Innovation Lab for Small Scale Irrigation

Innovation Lab for Small Scale Irrigation (ILSSI) Stakeholder Consultation Workshop Report: Tanzania

Identifying and prioritizing constraints and opportunities

Dar es Salaam, Tanzania
25th July 20

Table of Contents

This Report is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the International Water Management Institute (IWMI) and the International Livestock Research Institute (ILRI) and do not necessarily reflect the views of USAID or the United States Government.

1 Introduction and background

The ***Feed the Future Innovation Lab for Small-Scale Irrigation*** (ILSSI) project aims to enhance food security, improve nutrition and reduce poverty. The project team is achieving this by developing and introducing promising, context appropriate, small-scale irrigation systems into food and agriculture production on small farms in Ghana, Ethiopia and Tanzania. The project is piloting and modelling high potential interventions in small-scale irrigation and irrigated fodder production through development, and use of, an *Integrated Decision Support System* (IDSS).

The project, funded by USAID, is led by Texas A&M University (TAMU) in collaboration with the International Water Management Institute (IWMI), International Livestock Research Institute (ILRI), International Food Policy Research Institute (IFPRI) and North Carolina A&T State University.

In Tanzania the project is also partnering with Sokoine University and the Tanzania Livestock Research Institute (TALIRI) - Mabuti. Strong engagement with research institutions and non-governmental organizations such as these, as well as with the government of Tanzania and other stakeholders active in the country, including farmers, is a key component of the project. The project, which runs from October 2013 – September 2018, is comprised of five major interrelated components:

- Assessment of promising small scale irrigation technologies
- Small-scale irrigation interventions in the field
- Stakeholder consultation at multiple levels of scale
- Engagement with national partners and farmers in order to conduct field studies
- Surveys of farming families in the area surrounding the field test sites
- Analysis of the production, environmental and economic consequences of small scale irrigation options, including but not limited to interventions in farmers' fields, using the Integrated Decision Support System (IDSS)

Capacity development and training at multiple levels of scale are also substantive elements of the project.

Background to this workshop

Consultation with national stakeholders, to assist in planning, implementation and validation of results, forms a key part of the activities of the ILSSI project. This approach to partnerships is an ongoing process conducted throughout the 5 year duration of the project in all three countries. In the first phase of the project, initial engagements at local, regional and national levels helped to identify and define the most promising small-scale irrigation (SSI) scenarios that, with the support of further research, could potentially lead to sustainable adoption and significant development impact.

Over the past two and a half years researchers, through a combination of field surveys, analysis and modelling, have generated a set of initial results that focus on high potential interventions in small-scale irrigation and irrigated fodder production. These results, and corresponding experiences in the field, have been used to identify a number of constraints that affect the adoption of these small-scale irrigation interventions (both those studied in the field and a broader set evaluated using models).

This one day participatory stakeholder workshop provided an invitation to national experts in Tanzania to share their knowledge and experience, and draw on the institutional interests and priorities they represent, in order to evaluate and prioritize the constraints that have been identified so far by the ILSSI research team. The workshop took place at the Protea Courtyard Hotel.

Through this stakeholder consultation and evaluation process the research team aimed to collaboratively prioritize a short-list of these constraints specific to Tanzania, as a guide for further analysis. It is anticipated that this in turn will result in concrete, context specific proposals emanating from the project to mitigate these constraints and so make the most of opportunities to scale out solutions. The Integrated Decision Support System (IDSS) will be used in this analysis for each of the three countries of the study. A representative of the ILSSI External Advisory Committee, Permanent Secretary Mbogo Futakamba, was invited to provide perspectives, during the workshop, on the evolution of the project.

2 Objectives and planned outputs of the workshop

The workshop had three key objectives, namely:

- To share research and experiences on small-scale irrigation and irrigated fodder interventions in Tanzania.
- To collaboratively prioritize the key constraints to successful and productive small-scale irrigation and irrigated fodder interventions in Ethiopia that the Integrated Decision Support System can help to address.
- To continue and expand participatory consultation with stakeholders to foster dialogue, networking and enhance partnerships.

The main planned workshop output was to produce a consensus based, prioritized list of constraints to successful and productive small-scale irrigation and irrigated fodder interventions in Tanzania, that the next phase of work with IDSS can focus on with a view to out-scaling small scale irrigation for transformative livelihood benefits in rural communities.

3 Participants

Participants of this latest ILSSI project Stakeholder Consultation Workshop included representatives from relevant agencies of the Government of Tanzania, research and academia, non-governmental development organizations and donors active in Tanzania. Please see the full participant list in **Annex 1** for further details.

ILSSI project Tanzania stakeholder workshop participants, Dar es Salaam, Photo: IITA

4 Workshop proceedings

In advance of the workshop, participants were provided with a set of background documents to review in order to further familiarise themselves with the project, its aims and approaches, the IDSS and most importantly the set of constraints, identified through the project that would be discussed and prioritized during the workshop. These documents included:

- An ILSSI project and IDSS background summary
- An example of the IDSS gap and constraints analysis for small scale irrigation systems developed by, and used in, the ILSSI project
- The rationale and agenda for this workshop

The workshop was split into two main sections (please see the workshop agenda in **Annex 2** for further details) providing opportunities to:

- Share the latest developments, findings and approaches of the ILSSI research project team through presentations from project partners.
- Discuss high potential interventions in small-scale irrigation and irrigated fodder production in Tanzania, and collaboratively work to prioritize a set of constraints to the adoption and success of these interventions that represent a synthesis of workshop participant expertise and those identified by the ILSSI project through field work, household surveys and the use of the Integrated Decision Support System (IDSS).

Following a morning of presentations from representatives of TAMU, IWMI, ILRI and IFPRI the second half of the workshop involved a group exercise to collaboratively prioritise the constraints to adoption of small scale irrigation interventions studied in Tanzania.These will then provide the focus for the next phase of work with IDSS with a view to out-scaling small scale irrigation for transformative livelihood benefits in rural communities in Tanzania, as well as in Ghana and Ethiopia.

4.1 Opening

Ben Lukuyu, an animal nutritionist and Uganda country representative for ILRI welcomed participants to Tanzania. He encouraged cross-project collaboration during implementation of ILSSI in the production of irrigated fodder to overcome feed shortage in Tanzania. Lukuyu also called for sustainable intensification of mixed crops, health and nutrition to maximize benefits and minimize harms by working with various partners and the private sector.

The facilitator, Tsehay Gashaw a Knowledge Sharing and Web Communication Officer from ILRI, led the introduction exercise, where participants went outside and rotated in groups to know each other and share their expectations; there were three rounds, each lasting three minutes. Mrs. Gashaw then introduced the agenda and ground rules of the workshop.

4.2 Presentations

Below is a brief summary of each of the presentations given by project partners. Please see **Annex 3** for further details and copies of the full presentation slide decks.

1) Introduction to Feed the Future Innovation Lab for Small Scale Irrigation - Tanzania

Dr. Jennie Barron, Research Theme Leader for Sustainable Water at IWMI, presented a summary of the project's background, objectives, partners and the key research questions that the project aims to address. She noted that a conducive national policy environment in Tanzania continues to bring science into use. Dr. Barron also introduced the workshop objectives and its expected outcomes.

2) Field level pilot interventions in small-scale irrigation and agricultural water management

Dr. Petra Schmitter, an agricultural water management specialist from IWMI presented the project sites, main activities and the intervention technologies for small scale irrigation in Tanzania. She presented the progress of work achieved together with the project partner Sokoine University of Agriculture. She presented on credit arrangements for pump sharing in Mkindo and Rudewa, the adoption of kitchen gardens for household nutrition and a feasibility study of pump irrigation for high value crops. She concluded her presentation with opportunities and constraints observed during the implementation of the project by farmers.

3) Field Level Pilot Interventions in Small Scale: Fodder Cultivation

Dr. Ben Lukuyu presented the latest activities done in Morogoro and Manyara sites, fodder market studies and ex ante assessments carried out, plus the early findings and lessons learned. According to Dr. Lukuyu, the project identified knowledge gaps and trained farmers on advantages of irrigated fodder, and on producing, harvesting and managing forages. He added that a lot of work is currently ongoing e.g. trials in the project sites are led and observed by farmers, which has produced positive results.

4) Small-scale irrigation technologies and agricultural water management practices - analyzing nutrition, health and gender outcomes

Dr. Christopher Godlove presented the activities done by IFPRI, early findings, method of data analysis (e.g. WEAI- Women Empowerment in Agriculture Index), water lifting technologies and constraints and opportunities to promote gender equality in irrigation.

According to Dr. Godlove, IFPRI has conducted a series of gender-irrigation technical workshops to counter the constraints to adoption of irrigation by women. Dr. Godlove mentioned that most households use buckets, hose pipes and a few are using pumps. The major constraints noted were insect and animal damage, insufficient water and plant diseases. He added that non-irrigators are more food insecure compared irrigators.

