IMPROVING MANAGEMENT OF LIVESTOCK IN AWASH RIVER BASIN: A CHALLENGE TO ETHIOPIA

Girma Taddese, Don Peden, Abiye Astatke and Kai Sonder
Figure 1. River Basins of Ethiopia.
Objectives

- To assess livestock water demand in the Basin
- To assess livestock feed demand
- To assess livestock grazing impact in the Basin
- To assess RUE
- To see land degradation and desertification
Methods

- Controlled grazing plots
- Biomass yield calculation from Climate
- GIS tool
- NDVI estimation from Satellite
- *In Situ* Photographs
Rainfall water Use Efficiency (RUE)

For calculating RUE (kg/ha/mm rainfall)
The following formula was used

\[
RUE = \frac{\text{Crop Yield T/ha} \times 1000}{\text{GSR} - \text{Ev}}
\]

- The calculation requires the actual yield received.
- **Effective rainfall** is the growing season rainfall minus an evaporation factor
- **GSR** is the growing season rainfall plus allowance for pre-season stored soil moisture
- **Ev** is the evaporation factor, which differs for each crop type and between regions
- Annual runoff within the basin is estimated at 4.6 km$^3$.
- 3850 Mm$^3$ is currently utilized.
- The available water from rainfall in the basin is 39,845 Mm$^3$ (y$^{-1}$).
- 72% of the rainfall (28383 Mm$^3$/yr) is lost through evapotranspiration, and
- 18% (7386 Mm$^3$/yr) runoff.
- 10% (4074 Mm$^3$/yr) is rechargeable water.
- The potential for major groundwater development for irrigation is limited in Awash River Basin with the recharge of 14-26%.

**Figure 2. Monthly Awash River Flow.**
Figure 3. Agro-ecological zones of Awash River Basin.

- Uplands land above >1500m a.s.l & mean annual rainfall >800mm
  - Eastern catchments
  - Western catchments
  - Upper Basin
- Upper Valley land varies from 1000-1500m a.s.l & mean annual rainfall varies from 600-800mm
- Middle Valley land varies from 1000-1500m a.s.l & mean annual rainfall varies from 200-600mm
  - Melka werer – Awash to Hertale
  - Gewane-Hertale to Gedebassa outlet
  - Mille- Gedebassa outlet to mile confluence
- Lower Plains land from 200-500m a.s.l & mean annual rainfall is < 200mm
  - Eastern catchment is closed sub-basin from 1000-2500m a.s.l
    - Pediment slopes- between 1000-1500m a.s.l limited rainfed agriculture is practiced
    - Plains below 1000m the inhabitants are Issas and the resource base is ground water & seasonal surface water flows.
Figure 4. Altitudinal ranges of Awash River Basin.

1. Area 110000km²
2. Starts from Ginchi highlands 2700masl & terminates in Lake Abe
3. Total length is 1200km
Figure 5. Human population density in Awash River Basin.
Livestock water requirements

Livestock water consumption depends on a number of physiological and environmental conditions such as (King 1983):

- Type and size of animal
- Physiological state (lactating, pregnant or growing)
- Activity level
- Type of diet-dry hay, silage or lush pasture
- Temperature-hot summer days above 25 °C can sometimes double the water consumption of animals rose outside.
- Water quality - palatability and salt content
Figure 6. The Biosphere around a livestock water point.

- **Nutritious grass zone**
  - Nutritious & palatable grass species

- **Bush encroachment zone**
  - Negligible soil changes
  - Bush encroachment and enhanced shrub layer

- **Sacrifice zone**
  - Surface disruption by wind and soil erosion

- **Soil change**
  - High nutrient accumulation

**Vegetation change**
- 50 m
- 500 m
- 1000 m
- 2000 m
Plate 1. Livestock around Batu Degaga irrigation schemes are gathering at the river bank of Awash; to drink water, to cool their body and to drop their wastes in the river (Photo Courtesy: Yusuf Kedir 2004).
Figure 7. Estimated livestock (cattle, sheep & goat) daily dry matter intake.

