Implementing a holistic approach to watershed management

By

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on behalf of the wider project team

Final Workshop of the project

Reducing land degradation and farmers' vulnerability to climate change in the highland dry areas of north-western Ethiopia

Bahir Dar, Jacaranda Hotel, June 20th – 21st, 2016

Austrian Development Agency

ICARDA
Science for Better Livelihoods in Dry Areas

ARARI

BOKU
Universität für Bodenkultur Wien

…A story that began in 2009….

When a team of ICARDA researchers visited the region and, together with ARARI colleagues, selected the watershed based on a set of criteria as a very promising site for research

1. Unlocking the potential of rainfed agriculture in Ethiopia for Improved Rural livelihoods (ADA, 2009-2012)

2. Combating land degradation and improving productivity through integrated watershed management, monitoring, and community participation (CRP–WLE, 2012-2016)

3. Reducing land degradation and farmers' vulnerability to climate change in the highland dry areas of north-western Ethiopia (ADA, 2013-2016)

4. Strategic Interventions to Simultaneously Reduce Women's Drudgery, Youth Unemployment, and Ecosystem Degradation (CRP–WLE, 2014-2016)

5. Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas (IFAD, 2014-2016)

…A story of people….

Some no longer in the team…just to mention some:

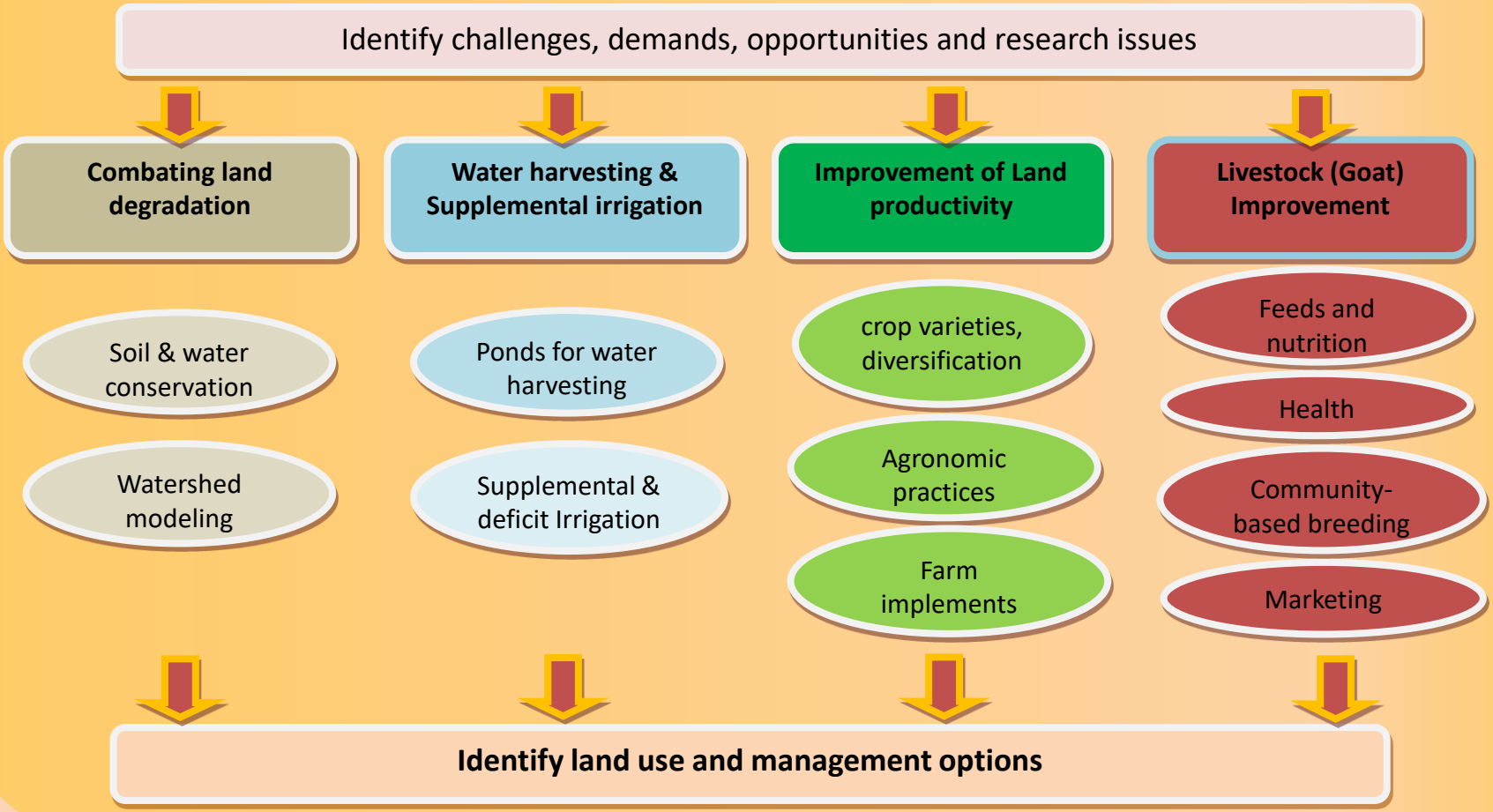
Rolf Sommer
Wondimu Bayu
Abraham Abiyu
Feras Ziadat
Debra Turner
Mohammed Boufaroua…