5) Overview of Integrated Decision Support System (IDSS)

Dr. Yihun Dile from Texas A&M University presented an analysis of the Kilosa watershed, where the project works in collaboration with Sokoine University of Agriculture. Three scenarios were compared (scenario 1: non-fertilized rainfed crops + irrigated vegetable crop, scenario 2: fertilized rainfed crops + irrigated vegetable crop and scenario 3: System of Rice Intensification (SRI) data was then analyzed using the IDSS.

Results of the modelling study include:

- Implementation of irrigation did not cause significant reduction on the average monthly stream flow
- Application of fertilizer increased the crop yield substantially and reduced soil loss
- The irrigation of vegetables use of fertilizer and practice of SRI was the most profitable scenario

6) Candidate constraints from research experience and a preview of the constraints analysis method

Dr. Yihun Dile then gave a presentation on the candidate constraints identified through the ILSSI project to date, and also on the methods used for constraints analysis. Dr. Dile used the example of research conducted into the Robit watershed of Ethiopia to show how the IDSS is used at the watershed scale to analyse resource and environmental constraints. He included a map of Ethiopia that's been produced showing land suitability for irrigation, details of available water in the Robit watershed, and the impacts of SSI at the watershed scale. He also showed how IDSS can be used to; analyse nutritional and economic constraints at the household level, examine field scale irrigation water management and investigate the impacts of fertilizer use on agricultural productivity.

4.3 Plenary discussion and comments and questions from participants

A number of questions and comments were raised by participants after each presentation and at the end of the workshop's presentation session. These included:

Comments:

- Land tenure system is an issue in Tanzania and needs to be taken into consideration because people may hesitate to invest in proposed water lifting and irrigation technologies.
- We have to improve water use technologies e.g. in Kilosa. *We are aiming at transferring knowledge obtained in other ILSSI sites e.g. Ethiopia with regards to irrigation scheduling and irrigated fodder (see FtF factsheet on irrigated fodder)*
- Recent data on soil is available in the government ministry, consult and incorporate this in the modeling

Questions:

- Do you use gravity-fed water in irrigation? *It depends on the site and the suitability for gravity fed irrigation. In the Tanzania case once water is lifted it is distributed gravitationally*
- Is there surface water use? *Yes all sites in Tanzania use surface water, in other ILSSI sites in Ghana and Ethiopia it is a combination of both*
- This is an eye opener to the government especially now in dealing with conflicts over fodder access? Are there any water saving technologies?

- What irrigation is used for fodder, is it drip irrigation? *It is a combination of pump irrigation and gravitational river diversion. We plan to help them purchase more pumps as irrigated fodder produces more than double the yield of rain fed fodder farming.*
- What led to higher yields of the irrigated fodder by the project compared to yields of irrigated fodder outside the project? *Cost Benefit Ratio (CBR) varies among farmers because of different practices.*
- How much acreage did you consider in the household surveys? *The maximum plot size is five acres.*
- What is the household sample size and what do you mean by women empowerment? *Our sample size is 451 households, women empowerment includes five domains: decision-making in production, access to productive resources, control over use of income, community leadership and time allocation.*
- Out of 451 households how many are beneficiaries of the project? *We have two villages, Mkindo and Rudewa which both have about 48 farmers.*
- What are the disadvantages of irrigation? *We just started last year in Tanzania, we are still collecting data and we will identify the constraints potential mitigations.*
- What is the size of the watershed in Kilosa? *We estimate it to be 1,500 ha but yet to confirm. All our primary data is from project partners and secondary data is from the Food and Agriculture Organization of the United Nations (FAO).*
- By applying nitrogen on the farms, what are the effects of water quality? *When you apply the right amount of fertilizer at the right time, it is not such a big challenge, especially in sub-Saharan Africa where fertilizer is applied on low scale.*
- How do we communicate feedback on findings to farmers? *These results are not strongly validated as we are thinking of how to share the Cost Benefit Ratio (CBR), but we work very closely with farmers and organize workshops to present translated results in local languages.*
- Why is the slide on soil uniform? *We got our data from FAO.*
- Why did you use SWAT model analysis? *It is a state-of-the-art model; it is well validated and used internationally.*
- How did the model calculate such low figures, considering traditional farming of rice yields 2-4 tons/ha and this model shows irrigated yield is 4-5 tons/yield? *This is an ex ante analysis, we appreciate your observation and we will improve with locally available data on yields, soils etc. to make sure results are relevant.*
- What is the contribution and impact of fertilizer in the SRI? *The way water is managed determines the yield. Increased use of fertilizer improves the yield.*
- What variable contributed to the water lifting technology? Did you consider some assumptions in your probabilities? *From our field experience labour is one of the factors as water lifting technologies are labour intensive; we assume there is market for the produce.*

4.4 Group work

4.4.1 Group work assignment: prioritization of constraints

Workshop participants were divided at random into 4 groups of around 5-6 individuals. A member of the ILSSI project research team was assigned to each group. Each group was provided with a flipchart and paper, colored cards, pens and guidance on the group work process.

All four groups were then given forty minutes in which they were asked to:

- Consider from their knowledge and experience what they believe to be the key constraints to small-scale irrigation in Tanzania.
- Review the list of provisional constraints identified by the ILSSI project and see where the synergies/differences/gaps are (referring to the list of identified constraints on page 4 of project overview document if required)
- Discuss as a group and prioritize these constraints (based primarily on national considerations). Suggested criteria for prioritization include (but are not limited to) those with the:

- biggest positive development impact
  - least negative environmental impact
  - biggest potential for scaling up
  - greatest opportunities to result in improved productivity and incomes
- Aim for group consensus on the top ten constraints (representing the most appropriate synergy of constraints from a) participant's experience and knowledge, and b) those already identified by the ILSSI project.
- Write the group's top 10 constraints on colour cards (individually) and stick them to the flip chart paper in two groups of five:
  a) top priority
  b) very important but secondary priority
- Choose a representative to present these findings back to all workshop participants in plenary.

The group work sparked energized discussions about what the key constraints to adoption of small-scale irrigation in Tanzania are, as group members made the case for constraints they felt should be in the top ten and subsequently in the top priority five, based on their expertise, experience and knowledge.

4.4.2 Results of group work

Group 1

Group 1 chose to focus only on agreeing on the top priority 6 constraints.

Top Priority

- Climate change
- Tenure arrangements
- Finance modalities
- Capacity development
- Policy constraints
- Good extension and knowledge support

Group 2

Top Priority

- High initial costs of irrigation inputs
- Water availability and quality
- Accessibility to market is limited
- Inadequate knowledge
- Land tenure

Second Priority

- Source of energy
- Legislative requirements

Group 3

Top Priority:

Gender was identified as cross cutting in the following priorities:

- Climate and rain variability
- Agricultural Financing (credit, insurance)
- Access to inputs (e.g. seeds, fertilizer and low genetic potential for livestock) and land tenure
- Access to markets for selling produces
- Irrigation infrastructure and policies

Second Priority:

- Poor extension services (e.g. Irrigation and crop calendar knowledge)
- Mechanization
- Labour related to irrigation
- Cultural and social practices
- Operational costs

Group 4

Group 4 chose to focus only on agreeing on the top priority 6 constraints.

Top Priority

- Weak enforcement of regulation on water use
- Lack of awareness on irrigation technologies
- Use of non-appropriate data
- Inadequate attention on environmental issues
- Fodder technology (targets specific production systems)
- Land tenure and gender policy

Group 1 and 3 brainstormed on how the identified constraints could be turned into opportunities:

1) Climate change agenda provides a springboard to motivate water management for irrigation as well as potential investments
2) Policy (land, water tenure) water custodians gives opportunity for integration policies/development agenda
3) Land and ground water potential for irrigation
4) Food insecurity when moving from food crops to cash crops (e.g. male vs female irrigators)
5) Climate-smart agricultural technologies e.g. agroforestry
6) Link farmers to agro-dealers, existing local financial village banks (VICOBA), contract farming and improving infrastructure
7) Capacity in the country: more research on improved seeds and breeds according to the agro-ecological zones
8) Kitchen gardens to empower women to build upon existing projects related to empowerment

Consensus-based consolidated list of top priority constraints

After a representative from each of the four groups presented the group's findings (detailed above) to all workshop participants, the facilitator and one of the participants clustered the cards detailing the priority constraints from each group. The facilitator then led the group in consolidating the constraints. This was done by recognizing duplication, or constraints that were very similar, and thereby reducing the total number of top priority constraints to the categories detailed below.

