Sustainable Land Management and Agricultural Practices Research in Ethiopia

Tolessa Debele and Beshir Abdulahi

Prepared for

United Nations Expert Group Meeting on SLM and AP, Gothenburg, Sweden

16-17 April 2009

Presentation Outline

1. Soil and water resources of Ethiopia
2. Agricultural potential and major production constrains
3. Major land degradation problems in Ethiopia
4. SLM issues in Ethiopia
5. Strength, challenges and opportunities of the SLM interventions in Ethiopia
6. Available SLM technological options in Ethiopia
7. Major research gaps in SLM to feed into Extension
8. Working SLM options in Ethiopia
9. Working but challenged SLM options
10. Good experiences of SLM
11. Conclusions

Soil resources of Ethiopia

- Ethiopia has a total land area of 1.13 million km^2 and more than 18 soil associations
- The major soil types are
  - Lithososls 17.1%
  - Nitisols 12.2%
  - Cambisols 11.6%
  - Regosols 10.9%
  - Vertisols 10.0%
  - Fluvisols 8.3%
- When only arable lands are considered the important once are:
  - Nitosols 23%
  - Vertisols 19%
  - Cambisols 18%

Water resources of Ethiopia:

- 12 river basins
- 11 fresh lakes
- 9 saline lakes
- 4 crater lakes
- >12 major swaps and wetlands
  - With mean annual water flow of 112 billion m^3
- If properly conserved, the available water resources are large enough to cover the irrigation water demand of the country
- But, Ethiopia is not conserving and utilizing its water resources properly

Agricultural potential and major production constraints in Ethiopia

- Ethiopia has very huge agricultural potential:
  - Favorable climate
  - Productive soils
- Major production constraints are:
  - Land degradations
  - Non-sustainable cropping practices, particularly plow- or hoe-based cultivation
  - Poor drainage of Vertisosl and Fluvisols
  - Moisture stress in the dry areas

Major land degradation problems in Ethiopia

- Due to high variability in climate, relief, soil type, altitude and farming systems, all types of soil degradation take place in Ethiopia

1. Physical soil degradation:
   - Soil erosion (mainly water erosion)
   - Ethiopia loses 1.5 billion tons of topsoil each year
   - 30,000 ha of farmland lost annually from water erosion
   - more than 2 million hectares have already been severely damaged and reached at the stage where only huge investments can make them productive again
   - 62,000 ha of land under deforestation annually

Gully erosion in Ethiopia

Soil erosion in Ethiopia

Gully erosion in Ethiopia

2. Chemical Soil Degradation:

- Soil acidity
  - About 40.9 % of Ethiopia is covered by acid soils
  - 28% by moderately acidic soils (pH 4.5 - 5.5)
  - 13% by strongly acidic soils (pH <4.5)
- Soil salinity and sodicity
  - 11 million ha of land in Ethiopia are salt affected soils
  - about half of these soils are saline and the remaining half are saline-sodic and sodic soils
  - The main sources of salinity are:
  - Inadequate irrigation water management
  - Shallow ground water tables
  - Natural saline seeps
- Soil fertility decline

White salt crusts on the surface soils of irrigated lands in the Awash River basin indicating the presence of severe soil salinity

Biological Soil Degradation:

- Biological Soil Degradation:
  - Depletion of vegetation cover and SOM
  - Reduction of biological activities
- The problem of land degradation is more complex in the highlands of Ethiopia where it intricately embedded with high level of poverty and further associated with dynamic rapid changes that increasingly render agro-ecosystems vulnerable to uncertainty
- Consequently, land degradation not only persists, but is increasing at an alarming rate
- This has culminated into household and national food insecurity with severe consequences on vulnerable groups notably women, children and the aged

Sustainable land management issues in Ethiopia

- Ethiopia has elevated SLM as a critical research and development agenda
- SLM has been consistently identified as a major priority in national strategies and policy documents
  - Sustainable Development and Poverty Reduction Programs I & II
  - Plan for Accelerated and Sustained Development to End Poverty (PASDEP)
  - SLM is mainstreamed in the National Agricultural Research strategy
- Community based participatory watershed management guideline developed

SLM issues in Ethiopia…

- Ethiopia has adopted the regional poverty alleviation efforts through the Comprehensive Africa Agricultural Development Program (CAADP) and the Environment Programme and Action Plan of the New Partnership for African Development NEPAD (2003)
- National and regional platforms for SLM established
  - Joint government – development partners coordination forum
  - Steering and technical committees
  - Secretariat

SLM issues in Ethiopia…

- Though SLM has been given prominence in national development strategies, different types land degradations have persisted in the country
- The mainstreaming of SLM policies into national development strategies and policies has not resulted into effective implementation of SLM at landscape levels

Strengths, challenges and opportunites of the SLM interventions

1. Strengths:

- Demand is created for wider utilization of improved crop varieties, diary cows and indigenous trees
- Knowledge of farmers on introduced SLM technologies, and researchers and other partners on locally available SLM resources improved
- Bylaws, local institution and collective actions received much recognition
- The income of farmers who adopted SLM interventions increased

Challenges associated with SLM interventions:

- Open livestock grazing hinders the integration of some SLM interventions such as high value trees on farmlands and biological SWC measures – lack of livestock raring policies
- Shortage of some SLM technologies
- Lack of capacities on how to integrate and practice SLM best practices
- High level of poverty
- The long term benefit nature of most SLM practices
- Unpredicatble weather

Opportunities

- Provision of land certification
- Prepartion of landuse policy
- Decentralized governanace – SLM action at grass roots should be easy to effect
- Presence of different stakeholders and institutions
- SLM is a priority agenda of the district, Region and the Federal Government

Available SLM technological options in Ethiopia

- Mineral fertilizer use
- Crop residue management
- Animal manure
- Cover crops
- Green manuring
- Agro-forestry
- Bio-fertilizers
- Cropping systems (crop- association and crop rotation)
- Gully stabilization
- Tree species to reclaim degraded land

Soil and water loss as affected by different bio-physical soil erosion controlling measures

Bio-physical measures	Soil loss (t/ha)	Water loss (m^3/ha)
Bare land	139.3	182.8
Level bund	25.4	116.3
Bench terrace	4.6	102.8

Soil and water conservation

Vegetative strips vs soil bund

Participatory assessment of run-off, soil and nutrient losses from the different land use systems.

Niche-compatible afforestation

Community nursery at the watershed

Tree planting around the homestead

Integrated production and nutrient management


Improved linseed varieties


Garlic varities

Species promoted for compost preparation and direct application

Senecio gigas

Hagenia abyssinica

Integrated energy management

Woody and non-woody fuel biomass resource availability and consumption assessment.

Introduction, demonstration and evaluation of improved energy saving stoves.

Livestock husbandry

Oat varieties

Cross breed cows

Milk processing for consumption & income

Indigenous tree and shrub species studied and promoted for animal feed

Rehabilitated and slope farming

Major research gap in SLM to feed into extension in Ethiopia

- Inadequate method or approach to scale-up the available SLM technologies
  - How to deliver the technologies to farmers?
  - How to reach as many farmers as possible?
- Lack of appropriate technologies for the highlands as most of the technologies available in the country are for the mid-altitude areas
- Weak linkage between technology generation and dissemination

Working SLM options in Ethiopia

- Mineral fertilizer uses
- Improved and market oriented crop varieties
- Improved livestock breeds i.e., dairy cows
- High value tree crops
- Homestead agro-forestry or woodlot, especially fast growing species
- Minimum tillage and crop residue management
- Some soil and water conservation bio-physical practices

Working but challenged SLM options

- Integrated soil fertility management
  - Animal manure – because of competitive use as household fuel
  - Crop residue for soil amendments – because of competitive as fodder, fuel and construction
  - Minimum tillage – because of increasing cost of herbicides
- Out field soil and water conservation measures
  - Biological measures because of competitive uses as fodder (grasses) and as fuel and construction material (trees and shrubs)
  - Physical measures challenged because of free grazing during off-seasons

Good experiences of SLM and agricultural practices in Ethiopia

- The low national average yields are attributed to:
  - Non-sustainable cropping practices, particularly plow- or hoe-based cultivation
- Generally, CT has been world-wide the basic tool of cropping for centuries
- However, the need to produce more food
  - for an increasing population
  - with decreasing soil and water resources
    - ►caused a shift to MT
- MT is recognized for its role in conservation of both soil and water on account of CRs remaining on the surface

- **Minimum tillage and crop residue management has been found successful as SLM options and popularized to many areas on different crops**:
  - **Maize**
  - **Soybean / Haricot bean**
  - **Wheat**
  - **Faba bean**
  - **Tef**

Comparison of minimum tillage with crop residue retention and conventional tillage

Parameters	MTRR	CT
Grain yield (t/ha)	6471	5768
N derived from fertilizer (kg/ha)	42.9	50.1
N derived from soil (kg/ha)	76.8	55.3
N remained in soil (kg/ha)	12.2	10.9
N accounted for (kg/ha))	32.9	31.0
N recovery efficiency (%)	46.6	54.4
N balance		
N recovered by maize (%)	47	54
N remained in the soil (%)	17	12
N unaccounted for (%)	36	34

MTRR vis-à-vis CT

- In comparison with CT, MTRR resulted in higher contents of organic C, total N, extractable P and K which is reassuring
  - since all of them can be very beneficial for sustainable cropping
- However, MTRR resulted in a higher PR and lower pH which is alarming
  - since both of them should be managed carefully for sustainable cropping

Conclusions

- The major soil and water conservation research at national level has been done by the Soil Conservation Research Project (SCRP) of the MoA and by the IAR
- The effectiveness of different bio-physical soil conservation measures were evaluated on farmers fields
  - The innovations have proved successful in the pilot sites for participating farmers
  - Despite ample scientific innovations generated to mitigate soil degradation, little has been translated into action

The Way Forward

- **Scaling-up of SLM and Agricultural Practices**
  - **Integrated soil fertility management**
  - **Soil and water conservation**
  - **Improved crop varieties and livestock breeds**
  - **Value addition and marketing systems**
  - **Scaling up farmer's collective action – Community mobilization**
  - **Strengthen research on SLM**

Thank you for your attention