Ethiopian Central Rift Valley: Current status, developments and policy implications

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Content

- Introduction to Central Rift Valley
  - Current problems, general information
- Resource use in the CRV
  - Water and land use
- Developments
  - Climate change, land use, expansion Sher-Ethiopa
- Policy implications
Interrelated problems

- Poverty
- Lack of employment opportunities
- Deforestation (charcoal, land clearing)
- Intrusion of people in NP Abijata/Shala
- Overgrazing
- Low agricultural productivity
- Groundwater of low drinking quality
- Over-fishing of lakes
- Etc, etc. but most prominent.....
Falling water table Lake Abijata
Objective of study

Development of knowledge base to strengthen local authorities in the field of environmental management enabling a sustainable development of the CRV.

- Clarify interrelated problems
- Identify options for improved resource use
- Contribute to research and policy agenda
Data limitations:

- Hydrological area ≠ administrative area
- Lack of data
  - e.g. use of irrigation water
- Inconsistent data
  - e.g. boundaries of woredas
- Variability/dynamics
  - e.g. livestock population

Therefore, shown numbers are indicative, but do not affect conclusions.
General characteristics Central Rift Valley

- Catchment area: 1.0 Mln ha
- 10 Woreda’s in catchment: 0.86 Mln ha
- Human population: 1.5 Mln
  - growth rate: ± 3%
  - average family size: 5.3-7.5 persons
- Livestock population: 0.86 Mln TLU
### Land use 1999

<table>
<thead>
<tr>
<th>CoverType</th>
<th>In ha:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated land</td>
<td>6600</td>
</tr>
<tr>
<td>Intensively cultivated</td>
<td>218440</td>
</tr>
<tr>
<td>Open acacia woodland</td>
<td>88493</td>
</tr>
<tr>
<td>Swamp/wetland</td>
<td>21706</td>
</tr>
<tr>
<td>Lake</td>
<td>82611</td>
</tr>
<tr>
<td>Forest</td>
<td>17249</td>
</tr>
<tr>
<td>Afro-Montane</td>
<td>38633</td>
</tr>
<tr>
<td>Degraded savanna</td>
<td>43847</td>
</tr>
<tr>
<td>Open woodland</td>
<td>82443</td>
</tr>
<tr>
<td>Mixed cultivated/wood land</td>
<td>231185</td>
</tr>
<tr>
<td>Bare land</td>
<td>6984</td>
</tr>
<tr>
<td>Mixed acacia/cultivated land</td>
<td>212898</td>
</tr>
</tbody>
</table>

Land cover map of CRV, Ethiopia based on Landsat MSS image, 1999
Average rainfall 1996-2005 (17 stations)

- Total annual rainfall in CRV: 8900 Mln m³
- Coefficient of variation rainfall: 13 – 25%
Rainfall in Ziway (1996-2005)

- Distribution within year highly variable
- Risk for rainfed production
Resource use in the CRV
Water users

- People
- Livestock
- Soda Ash plant in NP Shala/Abijata
- Sher-Ethiopia
- Irrigated smallholders and state farm
Water use: Domestic & livestock

- Human population: 1.5 Mln
  13.3 l/d/pers (average domestic use Ethiopia)
  Total water use: 7.2 Mln m³

- Livestock population: 0.85 Mln
  15 l/d/TLU in wet season, 30 l/d/TLU in dry season
  Total water use: 7.7 Mln m³
Water use: Abijata soda ash plant

Soda-ash (Na$_2$CO$_3$) process:
1. NaCl is extracted from lake water by evaporation
2. Chemical process: NaCl + CaCO$_3$ $\rightarrow$ Na$_2$CO$_3$ + CaCl$_2$

Assuming (needs check!):
Annual production of Na$_2$CO$_3$: 10,000 ton
NaCl concentration lake water 7 g/l (seawater 24 g/l)
Total water evaporated: 1.5 Mln m$^3$
Water use: Sher-Ethiopia

- Average use: 25000 m$^3$/ha/year
- Current area, ±50 ha: 1.2 Mln m$^3$
- Target area 1$^{st}$ phase, 250 ha: 6.2 Mln m$^3$
- Target area 2$^{nd}$ phase, 450 ha: 11.2 Mln m$^3$
Water use: Irrigated smallholders and state farm

- **Uncertainties:**
  - Total irrigated area
  - Number of crops per year
  - Growing period
  - Crop types / duration (annual or perennial)
  - Irrigation water use efficiency

- **Heroic assumptions:**
  - Total irrigated area: 8000 ha
  - Average use: 20000 m³/ha/year
  - Total water use: **160 Mln m³**
## Current water use: In summary (Mln m^3)

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic use</td>
<td>7.2</td>
</tr>
<tr>
<td>Livestock</td>
<td>7.7</td>
</tr>
<tr>
<td>Soda ash plant</td>
<td>1.5</td>
</tr>
<tr>
<td>Sher-Ethiopia</td>
<td>1.2</td>
</tr>
<tr>
<td>Smallholder + state farm</td>
<td>160</td>
</tr>
</tbody>
</table>
Relation between irrigation water withdrawals and water table of lake Abijata?