The following constraints were identified as cross-cutting:

- Access to inputs e.g. fertilizer, labour, fuel
- Gender i.e. inter and intra-household activities for irrigation

1. **Capacity development and capacity development + irrigation expertise**
   - First degree hydrology graduates are too few
   - Poor knowledge of farmers on irrigation technologies
   - Land tenure and gender limits adoption in some technology i.e. fodder production
   - Irrigation and crop calendar—optimizing cropping period and water needed
   - Poor extension services due to a gap in knowledge and skills
   - Lack of access to knowledge and information by irrigation technicians
2. **Finance modalities and access to electricity, solar and wind**
   - Community organized finance and micro-credit schemes
   - High initial costs of irrigation inputs e.g. drilling, land acquisition and pumps

- Operational costs for repair and maintenance of pumps and scarcity of spare parts
- Labour demanding e.g. maintenance of canals, farrow, rain harvesting structures
- Affordability and availability of machinery to mechanize irrigation. e.g. pumps are difficult to use
- Agricultural financing e.g. credit, saving and insurance

3. **Policy constraints and market value chains**
    - Market functions of irrigation value chains
    - Irrigation infrastructure and policies, e.g. by-laws for water abstraction and schemes are not finalized
    - Legislative requirements
    - Land tenure is a disincentive to invest
    - Farmers should form associations to market their produce
    - There is limited accessibility to markets due to poor infrastructure
4. **Climate change/water and temperature variability**
    - Water availability and quality
    - Extreme events i.e. drought and flooding
5. **Competing water uses (with other sectors)**
    - Weak enforcement of regulation on water use/regulations and inadequate staffing
6. **For integrated irrigation gabion and nutrient efficiency, the soil needs micro and macro nutrients e.g. in SRI**
7. **Cultural and social practices related to stereotyping crops e.g. fodder, rice**
8. **Fodder technology is targeted to specific systems, either intensive or extensive system**
9. **Low genetic potential for livestock**
10. **Source of energy for water lifting and irrigation**

Other notes related to project:

- The project should plan to scale-up to other areas
- Project should align with the national policy
- Ground water potential needs to be assessed
- Use of non-appropriate data as with IDSS (data sources)
- Inadequate attention to environmental issues in the project

5 Significance of the workshop

The stakeholder workshop in Dar es Salaam succeeded in bringing key national stakeholders together to; a) share research and experiences on small-scale irrigation and irrigated fodder interventions in Tanzania, b) foster dialogue, networking and enhance partnerships, and c) to collaboratively prioritize the key constraints to successful and productive small-scale irrigation and irrigated fodder interventions in Tanzania that the Integrated Decision Support System can help to address. The shortlist of constraints identified, discussed and prioritized represents participant consensus (based on local and national knowledge, experience and expertise) on those most appropriate for the next phase of work with the IDSS, with a view to out-scaling small scale irrigation for transformative livelihood benefits in rural communities in Tanzania.

6 Annex 1: Workshop participant list

Name	Job title	Organization	Contact
1. Amy Mchelle	Ag. Assistant Director-Research	National Irrigation Commission	amylabaa@gmail.com, amymchelle@yahoo.co.uk 0714080244
2. Praxeda Paul Kalugendo	Basin Water Officer	Wami/Ruvu Basin-Ministry of water	Praxeda.paul@maji.go.tz
3. Jackson Nicholaus Masakia	District Irrigation Engineer-Morogoro	Morogoro district	jmasakia@yahoo.com, masakiajackson@gmail.com 0785 395 370, 0762 855 469
4. Beverly Mcintyre		USAID/IWMI	b.mcintyre@cgiar.org/bmcintyre@usaid.gov
5. Tatu Mnimbo	Researcher	Sokoine University of Agriculture	Maureen3mnimbo@gmail.com 0764 381371
6. Lucia Chacha	Principal Livestock Officer	Ministry of Agriculture, Livestock and Fisheries	Gaticha2006@yahoo.com 0752 157651
7. Mbogo Futakamba	Permanent Secretary	Ministry of Water and Irrigation	0767 361574 Mfutakamba27@yahoo.com
8. Imani Nzobonaliba	Senior Engineer	National Irrigation Commission-Morogoro zone	Naliba2002@yahoo.com 0757951977, 0713789365
9. Martha Swamila	Natural Resource Economist	ICRAF	m.swamila@cgiar.org 0713067774
10. Angello Mwilawa	Pasture and Range Scientist	Tanzania Livestock Research Institute	ajmwilawa@yahoo.com 0787892240
11. Filbert Bartazar Rwehumbiza	professor	Sokoine University	Rwehumbizaf2002@gmail.com 0784931818, 0789057419
12. Mateete Bekunda	Chief Scientist	Africa Rising-ESA project	m.bekunda@cgiar.org 0682059802

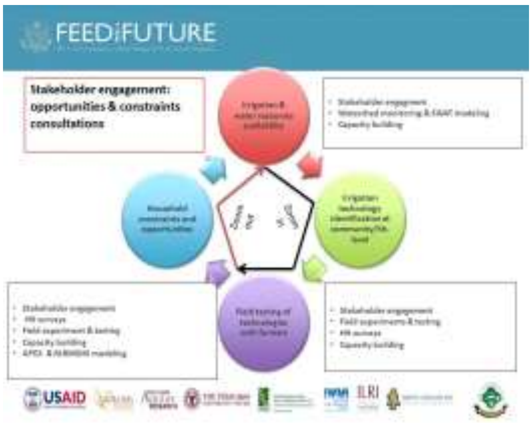
13. Frederick Kahimba	Associate Professor	Sokoine University of Agriculture	kahimbafcs@yahoo.com 0765173400
14. Lyamongo Tumanini Lukanazya	Environmental Officer	Wami/Ruvu Basin	tlamomongo@gmail.com
15. John Lwehabura	SIIL East Africa Coordinator	CIAT	j.lwehabura@cgiar.org 0675449518
16. Humuri Haymale	Irrigation Engineering	Nelson Mandela African Institute of Science and Technology	haymaleh@nm-aist.ac.tz 0782222136
17. Christopher Godlove Magomba	Lecturer	Sokoine University of Agriculture	Chris_magomba@yahoo.com 0788709709
18. Rachel Zakayo	Research Assistant	Gro-Future	rachelzaka@gmail.com 0785340880
19. Petra Schmitter	Agricultural Water Management Researcher	IWMI	+251929037487 p.schmitta@cgiar.org
20. Ben Lukuyu	Scientist	ILRI-Uganda	+254722820758 b.lukuyu@cgiar.org
21. Yihun Dile	Scientist	Texas A&M	yihundile@tamu.edu
22. Jennie Barron		IWMI	j.barron@cgiar.org +94776631632
23. Mercy Becon	Communication specialist	ILRI Tanzania	m.becon@cgiar.org 0776000036
24. Tsehay Gashaw	Knowledge Sharing and Web Communication specialist	ILRI Ethiopia	t.gashaw@cgiar.org

7 Annex 2: Workshop Agenda

Time	Duration	Activity	Lead person
8.30 - 9.00		Registration	
9.00 - 9.10	10 mins	Welcome – recognize External Advisory Committee member for Tanzania and government officials Opening Comments	ILRI Head of Office (Tanzania) Permanent Secretary Mbogo Futakamba
9.10 - 9.30	20 mins	Participant introductions and icebreaker exercise	Facilitator
9.30 - 9.45	15 mins	*Presentation:* Overview of the ILSSI project: objectives, partners and activities - 10 mins ; Q&A – 5 mins	Dr. Neville P Clarke, Texas A & M University
9.45 – 10:00	15 mins	*Presentation:* Field level pilot interventions in small-scale irrigation and agricultural water management (SSI/AWM) - 10 mins; Q&A – 5 mins	Dr. Petra Schmitter, IWMI
10:00 - 10.15	15 mins	*Presentation:* Field level pilot irrigated fodder and integrating livestock – 10 mins; Q&A - 5 mins	Dr. Ben Lukuyu, ILRI
10.15 - 10.30	15 mins	*Presentation:* Household level surveys on impacts from SSI/AWM (including gender and nutrition) – 10 mins; Q&A – 5 mins	Dr. Christopher Godlove Magomba SUA representing IFPRI
10:30 – 11:00	30 mins	Group photo followed by tea/coffee break	
11:00 – 11:20	20 mins	Presentation: Overview of Integrated Decision Support System (IDSS) -15 mins; Q&A - 5 mins	Dr. Yihun Dile, Texas A & M University
11:20 – 11:50	30 mins	Presentation: Candidate constraints from research experience and a preview of the constraints analysis methods - 20 mins; Q&A – 10 mins	Dr. Yihun Dile, Texas A & M University
11:50 – 12:30	40 mins	Group work on preliminary constraints identified	Facilitator
Participants divided into 4- 5 groups (depending on total number of participants), supplied with flipcharts, pens and cards in various colours			
12:30 – 1:30	1 hour	Lunch	
1:30 – 1:45	15	Welcome back, review, icebreaker	Facilitator
1.45 – 2:45	60 mins	*Group Work* Prioritization of constraints to adoption (nationally) of small scale irrigation interventions studied in Tanzania, for further analysis.	Facilitator
2:45 – 3:15	30 mins	Group representatives present back to plenary	Group reps / facilitator
3:15 - 3.45	30 mins	Consolidate list of prioritized constraints, summarize group work outputs and describe how these will be used for the next steps of the project	Facilitator / Dr. Yihun Dile, Texas A & M University
3:45 – 4:10	25 mins	Coffee break	
4:25	15	Next Steps	Dr. Neville Clarke, Texas A & M University
4:25 – 4:45	30 mins	Closing remarks Wrap up	Permanent Secretary Mbogo Futakamba Facilitator and Neville Clarke

8 Annex 3: Presentation slides

Presentation 1: Introduction to Feed the Future Innovation Lab for Small-scale Irrigation



FEED THE FUTURE

Asante sana!