Many researchers not present today…

Many Ethiopian and Austrian students….. and farmers, and stakeholders…

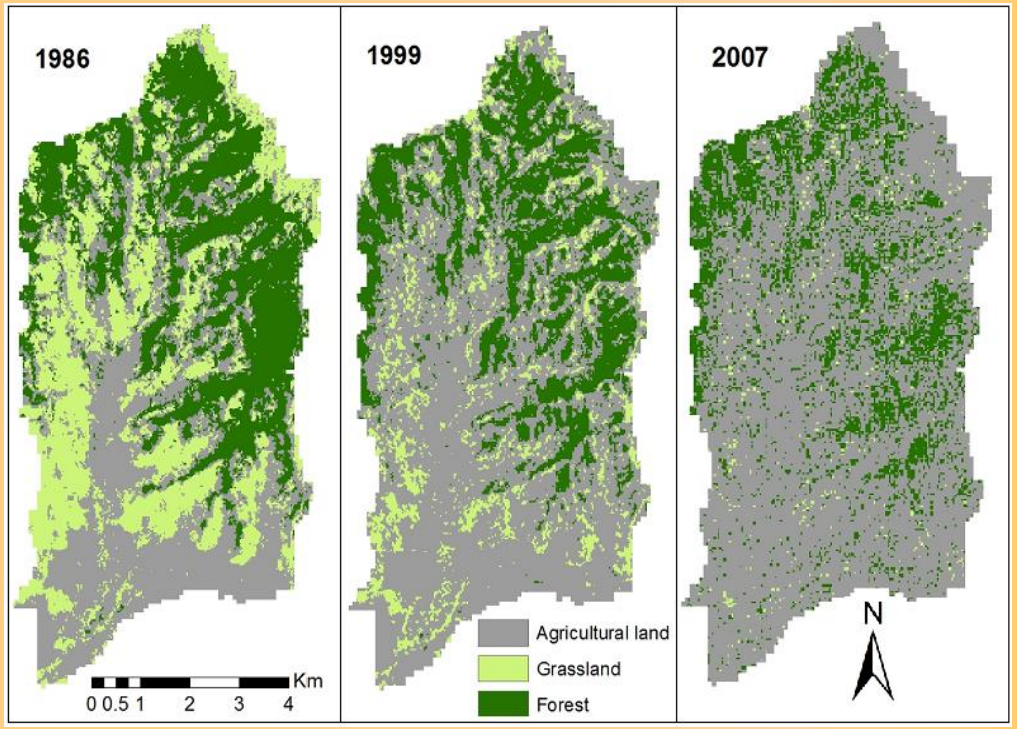
…An evolving story….