1. Upland has high livestock heads
2. Middle & Lower Basin have low livestock heads
Figure 8. Livestock water requirement (cattle, sheep & goat) at dry hot air temperature season (27°C).
<table>
<thead>
<tr>
<th>Location</th>
<th>Local Name</th>
<th>Site ID</th>
<th>Status</th>
<th>Value (kg/ha)</th>
<th>Value</th>
<th>Trend</th>
<th>Deviation %</th>
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**Table 1. Forage availability in Middle and Lower Awash River Basin.**
Source: [http://cnrit.tamu.edu/maps/map_init.html](http://cnrit.tamu.edu/maps/map_init.html)
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<th>District</th>
<th>Location</th>
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Figure 9. Pathways of integrated conservation based crop/livestock production, human health and well fare.
Table 2. Typical crop residue yield and water content of the Ethiopian farmer.

<table>
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<tr>
<th>Type of feed</th>
<th>Yield (kg/year)</th>
<th>% Water in 100 kg</th>
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<td>Teff straw</td>
<td>427</td>
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<td>27.4</td>
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<td>Rough pea straw</td>
<td>92.6</td>
<td>16</td>
<td>14.8</td>
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<td>Chick pea straw</td>
<td>22.6</td>
<td>14</td>
<td>3.2</td>
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<tr>
<td>Maize stover</td>
<td>1970.6</td>
<td>65</td>
<td>1281.0</td>
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<tr>
<td>Corn-cob</td>
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<td>102.8</td>
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<td>Teff aftermath</td>
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<td>Wheat aftermath</td>
<td>76.2</td>
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<td>Hay</td>
<td>179.3</td>
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<td>16.1</td>
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<td>Grazing natural pasture</td>
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<tr>
<td>Browse</td>
<td>2.7</td>
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<td>1.8</td>
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</table>

Source: Getachew Eshete, 2002
Figure 10a. Rainfall Use Efficiency (RUE) at Doni irrigation Scheme (Yusuf et al., 2005)
Figure 10b. Rainfall Use Efficiency (RUE) at Batu Degaga irrigation scheme (Yusuf et al., 2005).

\[
\text{RUE} = \frac{\text{Crop Yield T/ha} \times 1000}{\text{GSR-Ev}}
\]
Figure 10c. Rainfall Water Use Efficiency (RUE) at Godino irrigation Scheme (Yusuf et al., 2005)

RUE = Crop Yield T/ha x 1000/GSR-Ev

Total Yield (kg/ha/mm)
Figure 10d. Rainfall Use Efficiency (RUE) at Markos irrigation Scheme (Ysuf et al., 2005)

RUE = \frac{\text{Crop Yield T/ha} \times 1000}{\text{GSR-Ev}}
Livestock grazing

- **Heavy grazing pressure is deleterious effect on natural resources**
- **Heavy stocking rate can compete with meager water and land resources**

- **Grazing system** A defined, integrated combination of animal, plant, soil, and other environmental components and the grazing method(s) by which the system is managed to achieve specific results or goals.
- **Stocking density** Relationship between the number of animals and the specific unit of land being grazed at any one point in time (animal units at a specific time/area of land).
- **Stocking rate** Relationship between the number of animals and the grazing management unit utilized over a specified time period (animal units over a described time period/area of land).
Figure 11a. Relationships between stocking rate (AUM/ha and biomass production (source: Girma Taddese et al., 2001).
Land use intensification throughout the rangelands is fragmenting landscapes into simpler, discrete units. The result is a reduction in the scale of landscape-animal-human interactions. At the higher quality resources (waters, grazing, cropping lands, etc) could be reduces.

**Figure 11b. Hypothesised process of fragmentation and reduction in scale in rangelands** (Andrew Ash et al., 2005).

If there is a significant difference in the nature of these stocking rate – animal performance relationships at different spatial scales then it is important to take into account in the context of landscape intensification. For example smaller, homogenous paddocks may provide the opportunity to increase stock numbers because of better water distribution.