FEED THE FUTURE

Methods

- Assess recent innovations in SSI
- Stakeholder engagement (iterative)
- National partners for field research
- Detailed experimental design
- Ex ante assessment of consequences
- Environmental assessment
- Field studies
- Ex post assessment and scaling out
- Constraints analysis and mitigation
- Training

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FEED THE FUTURE

COMPONENTS OF PROJECT

- Ongoing Stakeholder Engagement
- Assessment of natural resources
- Field Studies
- Household Surveys
- Integrated Modeling
- Synthesis and recommendations

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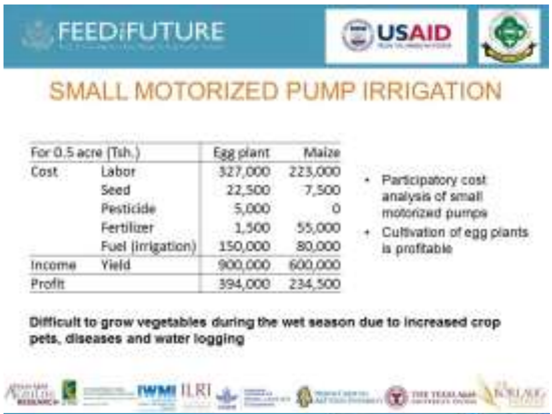
<u>Presentation 2: Field level pilot interventions in small-scale irrigation and agricultural water management (SSI/AWM)</u>



CONSTRAINTS IDENTIFIED

KEY RECOMMENDATIONS

- Farmers should receive adequate training on how to operate, repair and maintain the Water lifting and water use technologies
- Develop and proactively enforce policies, regulations and by-laws to protect water use structures
- Farmers must have access to credit tailored to their conditions.
- The local government must devise strategic means of availing financial resources to in invest in water lifting and water use technologies.
- Strengthening the local water governance institutions such as WUAs is important for sustainable up-scaling of WUTs.

FACTORS INFLUENCING ADOPTION

Farm/farmer related factors:

- ❑ Perception of farmers regarding the potential of technology in increasing crop yield,
- ❑ Farmer's choice of crop with high water productivity and returns per drop,
- ❑ Gender of a decision maker in the household,
- ❑ Education
- ❑ Secured land tenure.

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FACTORS INFLUENCING ADOPTION OF WATER USE TECHNOLOGIES

Technology-related

- ❑ Low initial capital investment
- ❑ Less labour requirement
- ❑ Locational suitability
- ❑ Simplicity of technical and design requirement.

Institutional factors

- ❑ Availability of credit to farmers,
- ❑ Extension services and
- ❑ Technical support.

U.S. GOVERNMENT PARTNERS

Presentation 3: Innovation Laboratory for Small Scale Irrigation: ILRI

Innovation Laboratory for Small Scale Irrigation: ILRI

Stakeholders Meeting
Dar es Salaam, Tanzania.
July 26 2016

Ben Lukuyu, Immaculate Omondi, Angello Mwilawa and Michael Blummel

ILRI ACTIVITIES TO DATE

- Stakeholder engagements
- Community engagement
- Rapid diagnosis – Feed resource assessments (FEAST)
- **Field Level Pilot interventions**
- **Preliminary Economic BCR and ex ante assessments**

FIELD LEVEL PILOT INTERVENTIONS IN SMALL SCALE: FODDER CULTIVATION

MAIN ACTIVITIES

- Testing irrigated fodder/forage cultivation to:
  - Improve on farm meat and milk production for improved nutrition and income
  - Evaluate fodder/forage production under irrigations systems
  - Employ fodder/forage cultivation to support diversification, intensification and sustainability

MAIN ACTIVITIES

- Technologies being tested and how
  - Testing of annual and perennial grasses and legumes for yield and fodder quality under different management
  - Fodder market studies for demand, price – quality relationships and value chain characteristics
  - Ex-ante assessments to predict impact of fodder interventions

PARTNERS

Tanzania Livestock Research Institute, MABUKI

- A regional agricultural research institute **with a national forage research mandate**
- Partner with ILRI for implementation of ILSSI's irrigated fodder activities
- Provide training to farmers and extension workers in the area of fodder establishment, management and utilization
- Partner with ILRI on fodder market studies

SITES

Fodder trial activities were conducted in

- Morogoro region
  - Mvomero district, Mkindo village
  - Kilosa district, Rudewa
- Manyara region
  - Babati district, Mawemairo and Gichameda

Farmers attending a field day at Rudewa Mbuyuni fodder plot

FODDER TRIAL FARMERS

Villages	Trial farms	Participating farmers		
		Men	Women	Total
Rudewa-Mbuyuni	3	12	9	21
Mkindo	2	6	4	8
Mawemairo & Matula	4	7	4	11
Gichemeda	2	5	7	12

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EARLY FINDINGS AND LESSONS

- There is an abundance of natural pastures for feeding ruminants in the wet season for 2-3 months followed by severe pasture shortages in the dry season.
- Absence of planted forages to supplement feeding in the dry season especially with irrigation
- Knowledge gaps on proper forage production, feed conservation, storage, processing and utilization of livestock feeds.

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FARMER TRAINING

- Conducted farmer trainings on:
  - The importance of establishing irrigated forage and its implication on alleviating feed shortages
  - Forage production, management, harvesting, conservation and or storage, processing and utilization.

The training was conducted by subject matter specialist form TALIRI, ILRI and extension service. A total of 57 were trained ahead of implementing the intervention.

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Researchers and farmers participating in establishing Napier grass (Kiloa-Rudewa Mbuyuni)

An irrigated Chloris gayana grass plot at Rudewa

An established Napier grass plot on a farm in Mawemairo in Babati district

An irrigated Napier grass fodder plot at Rudewa Mbuyuni

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NAPIER GRASS DRY MATTER YIELD AND QUALITY OBTAINED FOR A SINGLE CUT WITHIN ONE IRRIGATION CYCLE

Napier accession	Mean Yield (Kg DM/ha)	Yield range (Kg DM/ha)	SD	Leaf: Stem ratio
ILRI 14984	6.2	6-8	0.6	0.9
ILRI 16803	6.3	6-7	0.4	0.7
ILRI 16835	11.3	10-12	1.0	0.4
ILRI 16837	14.8	14-17	1.1	0.7
Kakamega 2	16.6	14-19	1.3	0.6
Overall	**12.1**	**6-19**	**4.3**	0.6

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FODDER MARKETS

- To develop a systematic understanding of fodder markets and interactions among various players along the fodder value chain.

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MAP OF TANZANIA SHOWING SITES OF THE STUDY

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PRELIMINARY FINDINGS: FODDER MARKETING

Fodder type	Availability (Months)		Cost (Tsh)		
	Wet season	*Dry season*	*Unit*	*Wet season*	*Dry season*
Natural grass mixture	Aug, Sept, Oct	Dec, Jan.	Pickup	30,000	40,000
Rhodes grass (Hay)	Jan, Feb, Mar	Apr, May	Bale	3,000	4,000
Rice straw	Nov, Dec (at harvest)		Lorry	35,000	-
Bean haulms	July, Oct (at harvest)		Lorry	800,000	-
Dry maize stover	Aug, Sept, Oct (at harvest)		Pickup Acre	30,000 20,000	40,000 55,000
Napier grass	Mar, Apr	Dec, Jan	Acre Load	50,000 1,500	70,000 3,000

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FEED THE FUTURE — INNOVATION LAB ON SMALL SCALE IRRIGATION

Farm level Cost-Benefit Analysis of Irrigated Forage Options: A case of farm households in Lemo, Ethiopia

Immaculate Omondi - ILRI

USAID IWMI ILRI

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STUDY APPROACH

Design

- Conducted at farm level
- The analysis evaluated three farmer categories (irrigation options):
  - Irrigated forage option
  - Non-forage Irrigation option (current dominant use of irrigation)
  - The current dominant rain-fed production option

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STUDY APPROACH

Sampling

- Data was collected from farmers households :
  - participating in irrigated forage trials (12 farmers - irrigated forage)
  - not participating in irrigated fodder trials but using irrigation (15 farmers - Non-project irrigation farmers/current dominant use of irrigation)
  - not using irrigation (16 farmers - practicing pure rain-fed farming)
- A census of all irrigated forage farm households (12)
- A Systematic random sample drawn for 30 control households
- Total sample size = 40 farm households

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STUDY APPROACH

Assumptions and limitations

- Small sample size limits the ability to make statistical inferences, consequently, a case study approach
- Due to estimation challenges, some costs and benefits were assumed to cut across all farmers/ farmer categories. This include:
  - Cost of free grazing land
  - Value of water used for irrigation
    - focus on the value of crops produced from irrigation instead

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STUDY APPROACH

Analysis

- Estimated mean costs, benefits and investment values
- Estimated mean benefit cost ratios (BCR) for the three farmer categories