The **first phase**: problem-driven, technology-oriented



Assumptions: need for watershed-scale action

- Deforestation upstream, accelerating erosion in all watershed
- Water (rainfall) shortage can be mitigated through catchment-based interventions at multiple interlinked scales (e.g., macro and micro water harvesting)
- Improved farming practices impact soil and water resources in a way that can be effectively quantified/modelled at watershed-scale



Around 30 percent of watershed forests were lost between 1986 and 2007

Assumptions: need for improved management and soil conservation

- Soil erosion, nutrient depletion:
  Degradation of natural resources

- Rainfall irregularity/shortage:
  Adapt agriculture to CC challenges

- Poor farming practices (inputs, technology, access to improved crop and breed varieties, crop-livestock integration):
  Food security

Annual soil loss during the rainy season easily goes beyond **10 t/ha**, and often reaches up to **20 t/ha** or more.

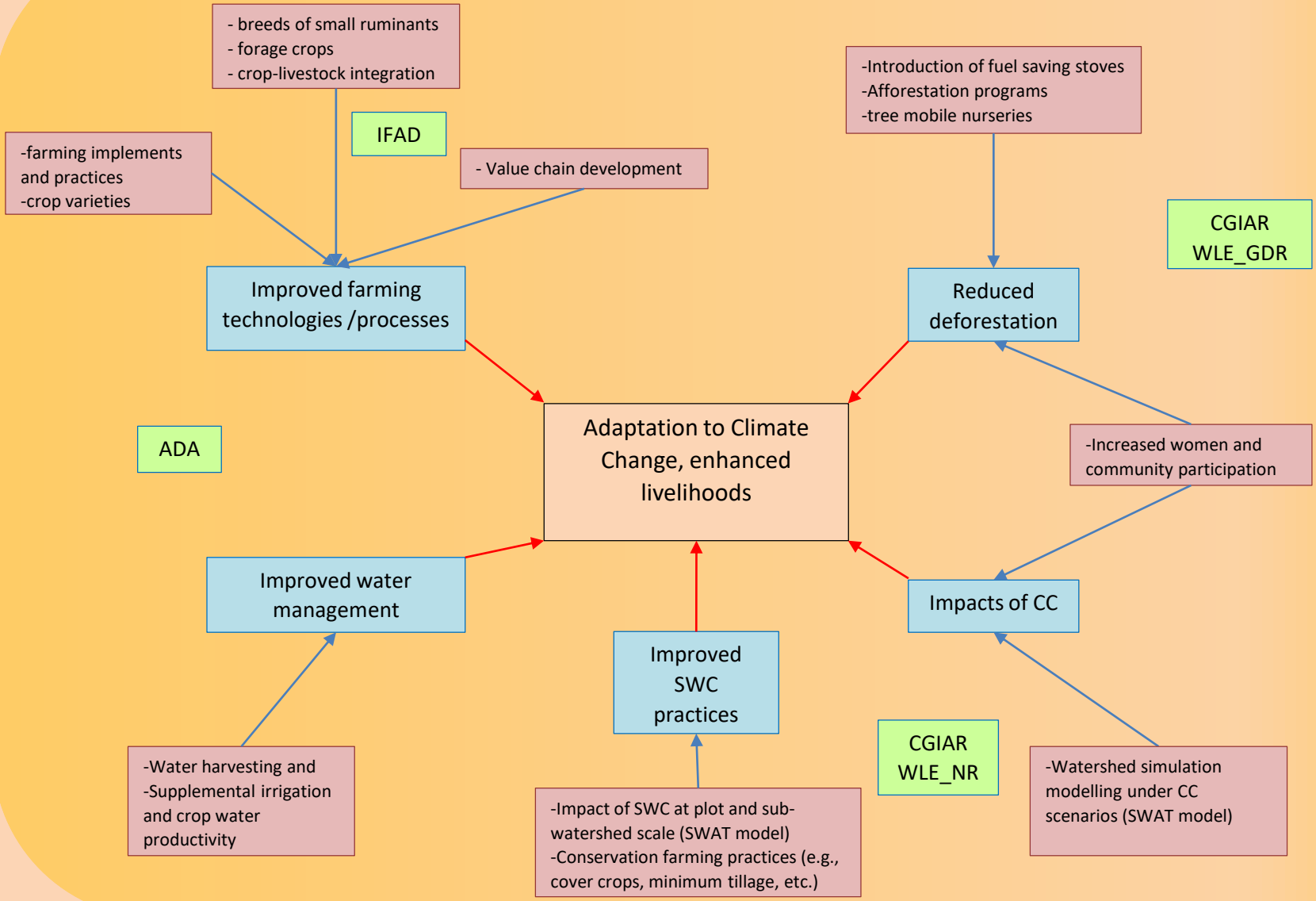
The "**second phase**" (2013-2016): From problem-driven, technology-oriented strategy, to a ***holistic approach to watershed management***

