 600g con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (kg)</td>
<td>19.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Final Weight (kg)</td>
<td>24.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.97&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27.60&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Average daily gain (g)</td>
<td>29.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>74.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>70.84&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Carcass weight (kg)</td>
<td>10.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.31&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.34&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dressing percentage (%)</td>
<td>44.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>48.2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fat thickness (mm)</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Rib eye muscle area (cm&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>13.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>HH</td>
<td>BHO</td>
<td>D x HH</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>In wt (7 month)</td>
<td>14.6</td>
<td>17.3</td>
<td>20.7</td>
</tr>
<tr>
<td>Final wt</td>
<td>18.1</td>
<td>20.9</td>
<td>27.0</td>
</tr>
</tbody>
</table>
Figure 5. Admixture plot of crossbred populations using selected AIMs
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±standard error of Awassi level and reproductive performances for top medium and worst performing ewes in Negassi-Amba and Chiro sites

<table>
<thead>
<tr>
<th>Perform</th>
<th>Negasi-Amba</th>
<th>Chiro</th>
<th>Chiro</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Awassi level (%)</td>
<td>LI</td>
<td>NLWEY</td>
</tr>
<tr>
<td>Top</td>
<td>ns</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>24</td>
<td>9.0±1.97</td>
<td>227±10.1^a</td>
<td>1.61±0.03^a</td>
</tr>
<tr>
<td>Medium</td>
<td>10.6±1.36</td>
<td>283±6.7^b</td>
<td>1.18±0.02^b</td>
</tr>
<tr>
<td>Poor</td>
<td>12.8±1.97</td>
<td>356±10.1^c</td>
<td>0.77±0.03^c</td>
</tr>
<tr>
<td>Overall</td>
<td>10.8±1.03</td>
<td>289±5.2</td>
<td>1.18±0.015</td>
</tr>
</tbody>
</table>

Source: Tesfaye Getachew 2015, PhD thesis