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PRELIMINARY FINDINGS

- Non-irrigating farmers (rainfed)
  - incurred no costs of investing in irrigation pumps
  - Had the highest mean BCR
- Irrigated fodder farmers
  - incurred comparatively higher costs labor costs, particularly on livestock and crops (spend comparatively more (70% of all costs) on labor compared to the other two farmer categories)
  - received lower revenues compared to non-project irrigating farmers
  - Had the lowest mean BCR – due to high labour expenditure

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RESULTS

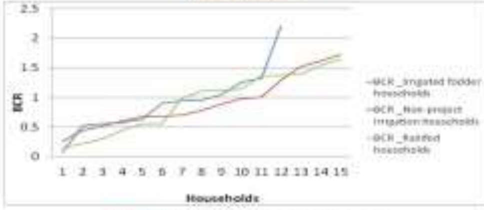

Figure 1: Individual Households' Benefit cost ratios

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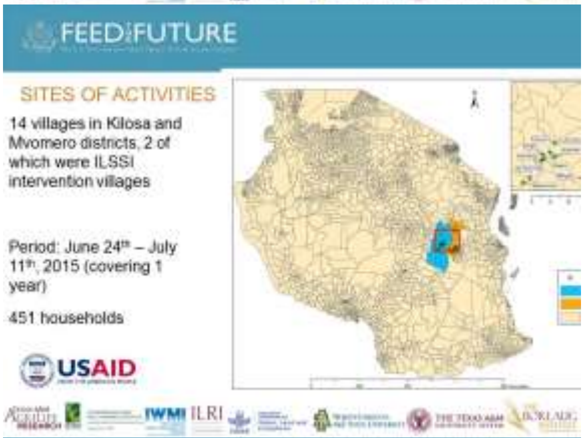
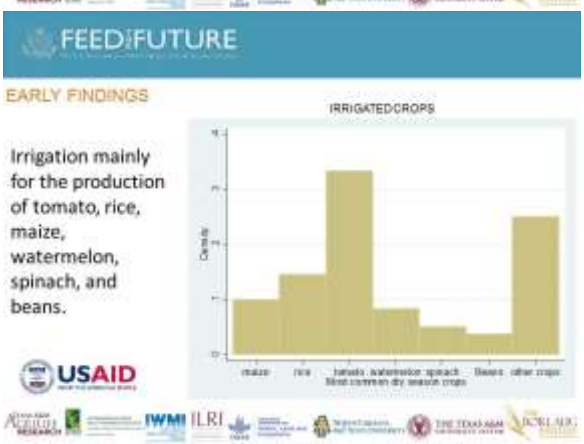
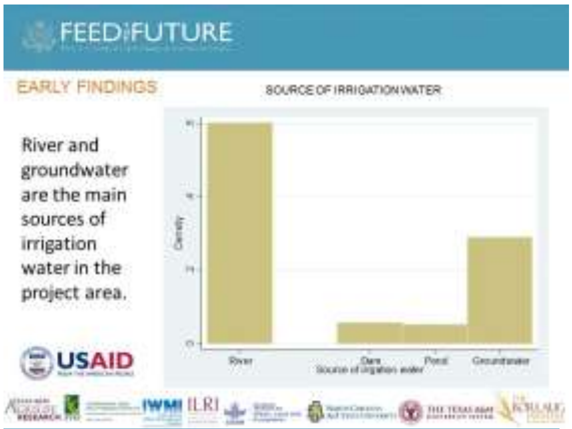
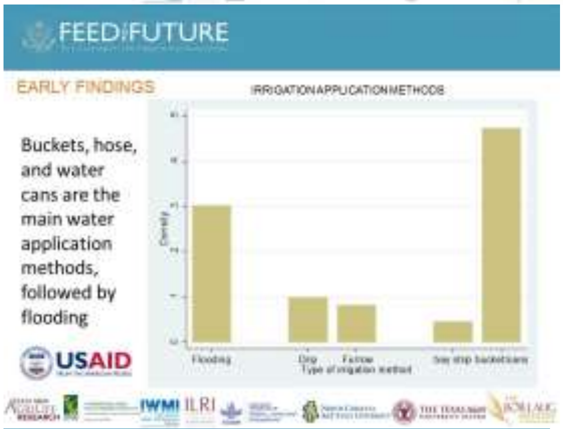
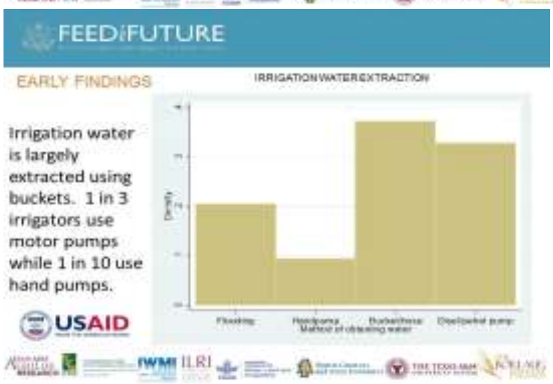
Presentation 4: Small-Scale Irrigation Technologies and Agricultural Water Management Practices

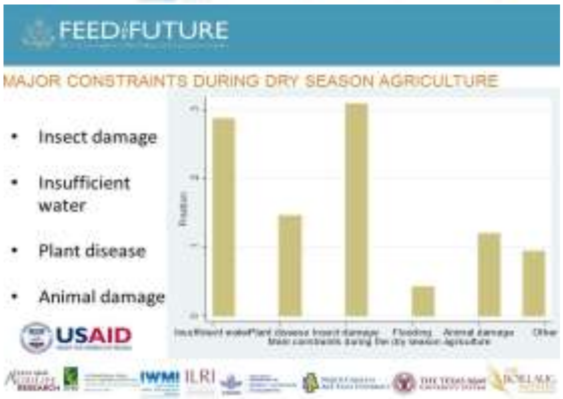












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HOUSEHOLD FOOD SECURITY IN TANZANIA

	Non-irrigators n=224	Irrigators n=227	p-value of two-sided ttest
	Mean	Mean	
Household food insecurity access scale, 0-27	3.92	2.58	0.0004
Female dietary diversity score: number of categories consumed	3.71	4.20	0.0030
Household dietary diversity: number of food categories consumed	4.88	5.63	0.0002

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GENDER-IRRIGATION TECHNICAL WORKSHOP SERIES

- Given country efforts to scale up irrigation for climate resilience, productivity, food and nutritional security, important to make sure women have equal access to irrigation
- **Three technical workshops** were organized with IWMI and national partners in:
  - Ethiopia (March 9-10) with Ministry of Agriculture and Natural Resources
  - Ghana (April 13-14) with Ghana Irrigation Development Authority (GIDA)
  - Tanzania (April 20-21) with Sokoine University of Agriculture and Platform for Agricultural Policy Analysis and Coordination (PAPAC)
- **Training and knowledge exchange:** gender training from IFPRI/IWMI; presentations and case studies from government, NGOs, researchers, and donors sharing lessons learned on promoting gender equality in irrigation

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Resources from the workshop available here

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DATA ON WOMEN'S EMPOWERMENT IN AGRICULTURE INDEX

- Intra-household survey tool
- The WEAI measures women's empowerment across **5 domains of empowerment (5DE)** shown on the right as well as a **Gender Parity Index**
- WEAI is on a scale from zero to one, with higher values = greater empowerment
- ILSSI is using a modified WEAI to include more details on irrigation

TABLE 1. THE FIVE DOMAINS OF EMPOWERMENT IN THE WEAI

Domain	Indicator	Weight
Production decision-making	Input in productive decisions	1/10
	Autonomy in production	1/10
Access to productive resources	Ownership of assets	1/15
	Purchase, sale, or transfer of assets	1/15
	Access to and decisions on credit	1/15
Control over use of income	Control over use of income	1/5
Community leadership	Group member	1/10
	Speaking in public	1/10
Time allocation	Workload	1/10
	Leisure	1/10

Source: Alkire et al. (2013).