(previous) Lessons learnt:

Rural communities depend on a variety of livelihood strategies to meet their basic needs - these are interlinked, and include a suit of alternative income generating opportunities.

Adopting a holistic approach allows to appreciate the complexity of the challenges and seek solutions through better focused multiple interventions.

Farmers observing exp. trials during demonstration day…."*Do I need this*"?


- breeds of small ruminants
- forage crops
- crop-livestock integration
IFAD
-farming implements and practices
-crop varieties
- Value chain development
Improved farming technologies /processes
-Introduction of fuel saving stoves
-Afforestation programs
-tree mobile nurseries
CGIAR WLE_GDR
Reduced deforestation
ADA
Adaptation to Climate Change, enhanced livelihoods
-Increased women and community participation
Improved water management
Impacts of CC
Improved SWC practices
-Water harvesting and
-Supplemental irrigation and crop water productivity
-Impact of SWC at plot and sub-watershed scale (SWAT model)
-Conservation farming practices (e.g., cover crops, minimum tillage, etc.)
CGIAR WLE_NR
-Watershed simulation modelling under CC scenarios (SWAT model)

…A story that continues….

The "**Third phase**": what's next?

From the *holistic approach towards*
integrated options *and* ***system approach***

Where we are

<u>On going: bio-economic modeling.</u> Building on the datasets generated so far, from hydrology records to household data.

The aim of the bio-economic-model is to **analyze system dynamics, productivity and constraints at the watershed scale, and to simulate socio-economic impacts determined by climate and land use scenarios**.

Where we aim to go

Integration in field options: research on integration of improved practices, to achieve **cumulative advantages**.

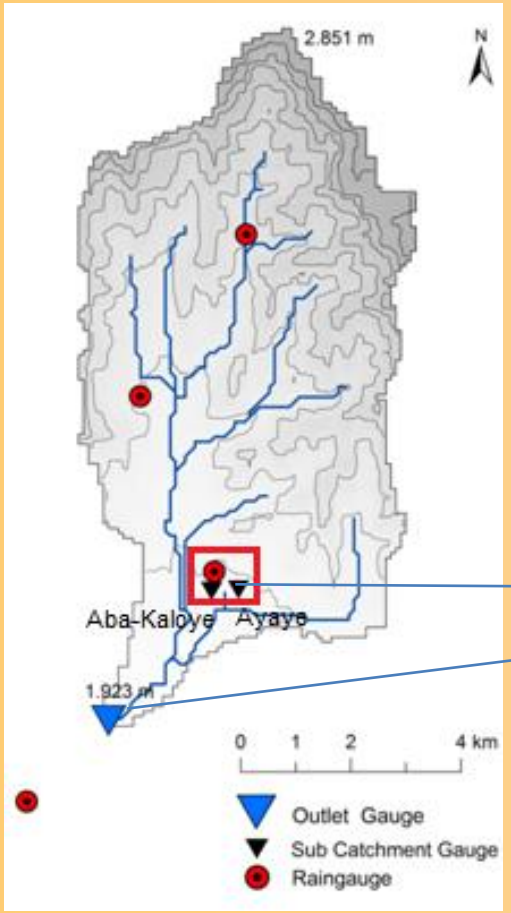
More **integrative modelling frameworks** to support **upscaling**

Increase **adoption by farmers, and better extension** processes, to generate **Impact**

…A very productive process..