Irrigated area in CRV: 8,000 ha
Total area CRV: 1.0 Mln ha
→ < 1% of CRV is irrigated

Water use irrigated smallholders & state farm: 160 Mln m$^3$
Total rainfall in area: 8.900 Mln m$^3$
→ < 2% of total rainfall is used for irrigation
Conclusion: No relation between irrigation water withdrawals and water table of lake Abijata?

Lake Abijata depends on rainfall & water from catchment (a.o. Bulbula river)

Water deficit Abijata (evaporation – rainfall): 180 Mln m$^3$

Estimated water extraction along Bulbula: 25 Mln m$^3$

10-15% of annual water requirements of Lake Abijata is extracted from the Bulbula
### Resource use: Value of irrigation water (Birr/m³)

\[
\text{(income – costs) / withdrawn irrigation water (Birr/m}^3\text{)}
\]

<table>
<thead>
<tr>
<th></th>
<th>(Birr/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roses</td>
<td>23</td>
</tr>
<tr>
<td>State farm: grapes</td>
<td>- 0.4</td>
</tr>
<tr>
<td>State farm: tomatoes</td>
<td>0.8 (5.5)</td>
</tr>
<tr>
<td>Smallholder production</td>
<td>???</td>
</tr>
<tr>
<td>Soda ash production</td>
<td>???</td>
</tr>
</tbody>
</table>
Value of irrigation water

Improvements through:
- Increased yields
- Crops with higher added value
- Reducing costs
- More efficient water supply
Resource use: Labour requirements

<table>
<thead>
<tr>
<th>Activity</th>
<th>(pers/ha/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roses</td>
<td>35</td>
</tr>
<tr>
<td>State farm</td>
<td>7</td>
</tr>
<tr>
<td>Smallholders</td>
<td>2 ?</td>
</tr>
<tr>
<td>Soda ash production</td>
<td>??</td>
</tr>
</tbody>
</table>
Resource use: Land

- Animal husbandry farming
  Livestock density: ± 1 TLU/ha
  Feed requirements: 3 t dry matter/ha
  Result: overgrazing

- Rainfed arable farming (± 400,000 ha)
  Low yields (± 500-1000 kg/ha maize) associated with low external input use
  Result: soil nutrient depletion and land clearing

- Animal husbandry and rainfed arable farmers: food insecure
  Result: deforestation for charcoal production

- Overall effect:
  Overgrazing + deforestation + soil depletion ➔ land degradation
Developments
Climate change: Annual rainfall 1968-2005

- No consistent trend
- Distribution within year?
- More station data available?
Climate change: Short-term annual rainfall trends (21 stations)

Decreasing rainfall trend (-10-15%)
Climate change: Max daily temperature (1968-2005)

- Consistent trend except for period around 1980s (measurement error?)
- Consequences: Increased evapotranspiration?

Land cover map of CRV, Ethiopia based on Landsat MSS image, 1973

Land cover map of CRV, Ethiopia based on Landsat MSS image, 1986

Land cover map of CRV, Ethiopia based on Landsat MSS image, 1999
## Land use 1973-1999 (in ha)

<table>
<thead>
<tr>
<th>Land Use</th>
<th>1973</th>
<th>1999</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degraded savanna</td>
<td>14.500</td>
<td>44.000</td>
<td>+300%</td>
</tr>
<tr>
<td>Intensively cultivated land</td>
<td>100.000</td>
<td>220.000</td>
<td>+220%</td>
</tr>
<tr>
<td>Open acacia woodland</td>
<td>120.000</td>
<td>88.000</td>
<td>-27%</td>
</tr>
<tr>
<td>Irrigated land</td>
<td>0</td>
<td>6.500</td>
<td></td>
</tr>
</tbody>
</table>
Expansion Sher (based on 450 ha)

- Water quantity: ± 11 Mln m³
  - Substitutes past water use of state farm

- Water quality: In general, nutrient and pesticide emissions are high in rose cultivation.
  - Consequences unclear, but Sher is close to Bulbula river……..

- High demand on labour: > 15.000 people employed.
  - Number of relatives that join migrants?
  - Enormous pressure on urban and social infrastructure of Ziway.
Policy implications

1. CRV is extremely vulnerable from a hydrological point of view.
2. Current water extraction along the Bulbula is relatively small but it has (had) an impact on the Lake Abijata water table.
3. Pollution risks associated with Sher-Ethiopia needs attention (e.g. risk assessment of emissions, urban planning).
4. Expansion of irrigated agriculture should take into account associated environmental consequences.
5. Climate variability and change and their consequences needs to be addressed in policy as well as research.
6. Land degradation needs urgently attention as it is a large problem in terms of ecosystem functioning as well as people involved.
Work in progress

- Hydrology of sub-catchments (Ketar, Meki)
- Relation among land use, river discharge and lake levels
- Review land use classification of land use maps (’73-’99)
- Land use map of 2006 (other satellite)
- Long-term rainfall and temperature (9 stations)
- Update estimation water use by soda ash plant
- Value of irrigation water used by smallholders
Thank you