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CONSTRAINTS TO WOMEN'S IRRIGATION ADOPTION

Key Constraints Identified:

- Technologies don't meet women's preferences (e.g. affordability, maintenance needs, fuel requirements, transportability, multiple uses)
- Less access to information (due to mobility constraints, not belonging to groups where info is disseminated, etc)
- Lack of access to and control over assets required for adoption (e.g. land)
- Exclusion from access to and decision making over collective water resources (e.g. irrigation canals)
- Limited access to credit

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EARLY FINDINGS

Irrigators have only a slight edge over non-irrigators in WEAI scores, which suggests that irrigation is not contributing much to women's empowerment in Tanzania

INITIAL RESULTS OF WOMEN-EMPOWERMENT-IN-AGRICULTURE INDEX (WEAI)

WEAI	Irrigators	Gender Parity Index	Non-irrigators	Gender Parity Index	Contributors to disempowerment
Tanzania	0.88	0.96	0.86	0.92	• Group membership • Credit access • Leisure time • Speaking in public • Autonomy in production

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OPPORTUNITIES TO PROMOTE GENDER EQUALITY IN IRRIGATION

Key Opportunities Identified:

- Great potential for participatory, user-centered technology design to better address women's needs and preferences
- Develop new outreach models to ensure information effectively reaches both men and women
- Facilitate access to credit on supply and demand side, providing financial literacy training for women and men, forming groups to manage and share risk
- Support women's participation in decision-making in groups (targets?)
- Targeting women with productive assets (e.g. HKI BF) or encouraging joint ownership/sharing of productive assets
- Sensitization of women's work and contributions (e.g. Send a Cow, Ethiopia)

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DECISION MAKING ON IRRIGATION IN TANZANIA

Women's Responses: Tanzania

	How much input did you have in making decisions about...		How much input did you have in decisions on the use of income generated from...	
	Irrigated food crop farming	Irrigated cash crop farming	Irrigated food crop farming	Irrigated cash crop farming
No input	0%	0%	1%	0%
Input into very few decisions	9%	11%	11%	14%
Input into some decisions	23%	31%	26%	30%
Input into most decisions	30%	24%	29%	23%
Input into all decisions	37%	34%	34%	34%
Total	100%	100%	100%	100%


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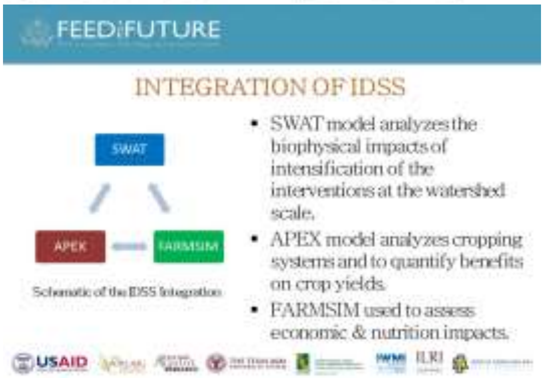
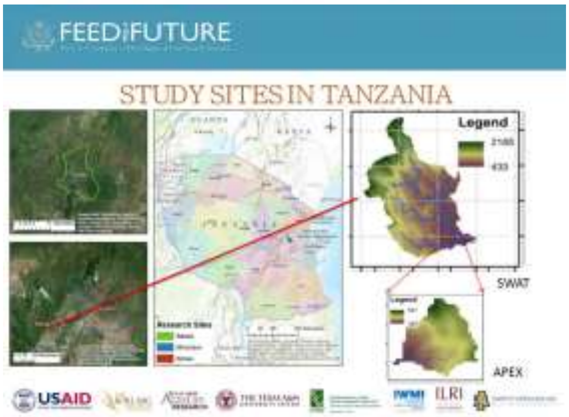
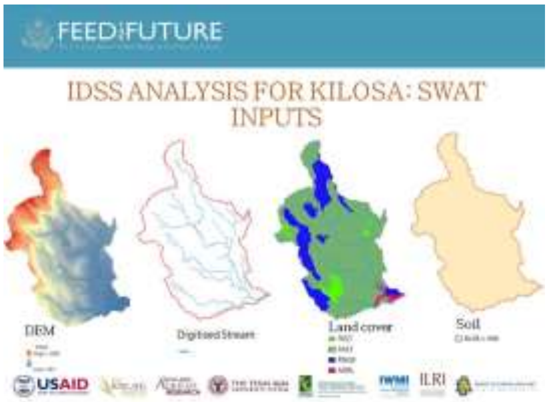
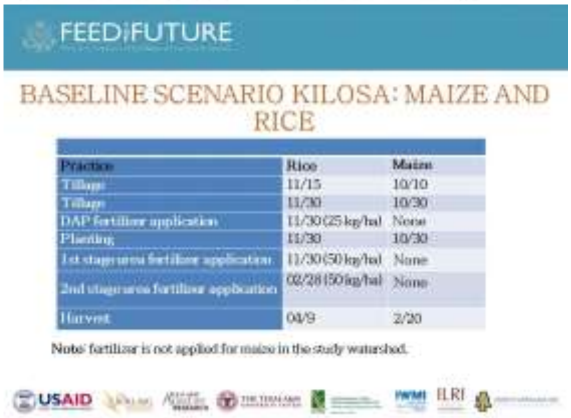
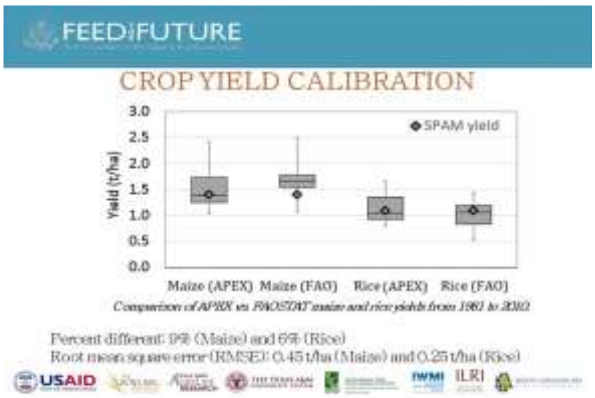
Presentation 5: Overview of Integrated Decision Support System (IDSS)











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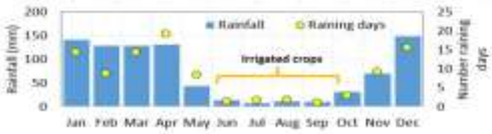
SCENARIOS

- *Alternative scenario 1*: Non-fertilized rainfed crops + irrigated vegetable crop
- *Alternative scenario 2*: Fertilized rainfed crops + irrigated vegetable crop
- *Alternative scenario 3*: System of Rice Intensification (SRI)



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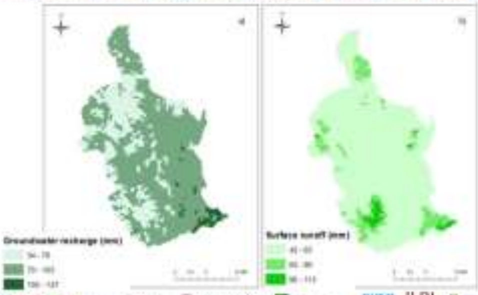
IDSS INTEGRATED RESULTS: KILOSA



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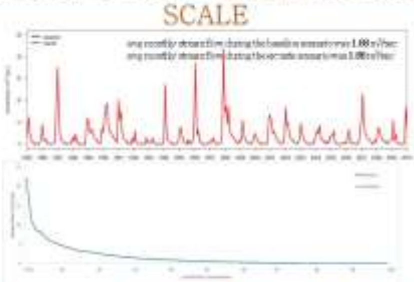
IMPACTS OF SSI AT THE WATERSHED SCALE



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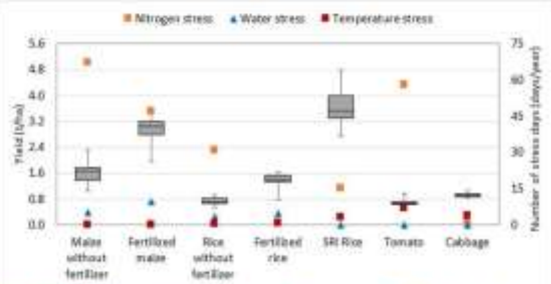
CROP YIELD



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CAPACITY BUILDING

Year	Ethiopia			Tanzania			Ghana		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
2014	52	5	57						
2015	68	8	76	66	8	74			
2016	95	9	104	27	11	38	65	6	71

382+

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NET PRESENT VALUE (NPV)

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CONCLUSIONS

- The agricultural land in the Kilosa watershed is very small, which accounts 1.46% of the entire watershed. The average annual irrigation volume of water was merely 0.14% of the annual stream flow leaving the watershed. Implementation of irrigation did not cause significant reduction on the average monthly stream flow.
- Application of fertilizer (50 kg/ha urea and 50 kg/ha DAP) increased the crop yield substantially (e.g. 83% for maize). Also addition of fertilizer reduces soil loss by increasing the crop cover.
- The irrigation of vegetables use of fertilizer and practice of System of Rice Intensification (SRI) was the most profitable scenario.