Long term monitoring (2011-ongoing) of erosion and runoff

Impact of soil conservation measures (stone bunds) on runoff and erosion: advanced measurement infrastructure at plot and (sub-) watershed level



Plot scale measurement in SWC (stone bunds-) treated and untreated

Automatic monitoring at the outlet of watershed and two sub-watersheds (stone bunds- treated and untreated)

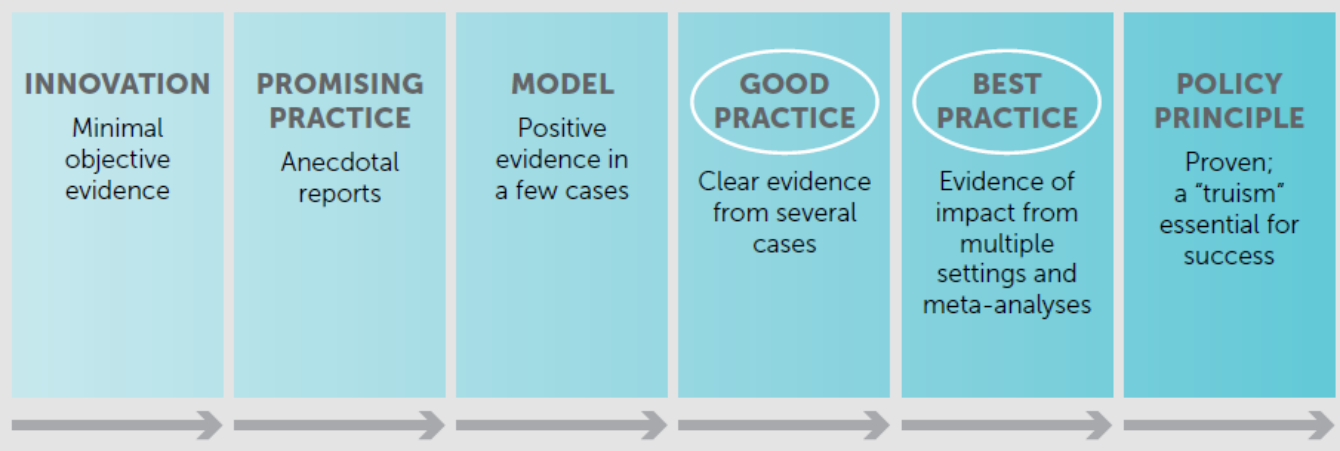
…A very productive process..(2)

SLM options

More than 25 trials conducted during the project duration (2013-2016)

Comparative evaluation of Practices in view of promotion/dissemination (*capitalization*)

Are they innovative? Good? Best?



Good practice (or best practice)	**Evidence of impact from multiple settings, several evaluations, meta-analyses, expert review, cost-efficiency analysis, good practice criteria**

(from World Bank sources

Scoring Criteria

Potential for promotion

- Physical performance (e.g., yield gain),
- Farmers preference,
- Easiness to adopt (tech.),
- Cost of adoption by farmers,
- economic impact
- climate resilience
- Confidence of the researcher (scientific soundness);

Reasons for promotion, or for not promotion !

Examples:

- Deficit irrigation of onion YES (garlic NO)
- Sorghum/faba bean intercropping YES
- Village-based goat improvement YES

Etc.

…A very productive process..(3)

Model approaches for Gender Mainstreaming

In the project: (we have tried to)

- ***Create opportunities for women to voice their opinions and concerns***
- ***Implement targeted activities that meet their needs***
- ***Encourage inter-disciplinary collaboration***
- ***Organize tailored capacity strengthening efforts***

…A very productive process..(4)

Publications

Students' work
(and much training at different levels)

PHD and Master Theses

PHD (ongoing)

Kindie, H. Assessment of the impact of rainwater harvesting and soil conservation structures on surface runoff and sediment yield from an agricultural watershed in Ethiopia. **PhD** dissertation, BOKU University, Austria.

Demelash, N. Climate change effects on watershed dynamics and ecosystem services for an agricultural watershed in Amhara region, Ethiopia. **PhD** dissertation, BOKU University, Austria.

Simegnew, E.T. Understanding Farmer Perceptions of Climate Change, Different Adaptation Strategies and Bio-economic Modeling of the Impacts of Climate Change on Smallholder Farmers' Livelihoods: The Case of Gumara-Maksegnit Watershed, North Gondar, Amhara Regional State of Ethiopia. **PhD** dissertation, BOKU University, Austria.

