Opportunities for small scale irrigators

Increasing food production through irrigation in the dry season improves livelihoods. Entrepreneurs and farmers are already using groundwater, river or stream pumping, and private small reservoirs and ponds in emerging irrigation systems. The **Innovation Lab for Small Scale Irrigation** is working in Ghana, Ethiopia, and Tanzania, where small scale irrigation can contribute to national development goals. ILSSI aims to identify how to create opportunities for farmers and other actors across scales. Researchers are examining mechanisms to improve access to small scale irrigation technologies for both men and women. When irrigation already takes place, they work with farmers and extension to pilot ways to improve water lifting, conveyance and field distribution. The project considers scaling the technologies and practices within the context of market and environmental sustainability.

Farmer using solar pump to irrigate avocado, vegetables and fodder in Lemo. (Photo: Petra Schmitter, IWMI)

Challenges

Transitioning from subsistence, rainfed systems to commercial irrigation requires upscaling best-bet technologies and efficient water management. Small scale irrigation technologies must be profitable for farmers and investors. Technologies must fit the context of the farm, the biophysical environment, and the market. And market and environmental boundaries must be considered in up-scaling irrigation at landscape scale.

Contributing to solutions

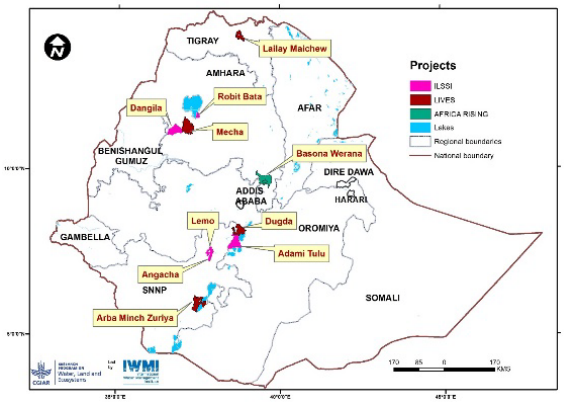
- Piloting small-scale irrigation technologies testing combinations of water sources (shallow, ground and surface water), water extraction technologies (motorized pumps, rope and washer, solar pumps and pulleys), and appropriate water application (overhead, drip, furrow) and irrigation scheduling tools.
- Generating biophysical and socio-economic data to assess opportunities and constraints to scaling.
- Identifying potential business models for access small-scale irrigation by men, women and youth.
- Exploring options for irrigating fodder for livestock production.
- Ensuring the environmental and economic sustainability of irrigation interventions from farmer to watershed scale through an integrated process-oriented modelling suite of SWAT, APEX and FARMSIM.
- Exploring potential pathways between irrigation and improved nutrition.

Project partners working toward impact

The ILSSI team is led by Texas A&M University with IWMI and ILRI leading field interventions and IFPRI implementing surveys. ILSSI engages scientists and students from Bahir Dar University, Arba Minch University, Amhara Regional Agricultural Research Institute and Southern Agricultural Research Institute.

Field level interventions and analysis: Piloting small scale irrigation with farmers

In Ethiopia, ILSSI is piloting interventions with around 200 women and men farmers. ILSSI works with university and research partners, extension, subject matters specialists, local irrigation and finance cooperatives, and women and men farmers to pilot technologies and practices that hold potential for scaling small scale irrigation. ILSSI has installed measurement instruments in the watersheds to collect primary data. ILSSI also tests water quality to monitor and analyse different water sources in consideration of multiple uses. Field interventions, instrumentation and sampling in the watershed, socio-economic surveys and farmer field books provide primary data. This is complemented with secondary data from national and international resources. ILSSI uses the data in a suite of models - SWAT, FARMSIM and APEX - to form an Integrated Decision Support System.



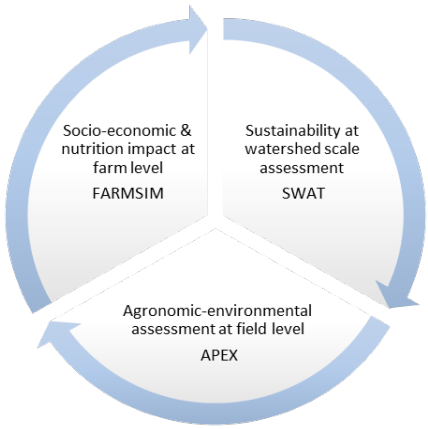
Pilot sites under ILSSI and related projects