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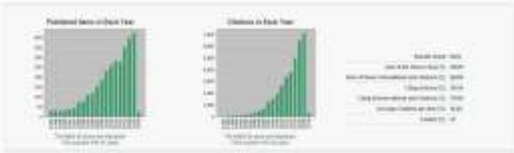
HIGH REPUTATION OF THE IDSS TOOLS

Historical trends of published SWAT-related peer-reviewed articles



Source: SWAT Literature Database as of Jan 23rd 2016 (Web of Knowledge Citations)

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IDSS TOOLS WIDELY APPLIED IN OTHER PROJECTS

- IDSS model development
  - Models developed over 30 years and widely used in USA for agricultural and environmental policy development
  - Worldwide application over past decade
- Past engagements in Ethiopia
  - IWMI and ICARDA hydrologic modeling of **Blue Nile** and **Lake Tana** basins
  - Simulation of farming systems with support from **Gates Foundation**
  - Growing use in **Ethiopian universities**

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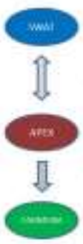
INTEGRATION OF IDSS



- SWAT and APEX share input data
  - Land use types, Soil types, Elevations, Weather, Crop management
- SWAT results (calibrated) are transferred to APEX
  - Hydrologic properties: Runoff/baseflow ratio and ET
  - Water quality: Edge of field sediment and nutrient loads
- APEX results (calibrated) are transferred to SWAT
  - Crop parameters
- APEX output is transferred to FARMSIM
  - Calibrated crop yields for 32 years were used in FARMSIM to set the reference condition for socio-economic analyses.
- Large scale SWAT results will also passed to FARMSIM
  - Area suitable for irrigation,
  - Availability of water for irrigation

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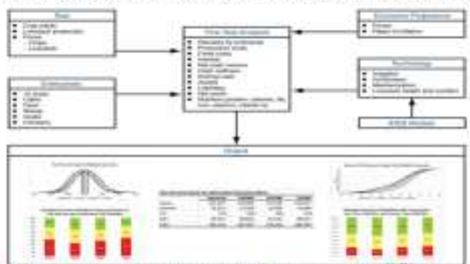
Farm Level Nutrition, Economic & Technology Simulation: FARMSIM



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c). Tomato, Cabbage and Fodder schedule

Operations	Tomato	Cabbage	Fodder Practice (Oats/Vetch)
Tillage	4/30	4/30	6/16
Tillage	5/15	5/15	7/1
1st stage urea fertilizer application	5/15 (34 kg/ha)	5/15 (34 kg/ha)	7/1 (25 kg/ha)
Planting	5/15	5/15	7/1
DAP fertilizer application	don't apply	don't apply	7/1 (50 kg/ha)
2nd stage urea fertilizer application	don't apply	don't apply	8/10 (25 kg/ha)
Harvest	9/22	9/12	8/30

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EX-ANTE STUDY RESULTS: KILOSA

- Scenario description
  - Baseline scenario: no or minimal irrigation
  - Alternative scenario 1: veg. irrigation + fert. Appl. + rice-rf
  - Alternative scenario 2: veg. irrigation + fert. Appl. + rice-sri
  - Alternative scenario 3: veg. irrigation + fert. Appl. + rice-sri (area increase)

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EX-ANTE STUDY RESULTS: KILOSA

- Scenario description
  - Baseline scenario: no or minimal irrigation (
    -mono crop: maize + rain-fed rice/ current fertilizers
    -no or minimal irrigation for tomato& cabbage, fodder and napier/current fertilizers
  - Alternative scenario 1: veg. irrigation + fert. Appl. + rice-rf
    -no irrigation: dual crop of maize/veg-fodder, rain-fed rice/ recommended fertilizer for maize
    -irrigation for tomato & cabbage, fodder and napier/optimum or current fertilizer

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EX-ANTE STUDY RESULTS: KILOSA

- Scenario description
  - Alternative scenario 2: veg. irrigation + fert. Appl. + rice-sri
    -no irrigation: dual crop of maize/veg / recomm fertilizer for maize
    -irrigation for Rice-SRI, tomato & cabbage, fodder and napier/optimum or current fertilizer
  - Alternative scenario 3: veg. irrigation + fert. Appl. + rice-sri (area increase)
    Note: same as alternative scenario 2 but with a large increase in area allocated to rice-SRI

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<u>Presentation 6: Candidate constraints from research experience and a preview of the constraints analysis method, based on Robit watershed in Ethiopia</u>

FEED THE FUTURE

Feed the Future Innovation Lab for Small Scale Irrigation

Candidate constraints from research experience and a preview of the constraints analysis method

Based on Robit watershed in Ethiopia

Stakeholder meeting (Protea Hotel, Dar es Salaam), June 26, 2016
Texas A&M Team, Texas A&M University

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Objectives of constraints and gap analysis

- To define and identify the **highest priority constraints** and their **mitigation** for further evaluation and for development of recommendations to stakeholders at multiple levels of scale.
- To engage with stakeholders to assure that the most important constraints facing decision makers, especially at the national level, are identified for further study, and
- To demonstrate that the modeling capacity and relevant databases of suite of IDSS models will allow stakeholders to address specific scenarios or questions.

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Gap and constraint analysis

- The following presentation is an **example** of how the IDSS will be used for constraint and gap analysis
- The example involves only a watershed scale assessment – the full analysis is at larger scales
- The highest priority constraints identified by stakeholders will be analyzed using this method
- Initial results will be developed by October 2016 (Ethiopian case, and follows it follows for Tanzanian and Ghanaian).

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Candidate Constraints and Gaps from Research

- Constraints and gaps are factors that limit the use of small scale irrigation.
- Candidate list of identified constraints and gaps:
  - Low land area/land availability per capita
  - Land ownership vs. rental
  - Costs related to water access
  - Access to seeds for agricultural intensification
  - Access to fertilizer for agricultural intensification
  - Water lifting technology access (market, prices, export, tax, interest/discount rates)
  - Labor requirements/costs
  - Micro-finance access for irrigation technologies and inputs (fertilizer, seeds)
  - Access to market for products (vegetables, fodder, livestock)
  - Energy cost
  - High numbers of low producing livestock
  - Low levels of mechanization
  - Gender sensitive evaluation of all the constraints mentioned above

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Gap and constraint analysis

- IDSS was used to assess the gaps and constraints on the **production**, **economic**, and **environmental** consequences of the interventions at multiple scales
  - SWAT model was used to study the ***environmental gaps and constraints*** of the use of SSI at the **watershed scale**.
  - APEX model was used to assess the ***resource constraints and knowledge gaps*** preventing maximum agricultural production at the **field scale**.
  - FarmSIM model was used to assess the ***economic and nutritional gaps and constraints*** at the **household level**.
- Alternative mitigations for the identified gaps and constraints were also discussed.

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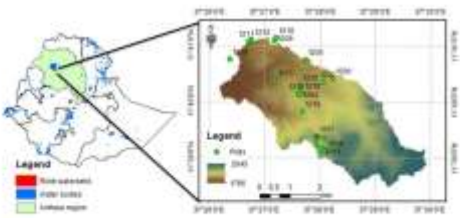
Robit watershed case study



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Watershed-scale analysis of resource and environmental constraints

- **Suitability of an area for irrigation and availability of water** were studied using the SWAT model based on:
  - land use type
  - soil characteristics
  - land slopes within the watershed
- SWAT simulates the Small-Scale Irrigation (SSI) interventions and evaluates their **environmental impacts** and **availability of water** resources at different sources (surface *vs* groundwater) at the watershed scale.

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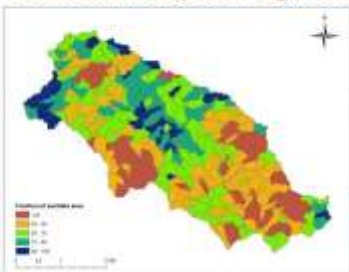
Land suitability for irrigation – Robit watershed



- ~50% of the watershed (1,506 ha) is suitable for irrigation.
- Major rainfed crops were maize, teff and finger millet.
- Dry season irrigated crops were tomato and onion (others can be considered also)

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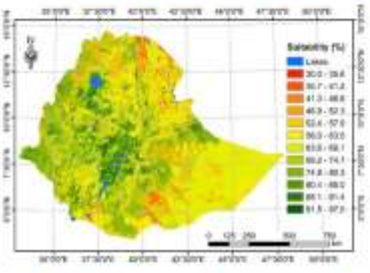
Land suitability for irrigation – Ethiopia



- Factors considered in the analysis were:
  - Land use
  - Soil
  - Slope map
  - Evaporation
  - Rainfall
  - Population density
  - Road network
- The suitable areas account 5% of the land mass (60,000 km²)

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Available water resources in Robit watershed

- Average annual rainfall = 1,400 mm
  - Average annual groundwater recharge = 280 mm (~4,000,000 m³ over the watershed or 20% of the rainfall)
  - Average annual surface runoff = 520 mm (~7,000,000 m³ over the watershed or 37% of the rainfall)
- Amount of water required for dry season irrigation for tomato = 1,500,000 m³
  - ~40% of the **groundwater recharge**
- At the watershed scale, groundwater recharge can support irrigation for vegetables (in suitable areas) in a sustainable manner.

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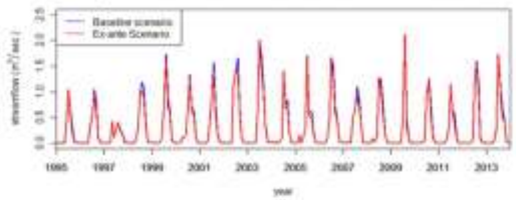
Impacts of SSI at the watershed scale



- The average monthly stream flow at the outlet of the Robit watershed reduced by ~6%, minor reductions in high flows.
- No major environmental impact such as erosion due to SSI was observed.