MASTER (ongoing)

Alemu, A. Assessing the efficiency and adoption of soil and water conservation interventions in Gonder zuria district. Masters thesis, Bahir Dar Univesrity, Bahir Dar, Ethiopia.

Martin Kaltenleithner, M. Investigation of the impact of stone bunds on soil water content. Masters thesis, BOKU University, Austria.

Tibebu, N. Balancing nutrient inputs in cropping systems in the Ethiopian highlands. Masters thesis, Bahir Dar Univesrity, Bahir Dar, Ethiopia.

MASTER (completed)

11. Stefanie WAKOLBINGER. Evaluation of the Impact of Stone Bunds on Soil Loss and Surface Runoff in the Gumara-Maksegnit Watershed, Northern Highlands of Ethiopia. BOKU University, Austria. Vienna **2016**.

10. Eva Maria OBEREDER. Investigation of the impact of stone bunds on erosion and deposition processes combining conventional and tracer methodology in the Gumara-Maksegnit watershed, northern highlands of Ethiopia. BOKU University, Austria. Vienna **2016**.

9. Jakob RIEDER. Assessments on the impact of stone bunds on water erosion in the Gumara-Maksegnit watershed, northern Ethiopia. Master thesis, BOKU University, Austria. Vienna **2015**.

8. Roman SCHIFFER. Simulation of Surface Runoff and Soil Erosion of a Watershed in Northern Ethiopia. Application and Verification of the SWAT Model for two small Agricultural Watersheds in the Gumara-Maksegnit Watershed. Master thesis, BOKU University, Austria. Vienna **2015**.

7. A. G. TSIGE. Water balance simulation and optimal reservoir sizing for supplemental irrigation in the Northern western Amhara region: A case study in Guma-Maksegnit sub watershed. Master thesis. Bahir Dar University, Faculty of Civil and Water Resource Engineering, Bahir Dar. **2015**.

6. Christoph, B.T. Spatial and temporal impacts of stone bunds on soil physical properties: A case study in the Northern Ethiopian highlands. Master Thesis, University of Natural Resources and Life Sciences, Vienna. **2014**.