Site specific interventions

Region	District	Village	Water source	Intervention(s) - technologies
Amhara	Dangila	**Danghesta**	Groundwater	Pulley, Rope and washer pumps, irrigation scheduling; Restrictive layer (groundwater recharge); Vegetable and fodder testing
Amhara	Bahir-Dar Zuria	**Robit**	Groundwater/river	Pulley, irrigation scheduling; Vegetable and fodder testing
Oromia	Adami Tulu	**Bochesa**	Groundwater/Lake/river	Motor pumps & furrow irrigation, Rope and washer pumps, irrigation scheduling; vegetable and fodder testing
SNNPR	Lemo	**Upper Gana**	Groundwater/river	Solar pump, Rope and washer, service provider & drip, irrigation scheduling; Vegetable and fodder testing

Initial analysis shows that vegetable production with small scale irrigation is profitable, but the level of profitability depends on the type of water lifting and the crop. Notably, vegetables with low market prices (e.g. onion) in combination with high irrigation labor demand for manual water lifting (e.g. rope and washer) is a less feasible option. Labor usually constitutes the primary cost for irrigators, and intense input of household labor is often not an option. Hence, water lifting technologies reducing irrigation labor (e.g. solar PV pumps) in combination with vegetables that require less labor appear to offer higher profit. Furthermore, the irrigation scheduling trials show that the access to information on how much to irrigate not only helps farmers to increase yields but also potentially increases profits. Initial results from the field trials suggest that the increased yield through improved water management also increases nutrient depletion. This necessitates updated fertilizer recommendations for irrigated agriculture for long-term sustainability of irrigated agriculture.

ILSSI also tested the *Berken* plough (BT) alongside conventional ploughing (CT), deep tillage (DT) and no tillage (NT). The results show that the tillage depth was significantly higher in DT (60 cm) followed by BT (28 cm) and CT (18cm). The different ploughing depths influenced root penetration with the deepest root zone found under deep tillage. Differences in ploughing depth increased infiltration rates in the plots from 115 mm hr^{-1} (NT), 120 mm hr^{-1}(CT) 242 mm hr^{-1}(DT) and 262 mm hr^{-1} (BT). Runoff decreased with increasing infiltration rates. ILSSI is repeating the experiment in 2017 to confirm findings obtained during the 2015-2016 period.



Modelling scenarios with IDSS

In addition to the primary data collection described above, secondary data are obtained from national and international resources. The project uses a suite of models, SWAT, FARMSIM and APEX as an Integrated Decision Support System. Together with stakeholders and partners, the project is developing scenarios to identify opportunities and constraints at landscape and market levels for upscaling high potential irrigation technologies and practices. Ex-ante scenarios have been developed in early 2016 to test the framework of the models. Initial scenarios with primary and recently collected data are expected by late 2017 following engagement with key stakeholders to ensure alignment with national goals.

Sample SWAT model of Robit watershed, Ethiopia

Gender and nutrition analysis

The Ethiopia endline household survey is finalized and data cleaning is currently ongoing. The survey covers issues related to household and farm level production, economics, microfinance and technology access, as well as an intrahousehold module that addresses nutrition and gender. Qualitative research on intrahousehold adoption of irrigation technologies drawing on insights from Ethiopia, Ghana and Tanzania focused on what happens after adoption to better explain low adoption rates by women farmers and identify entry points for enhanced adoption developing a framework that can increase intra-household understanding post-adoption and thus increase sustainability of adoption of technologies by both women and men. Additionally, the implementation of gender-irrigation trainings in Ethiopia in 2016 led to the following results: The Ethiopia ATA expressed interest to add a working group on water to the Gender and Agriculture Network they initiated in the beginning of 2016; ATA also expressed interest in adding water issues to the gender guidelines/policy within the Ministry of Agriculture as gender-irrigation linkages to date were not

Farmer, sharing her knowledge on how to irrigate using the wetting front detector
(Photo: Petra Schmitter, IWMI)

considered by any ministry. Further info on the workshop is available here: [What should we be asking to understand gender dynamics in irrigation?]

Pathway to Impact: Stakeholder engagement and Capacity development

The project expects to invest around USD 2 million in research, capacity development and engagement to support investment decision-taking in Ethiopia over the project period (2013 to 2018). ILSSI early on engaged stakeholders to identify priority issues in small scale irrigation to support identification of pilot field interventions. ILSSI also engaged with key stakeholders and partners to ensure that model scenarios align with national goals and priorities. In 2016, in a second stakeholder workshop, participants ranked constraints for further analysis by IDSS. Along the project impact pathways, ILSSI research results are being shared with national partners and private sector actors, and more broadly across Africa. Partners are expected to use the knowledge generated from the project for scaling solutions and improving policy and practices for sustainable intensified production.