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Field-scale analysis of resource constraints

- The APEX model was used to identify major resource constraints using tomato as a case study crop.
- The analysis was centered on **water and nutrient availability/limitation** for tomato production.
- Where available the analysis used the field studies and survey data.

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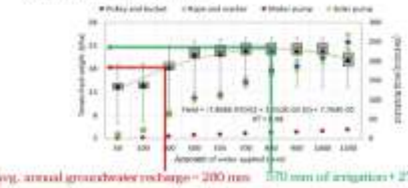
Field-scale irrigation water management

Water production function



Thus, groundwater recharge alone will not provide maximum crop yield at the field-scale.

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Fertilizer use

- Current fertilizer application rates are lower than rates recommended by the Ethiopian Agricultural Research Institute (EARI).
- Only 30-40% of smallholders use fertilizer.
- Lower applications of fertilizer inputs kept agricultural production and productivity low.
- However, there is an increasing trend in fertilizer use.

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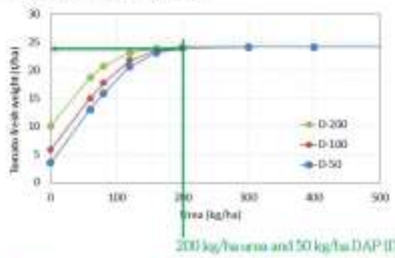
Fertilizer use

Fertilizer production function



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Household-scale analysis of economic and nutritional constraints

- FarmSIM model used information on **costs of agricultural inputs** and **irrigation equipment**, and **capacities of water lifting technologies** (WLTs) and corresponding **labor** to evaluate the economic and nutrition benefits of adopting SSI technologies.
- The WLTs evaluated include:
  - pulley and bucket
  - rope and washer pump
  - motor pump, and
  - solar pump
- Based on field data and simulation results from the APEX, each WLT was evaluated as to its capacity to pump enough irrigation water to cover the total potential irrigable land.

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Economic gaps and constraints

Table: Water lifting technologies (WLT)

Types of WLT	Operated by	Flow rate (l/min)	Cost WLT (Birr)	Issues/Constraints
Pulley/bucket	Hand	15	1310	require more labor
Rope and washer pump	Hand	14	3700	frequent breakdowns
Motor pump	Fuel	170	8500	high maintenance costs
Solar pump	Solar	18	18000	high capital costs

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Economic gaps and constraints

- FarmSIM analysis was divided into two case studies:
  - low irrigation labor cost, and
  - high irrigation labor cost (3X low cost category).
- The labor was split between hired and family labor to reduce the costs (forgoing the opportunity cost)

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Economic comparison of the different technologies

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Studied constraints and gaps of the candidate list

- Land ownership vs. rental (value for land leased/rented accounted)
- Costs related to water access (e.g. digging for wells, etc.)
- Water lifting technology access (access limited for solar pumps)
- Labor requirements/costs
- Micro finance access for irrigation technologies and inputs ([illegible] households received loan access, IFPRI survey [illegible])
- Energy cost
- Access to fertilizer for agricultural intensification in the irrigation season

Partially studied constraints and gaps of the partial list

- Less land available availability per capita

Constraints and gaps of the candidate list not yet studied

- Access to seeds for agricultural intensification
- Access to market for products (vegetables, fodder, livestock)
- High numbers of low producing livestock
- Low levels of mechanization
- Gender sensitive evaluation of all the constraints mentioned above

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Example of mitigation of constraints and identification of gaps

- Groundwater recharge can support irrigation water requirement at the watershed-scale, but not at field scale.
  - Locally available **surface runoff could be harvested** and used to support the irrigation water from shallow ground water.
  - It will also **reduce any potential environmental effects** since the surface runoff is harvested during high rainfall season.

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Example of mitigation of constraints and identification of gaps

- Low soil fertility, coupled with ineffective management practices (e.g. water and nutrient), is significant constraint to SSI.
  - application of rates of irrigation and fertilizers that provides the best combination of production, environmental and economic outcomes.

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Example of mitigation of constraints and identification of gaps

- high irrigation labor costs are a significant constraint on the profitability of irrigated tomato production and sale in Robit.
  - use of family labor and less labor-intensive irrigation methods (e.g. drip irrigation) may reduce labor costs.
  - proper training on the operation and maintenance of new WLTs can save resources.
  - policy changes to encourage smooth transition into environmental friendly technologies (e.g. solar pumps).

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Conclusion

- The ability to concurrently assess the production, economic, and environmental consequences of the interventions provides a new, integrated capacity to analyze and inform strategies and specific applications.
- Constraints and gaps were studied based on field experience (and ex-ante analysis) and corresponding mitigation strategies were proposed.
- This example shows how the IDSS will be used in subsequent constraint and gaps analysis identified by this committee.

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Way forward

- We seek your help on identifying and prioritizing opportunities and constraints that apply to SSI interventions for further IDSS analysis in Tanzanian case.
- A range of scenarios will be studied to show how the constraints can be mitigated and by how much?
- Optimum solutions that consider production, environmental and economic consequences will be looked for.

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Field-scale irrigation management

- Droughts and rainfall variability keep the agricultural production very low in Ethiopia and sub-Saharan Africa.
- The duration of the rainy season was about **three months** that farmers cultivate only once in a year.
- APEX model was used to assess **water and nutrients requirement** for tomato production during dry season using various **irrigation pumping technology tested at the field studies** and amount of **labor and time** required for irrigation.

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Constraints and gaps of the partial list (greens are studied, yellow partially studied and grays not studied)

- Lowland area/land availability per capita
- Land ownership vs. rental (*value for land leased/rented accounted*)
- Costs related to water access (e.g. digging for wells, etc)
- Access to seeds for agricultural intensification
- Access to fertilizer for agricultural intensification in the irrigation season
- Water lifting technology access (*access limited for solar pumps*)
- Labor requirements/costs
- Micro finance access for irrigation technologies and inputs (*40% households received loan access, IFPRI survey 2015*)
- Access to market for products (vegetables, fodder, livestock)
- Energy cost
- High numbers of low producing livestock
- Low levels of mechanization
- Gender sensitive evaluation of all the constraints mentioned above

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Economic gaps and constraints

- Constraints related to WLTs include labor, maintenance, and capital costs, as well as equipment breakdowns.

Table: Water lifting technologies (WLT)

Types of WLT	Operated by	Flow rate (l/min)	Cost WLT (Birr)	Issues/Constraints
Pulley/bucket	Hand	15	1310	require more labor
Rope and washer pump	Hand	14	3700	frequent breakdowns
Motor pump	Fuel	170	8500	high maintenance costs
Solar pump	Solar	16	16000	high capital costs

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9 Annex 4: Workshop evaluation

At the end of the workshop participants were asked to fill in a brief, 1-page, 18 question workshop evaluation questionnaire focusing on both the workshop content and the workshop process. Overall the responses were positive with a few respondents saying they would have liked a bit more time for presentations, group work and Q&A. The results of the evaluation are as follows:

Workshop content	**Agree**	**Strongly Agree**
I clearly understand the aims and work of the ILSSI project	10%	90%
I clearly understand the component contributions of each of the project partners	50%	50%
I clearly understand how the IDSS is supporting the overall objectives of the project	20%	80%
The constraints identified for prioritization were the right ones for the Tanzanian context	50%	60%
The workshop provided a good opportunity to share research and experiences on small-scale irrigation and irrigated fodder interventions in Tanzania	50%	50%
I would like to be kept informed of further ILSSI project work and developments	30%	70%
I am happy to be involved in future ILSSI project stakeholder engagement activities	40%	60%

Workshop process	**Disagree**	**Agree**	**Strongly Agree**
There was a good balance between presentations and group work	1%	5%	34%
I would have liked more time for the group work		10%	70%
I would have liked more time for the presentations		20%	60%
I clearly understood what was being asked of the participants		10%	20%
There was enough time for discussion			30%
There was enough time for Q&A			40%
The workshop was the right length for the content			60%
I found the workshop a useful learning and information sharing experience			20%
The information materials provided before and during the workshop were relevant and useful			20%
Communication about the workshop was clear and well timed			70%

In response to the question *'What would you like more information about in any follow up from the ILSSI project team?'* respondents replied:

- On ground implementation
- To be informed on further ILSSI project work and development
- Selection of priority project areas
- About the modal APEX, SWAT and FARMSIM
- Research findings to be shared with the research department in the National Irrigation Commission
- Workshop report to be shared among participants
- Implementation on irrigation of fodder/forage and marketing of products from the project areas
- Share the presentations
- Viable SSI technologies
- Feedback of the meeting, prioritized constraints and the way forward
- Gender issues on irrigation
- A summary of policy statements for line ministries
- Waiting for full results/outcomes from ILSSI

Additional comments:

- A useful workshop that gives insights on future work on irrigation and household studies.
- More collaboration between ILSSI and other Feed the Future projects
- Well-organized workshop, organizers, facilitator and presenters
- Grateful to share experiences in this workshop
- Research work on irrigation of fodder/forage in semi-arid areas
- I invite organizers to visit my Basin Authority at Wami Ruvu to see constraints and challenges we are facing.