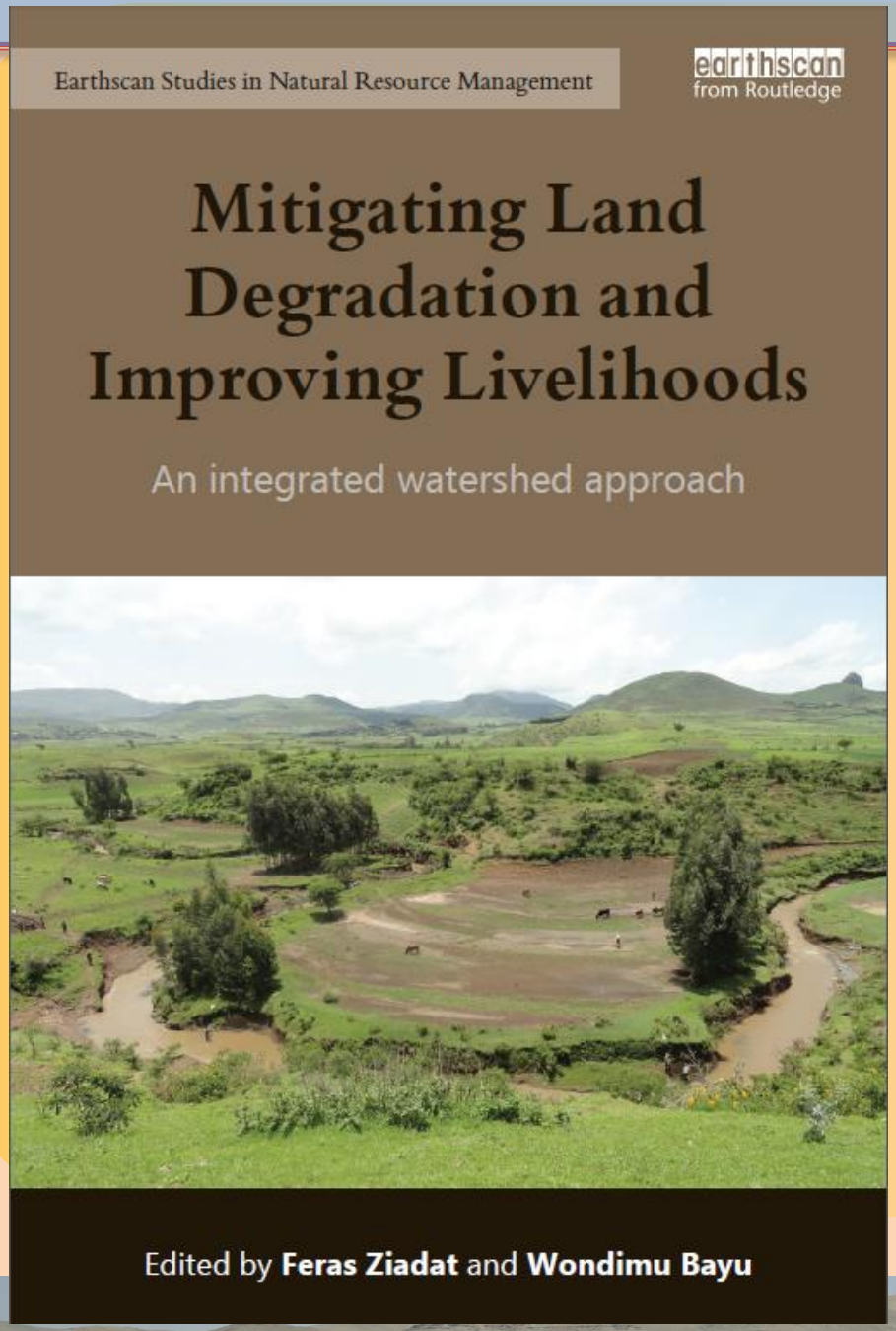
5. Florian, K. Assessment of gully erosion by linking photogrammetric approaches and field measurements. Master thesis, Institute of hydraulics and rural water management, University of Natural Resources and Life Sciences, Vienna. **2014**.

4. Gebretsadik, M. G. Soil moisture prediction in an agricultural field of Gumara-Maksegnit watershed, North Gonder, Ethiopia. Master Thesis, Department of Water, Atmosphere and Environment, University of Natural Resources and Life Sciences, Vienna. **2014**. Duration: 2012-2014.

3. Ingrid, B. Run off and sediment monitoring in an agricultural watershed in the Ethiopian highlands. Master Thesis, Department of Water, Atmosphere and Environment, University of Natural Resources and Life Sciences, Vienna. **2014**.

2. Brenner, C. Monitoring and simulation of soil erosion in the Ethiopian highlands on a plot scale. Master Thesis, University of Natural Resources and Life Sciences, Vienna.**2013**.

1. Sisay, K. Assessment of forest cover change and its environmental impacts using Multi-temporal and multi-spectral satellite images: The case of Gumara-Maksegnit watershed of North Gonder zone, Ethiopia. MSc Thesis, Hawassa University, Wondo-Genet College of Forestry and Natural Resources, Wondo Genet, Ethiopia. **2011**.



Science output

A book in 2015,
By Taylor & Francis Group publisher

17 chapters, 262 pages

Science output

Peer reviewed Journal articles

Several under revision

(…….)

Some already published

Addis, H.K., Klik, A., and Strohmeier, S., 2015. Spatial Variability of Selected Soil Attributes under Agricultural Land Use System in a Mountainous Watershed, Ethiopia. **International Journal of Geoscience** 6: 605–613.

Demelash, N., Tesfaye ,S., Bayu ,W., Sommer, R., Turner ,D., 2014. Effect of Compost and Chemical Fertilizer on Wheat Production and Soil Properties. **Nutrient Cycling in Agroecosystems**, 100: 357–367.