Ranked List of Constraints for Analysis

1. Access to markets
2. Water availability and access
3. Access to appropriate technology
4. Access to affordable inputs
5. Risk and vulnerabilities
6. Institutional issues

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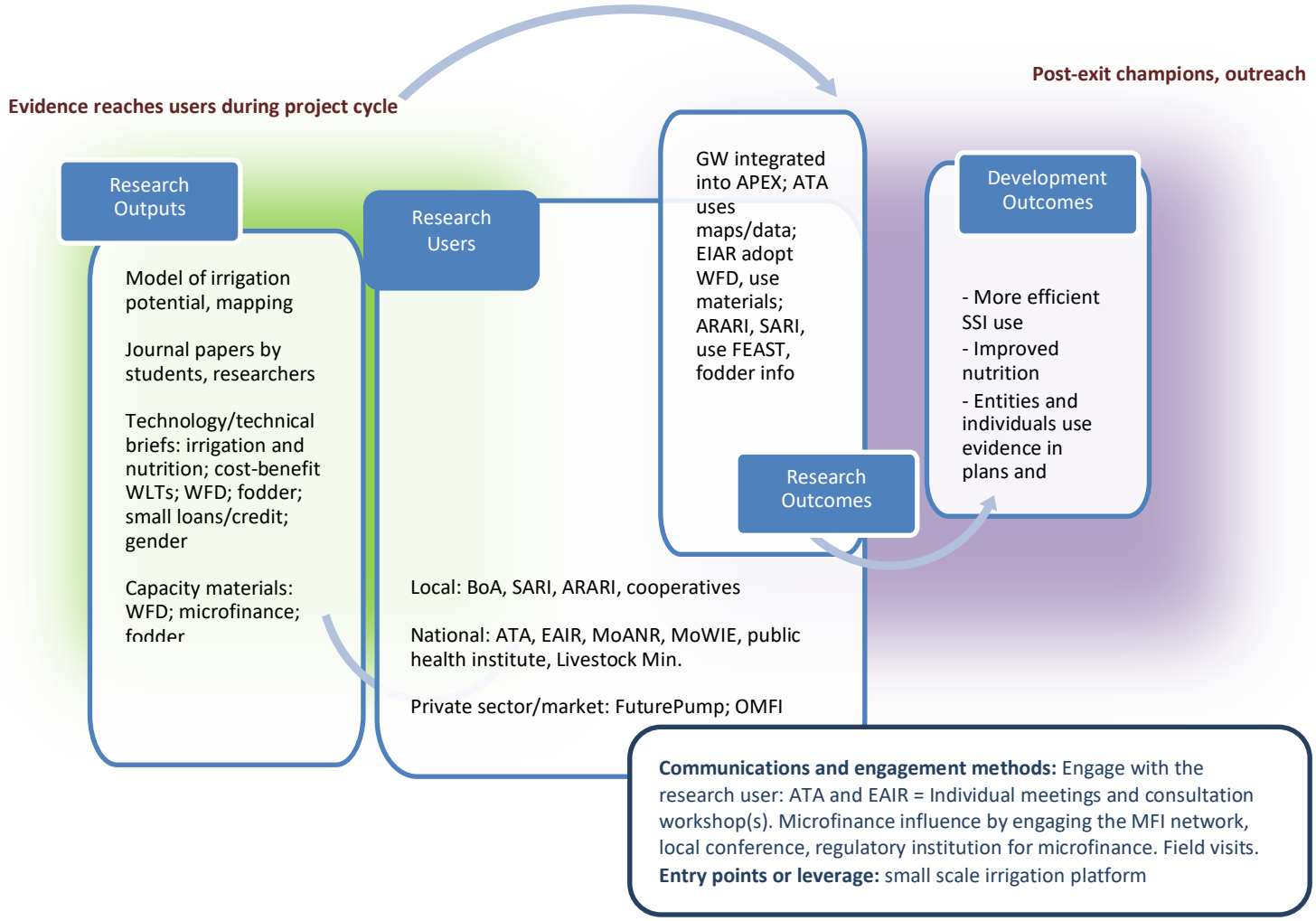

Capacity development

Capacity development is essential for long-term impact of the project. The project engages scientists and graduate students at different Ethiopian institutions to strengthen research skills and develop international journal articles and conference papers. Technical specialists, planners, students and scholars participate in training on the IDSS suite of models. ILSSI conducted four workshops in Ethiopia. To date ILSSI had held four work IDSS Workshops in Ethiopia. Conducted nationwide training includes sessions on SWAT, APEX, FarmSIM and Advanced SWAT. Currently ILSSI has trained 279 participants; of those 236 of them were males and 43 females (IDSS participants Figure). The project also strengthens the capacity of farmers, extension and private sector suppliers and service providers. Bahir Dar University, NCA&T and IWMI have trained local agriculture irrigation and microfinance suppliers and service providers.