**Figure 11c.** Stocking rate – animal production relationship in relation to scale and landscape complexity

Biomass production depends on adequate rainfall and other factors

Figure 12a. Effect of grazing pressure on yearly net primary production of plant biomass (Mg/ha) source: Girma Taddese et al., 2001
Net primary production (NPP) was calculated as the difference between biomass of non-grazed and grazed plots.

Plant growth is especially sensitive to two climatic variables, temperature and moisture. Both affect evapotranspiration, but to growing plants only actual evapotranspiration (AE) represents the true utility of water—its availability in necessary quantity and quality, at the correct phase, and during the correct season.

Figure 12b. Influence of rainfall efficiency on plant biomass production (kg/ha/mm)  
source: Girma Taddese et al., 2001
Heavy grazing pressure reduces the vegetation cover and increases soil loss (MDG= 1.8AUM/ha & HVG= 4.2AUM/ha).

Figure 12c. Effect of grazing pressure on mean soil loss and biomass yield (t/ha), (a) 0-4 % slope and (b) 4-8 % slope. 
Source: Girma Taddese et al., 2001.
1. Large irrigation has destabilized the pastoralist systems in the Lower Awash!
2. Livestock were pushed from wetlands and riverside.
3. Pressure has increased on surroundings forest and water resources.
4. As more wetlands are put, desertification has increased.

**Figure 13a. Human induced soil degradation in the Awash basin (Source ISRIC, UNEP GRID 1991).**
Figure 13b. Desertification in the Lower Awash River Basin.

(Photograph courtesy by Mulugeta Mammo 2001)
Figure 13c. Sand Trickle in Lower Awash River Basin.

(Photo courtesy by Mulugeta Mammo 2001)
• This area was once a food plain grazing area for the pastoralist
• Large scale irrigation development has disrupted the grazing land
• Bush encroachment has intensified
• Salinity has increased

*Figure 13d Prosopis Juliflora and Salt bush in Lower Awash River Basin
(Photo courtesy by Mulugeta Mammo 2001)*

Prospis Juliflora (exotic plant)

Salt bush
Figure 13e. Lower Awash Riverine

(Photo courtesy by Mulugeta Mammo 2001)
Conclusions

- The Awash River Basin is located in the Greater Horn Region which is under severe environmental degradation and frequent draught.
- So far developed large, small, and community irrigation schemes did not integrate livestock at initial planning stage.
- Which resulted in conflicts with surrounding farmers and pastoralists.
- Land fragmentation and crop intensification has marginalized livestock from communal and private owned grazing areas.
- Low rainfall has exhibited low vegetative production and Rain Use Efficiency.
- Crop residues are important feed in the upland of the Bain.
Continued Conclusions

- Community irrigations are easily to manage by the farmers and environmentally healthy.
- Farmers in the community based irrigation has managed to improve feed water availability for their livestock.
- Livestock is forced to walk long distances from home stead for water drink.
- In the Middle and Lower Awash River Basin forage availability is below normal in most of the years.
- As more wet lands and flood plains are put to irrigated crops deforestation is expanding.
Recommendations

- Community, small and irrigation should integrate livestock with crop production at initial planning of irrigation schemes.
- Community irrigation should practice producing irrigated fodder and pasture.
- Communities should stop using crop residues for fuel and selling the residues to urban areas.
- More watering points for livestock should be designed in the community based irrigation.
Continued Recommendations

- In the lower Awash River Basin draught and salt tolerant feeds should be introduced.
- Livestock water scarcity should be mapped frequently for the pastoralists.
- Destocking in the feed water shortage areas could be one way of managing of livestock production for the hot spot areas. This could be done through different wealth accumulation strategy.
- Restocking in favorable areas of community based irrigation could be benefit the poor farmers.
THANK YOU!!