Kidane, A., Melaku, S., Haile, A., 2014. Kidane, A., Melaku, S., Haile, A., 2014. Characterization of Goat Population and Breeding Practice of Goat Owners in Gummara-Maksegnit Watershed-North Gondar, Ethiopia. **Agricultural Journal** 9: 5-14.

Tarekegn, A., 2014. Adaptability of vetch (Vicia spp.) for potential feed production in Gumara-Maksegnit watershed, North Gondar, Ethiopia. **Livestock Research for Rural Development** 26, Article #120.

Mehammednur, N., Yitaferu, B., Kibret, K., Ziadat ,F.,2013. Soil-Landscape Modeling and Remote Sensing to Provide Spatial Representation of Soil Attributes for an Ethiopian Watershed. **Applied and Environmental Soil Science** V. 2013, Article ID 798094, 11 pp., http://dx.doi.org/10.1155/2013/798094.

PUBLICATION PLAN

No.	Tentative title	Exp. period	Authors
1	Effect of N and P chemical fertilizer rate for optimum teff yield in Gondar-zuria Wereda, North Gondar, Ethiopia	2014-2015	Baye A., Meron L., Muuz G. Nigus D., Ayalew Addis
2	Assessment of Runoff, sediment loss, Total N, Available P and Organic matter in Gumara-maksegnit watershed, North Gondar	2011-2015	Muuz G., Atkilt A., Nigus D.
3	Investigating the effect of split application of N fertilizer on sorghum productivity	2013-2014	Meron L, Nigus D., Ertiban W., Muuz G., Baye A., Ayalew A
4	Effect of timing of ridging and tie-ridging on the performance of sorghum at North Gondar, Ethiopia	2014-2015	Ertiban W., Muuz G., Atkilt
5	Evaluating the effect of deficit irrigation on growth and yield of garlic and onion using pond harvested rain water.	2014-2015	Ertiban W., Muuz G., Melkie D.,
6	Determination of rate and time of nitrogen application on wheat (Triticum aestivum) yield and yield related components	2013-2014	Nigus D., Meron L, Muuz G., Baye A., Ayalew A
7	Determination of weeding frequency to increase production and productivity of Sorghum in GM Watershed	2014-2015	T. Jemberu, Y. Abje and M. Azanaw
8	Evaluating the adaptability of different sweet lupine varieties in Gumara- Maksegnit watershed	2014-2015	A. Tarekegn, B. shemelis and Y. Demsie
9	Development and implementation of a pilot village-based goat improvement scheme Demonstration of goat feeding package in community based goat improvement village	2013-2016	S. Abegaz, A. Kidane, A. Hailu and S. Tsehay
10	Evaluation of sorghum/faba bean intercropping for intensifying existing production systems in the Gumara-Maksegnit watershed	2013-2014	T. Jemberu, W. bayu, Y. Abje and T. Jorgi
11	Participatory variety selection of improved lentil varieties in Gumara- Maksegnit watershed at Gonder zuria district	2013-2014	G. Tilahun Tewodros Tesfaye Ansha Ahmed
12	Pre-scaling up of early maturing & drought escaping improved chickpea vars. & agronomic packages through farmers' based seed production and local seed systems at the Gumara-Makisegnit Watershed.	2015-2016	Y. worku, S. Yedeme, B. Wube and E. Melesse
13	Demonstration of cow pea hay and Concentrate mixture supplementation for fattening of culled goats from community based breeding program in GM area	2015-16	Y. Worku, S. Yedeme, T. Zelalem, B. Wube and E. Melesse
14	Goat value chain analysis: The case of Gumara-Maksegnit watershed	2014-15	Y. Worku and M. Fenta
15	Evaluation of community based goat program at Gumara-makesegit watershed	2015	Y. Worku and S. Abegaz
16	Introduction of fuel saving technologies to reduce land degradation & CC, improve soil fertility, and livelihoods	2013-15	Y. Worku, Beza and Mesfin Fenta, S. Yedeme, E. Melesse and B. Wube

…What about today and tomorrow…

Project achievement ⟺ ***Experience sharing***

Working groups and final discussion:
your recommendations, and the way forward

(take notes and get ready with ideas!)


Thanks for your attention