National stakeholder events

Event	Date	Location	Output
Workshop: Gender and Irrigation	March 9th-10th , 2016	Addis Ababa	http://ilssi.tamu.edu/media/1186/ftf-ilssi-project-note-1-gender-equality-in-irrigation.pdf
Stakeholder Consultation Workshop	June 14th, 2016	Addis Ababa	http://ilssi.tamu.edu/media/1279/ilssi-stakeholder-workshop-report_ethiopia_finalannexes.pdf
IDSS Workshops	June 6-13, 2014	Country Wide	http://ilssi.tamu.edu/media/1334/report-on-ethiopia-idss-workshops.pdf
Partners planning meeting	October 2014	Addis Ababa	http://ilssi.tamu.edu/media/1100/report-of-partners-planning-workshop-feb-2015-ghana.pdf

List of knowledge products for Ethiopia to date

1. Assessing Potential land Suitability for Surface Irrigation using Groundwater in Ethiopia
2. Assessing Irrigation Potential and Land Suitability in Ethiopia
3. Report on Ethiopia IDSS workshop
4. An Example of gaps and constraints analysis for small scale irrigation systems in the Robit Watershed
5. Small Scale Irrigation Applications for Smallholder Farmers in Ethiopia Ex Ante Analysis of Options
6. Ex Ante Analysis of Small-Scale Irrigation Interventions: Robit
7. Ex Ante Analysis of Small-Scale Irrigation Interventions: Dangila
8. Ex Ante Analysis of Small-Scale Irrigation Interventions: Adami Tulu
9. Ex Ante Analysis of Small-Scale Irrigation Interventions: Lemo
10. Ex Ante Analysis of Small-Scale Irrigation Interventions in Dembiya
11. Gebregziabher, G., F. Hagos, N. Lefore, A. Haileslassie. 2017. Analysis of poverty impacts of household level water lifting irrigation technologies. ILSSI project report.
12. Hagos, F., G. Gebregziabher, N. Lefore, A. Haileslassie. 2017. Credit access and adoption of irrigation technologies by smallholder farmers: Evidence from Ethiopia. ILSSI project report.

13. Gedfew, M., P. Schmitter, P. Nakawuka, S. Tilahun, T. Steenhuis, S. Langan. 2016. Partial Nutrient Balance at Farm plot level under Different Irrigation Water Management for Tomato production. Poster presented on the Small Scale and Mirco Irrigation for Ethiopian Smallholders project. Amhara Agricultural Forum hosted by the Small Scale and Mirco Irrigation for Ethiopian Smallholders, a Canadian-Dutch funded project. Bahir Dar, 8-9 December 2016.
14. Schmitter, P., A. Haileslassie, Y. Desalegn, A. Chali, S. Tilahun, S. Langan, J. Barron. Improving on-farm water management by introducing wetting front detectors to small scale irrigators in Ethiopia. Presentation on the Small Scale and Mirco Irrigation for Ethiopian Smallholders project. Amhara Agricultural Forum hosted by the Small Scale and Mirco Irrigation for Ethiopian Smallholders, a Canadian-Dutch funded project. Bahir Dar, 8-9 December 2016.
15. Seifu A. Tilahun, Petra Schmitter, Prossie Nakawuka, Abdu Yimer, Debebe Lijalem, Temesge Enku, Tammo Steenhuis, Simon Langan, Jennie Barron. Shallow Groundwater Recharge and its Potential for Smallholder Dry Period Irrigation in Lake Tana Basin Presentation on the Small Scale and Micro Irrigation for Ethiopian Smallholders project. Amhara Agricultural Forum hosted by the Small Scale and Mirco Irrigation for Ethiopian Smallholders, a Canadian-Dutch funded project. Bahir Dar, 8-9 December 2016.
16. Moges M.A., Schmitter P., Tilahun S., Dagnaw D.C., Akale A.T., Langan S., Steenhuisen T. (2016) Suitability of Watershed Models to Predict Distributed Hydrologic Responses in the Awramba Watershed, Upper Blue Nile Basin (Online, Land Degradation & Development, in Press.
17. Muche, H., M. Abdela, P. Schmitter, P. Nakawuka, S. Admasu Tilahun, T. Steenhuis, S. Langan. 2017. Application of Deep tillage and Berken Maresha for hardpan sites to improve infiltration and crop productivity. ICAST conference 2017, Bahir Dar University

Further information: This handout has been developed by the Feed the Future Innovation Lab for Small Scale Irrigation (ILSSI; ilssi.tamu.edu). For more information on this project in Ethiopia, contact: **Dr. Neville Clarke**, **Innovation Lab Director**, (Neville.Clarke@ag.tamu.edu) and **Mr. Matt Stellbauer, project manager** (e-mail: Matt.Stellbauer@ag.tamu.edu)