



# FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

Semi-Annual Report  
October 1, 2014 to March 31, 2015

## I. Feed the Future Innovation Laboratory for Small Scale Irrigation

## II. Research Progress Summary

### Introduction

The major components of this cooperative agreement are (1) assessment of promising small scale irrigation technologies for small holders, (2) stakeholder consultation at multiple levels of scale to define the interventions to be used in field studies, (3) engagement with national partners and farmers for conducting field studies, (4) surveys of farm families in the region surrounding field test sites, and (5) integrated analysis of the production, environmental and economic consequences of small scale irrigation options, including but not limited to, interventions used in farmer's fields. In addition, capacity building and training at multiple levels of scale are substantive elements of the agreement. The overall plan established Ethiopia as a pilot country where the elements of the program are brought together and tested. These methods are being used as a template for studies in Tanzania and Ghana. The overall schedule for implementation was modified with a delay in the Ghana program because of the ebola outbreak in West Africa. After a delay of about six months, it has been possible to continue effort in Ghana with the expectation that field research on irrigation will be initiated in the next dry season and household surveys completed in the fall of 2015.

Year one of the agreement was mostly devoted to planning and stakeholder engagement in all three countries and set the stage for launching field studies, surveys, and analyses in year two. In year one, candidate interventions were identified with stakeholder participation and general locations for field studies and survey instruments were developed along with pilot studies that applied the analysis methodology, referred to hereafter as the integrated decision support system (IDSS) to candidate sites in Ethiopia. A major training workshop was held in Addis Ababa in June 2014 as was the first meeting of the newly formed External Advisory Committee and a stakeholder meeting to report initial progress.

This report covers progress made during the first half of year two of the agreement. The overall plan for year two is to finalize details of the experimental design, complete the selection of the location of field studies, engage national university partners to participate in conducting and evaluating field studies, select and engage smallholder farmers to participate in field studies and to initiate field studies. Also in year two, the household surveys of social, economic, and nutritional factors related to results of small scale irrigation adoption are to be completed in all three countries. The IDSS will be used to conduct baseline studies in the regions surrounding the field studies and to perform ex ante analyses on the interventions used in field studies as well as other options for small scale irrigation systems. These analyses will include scaling up the results of the interventions to watershed levels and beyond. Analytic methods were extended through linking International Food Policy Research Institute (IFPRI) and Texas A&M models to enhance scaling capacity. It is expected that engagement with the USAID Mission, other sponsors, the private sector and other innovation laboratories will provide assurances of the relevance of the results of the agreement and leverage the product through partnering with other entities. The report is organized under the major components of the approved year-two workplan.



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**Component 0: Plan, coordinate, and organize multi-institutional activities**

IWMI and IFPRI met with Texas A&M University System (TAMUS) collaborators separately and together in College Station and Washington to coordinate activities in year two, including linking and integrating analytic methodologies. Monthly Skype calls are being held to review progress and address issues arising from program initiation. Just prior to the beginning of year two, a second seminar was provided to USAID Bureau of Food Security in Washington Staff. A Google worksite was established for routine engagement of the Program Management Committee in ongoing administrative and leadership functions. A data transfer site for models, databases and analysis was established and is in use. The website for the innovation laboratory has undergone substantial extension, modification and continued development.

Semi-annual and indicator reports were submitted in October 2014 (Activity 0.2.1.). Sub-agreements were completed for field interventions in Ethiopia with Arba Minch University, Send-a-Cow, Dangeshita Multi-purpose Cooperative Society (Dangila), and Debere Tseyson Agricultural Multi-purpose Cooperative (Robit). A sub-agreement was established in Tanzania with Sokoine University of Agriculture (Activity 0.1.5.).

In Ghana, three initial meetings were held with stakeholders and terms of reference were subsequently developed for a sub-agreement with the University for Development Studies in Tamale. Two additional meetings were held and the facilities/capacity were assessed for water testing and for soil analysis and mapping in Ghana (University of Ghana, Legon; Water Research Institute).

Plans for the IDSS training workshop in Tanzania, the Program Management Committee, and the External Advisory Committee to be held the last week in July 2015 were initiated.

Specific plans have been made for joint field research and application of the IDSS model with the Feed the Future Africa RISING program and the CETA funded Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES). These collaborations will provide a larger number of sites and observations that will extend and broaden the ILSSI product in Ethiopia. In addition to these committed engagements, the following table shows the other pending collaborations.

**Cooperators - Innovation Laboratory for Small Scale Irrigation**

**April 25, 2015**

<b>Cooperator</b>	<b>Engagement</b>	<b>POC</b>
Africa RISING	Ethiopia – 4 sites Tanzania- exploratory Ghana- exploratory Field and analytic studies	Peter Thorne, Valentine Ghandi Mateete Bekunda Asamoah Larbi
LIVES (CETA)	Ethiopia 5 sites	Berhanu Gebremedhin
iDE	Ethiopia (initially) Pilot – field analytic – future joint proposals	Kebede Ayele
Sustainable Intensification IL	Scoping, regional platforms, bids, joint proposals – Cambodia, consultation	Vara Prasad, Robert Hijmans

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Nutrition IL	NIL-ILSSI pilot – Ethiopia-pilot	Jeff Griffiths, Shibani Ghosh
CSISA	South Asia, India, Bangladesh, Cambodia- pending exploratory	Andy McDonald
Soybean IL	Ghana – Tamale – pilot	Peter Goldsmith
Sorghum Millet IL	Exploratory – possible future pilot	Tim Daltan
Sust. Inten. Pgm–NIL	Cross project collaboration	SI labs & NIL – ILSSI method – Jerry Glover
Ministry of Environment and Forest	Pilot study on selected watersheds with SWAT	Shimeles Tadesse and Berhanu Gebremedhin

**Component 1: Identify promising, context appropriate small scale irrigation interventions, management, and practices for poverty reduction and improved nutrition outcomes.**

Surveys: Fieldwork on the household level and gender disaggregated survey has been completed in Ethiopia. Data verification and entry are underway. Data were collected from 442 households in 15 kebeles of Adami Tulu, Bahir Dar Zuria, Dangila, and Lemo woredas. In Tanzania, pretests of the questionnaire were conducted and adaptation to Tanzania was done in preparation for future fieldwork (Activity 1.2.1.).

Site and Intervention Selection and Implementation:

Principles for site selection in Ghana and Tanzania followed the pattern developed for Ethiopia. Site selection criteria include market access, irrigation potential, presence of promising partners and overlap with FtF Zones (Activity 1.3.2.). In addition to ongoing work in Ethiopia, site selection and preliminary identification of irrigation options are complete for Ghana and well advanced in Tanzania (Activity 1.3.3.).

Ethiopia: The research team (IWMI, ILRI, TAMUS, and Bahir Dar University (BDU)) met with communities multiple times in Robit Bata, Dangila, Lemo and Angacha. In Robit kebele (Bahir Dar-Zuria Woreda), Two water lifting technologies (i.e. Rope and Washer (R&W), improved pulley ‘bucket’ system) are being field tested for dry season irrigation to produce tomatoes; 23 farmers were selected (11 for R&W and 12 pulley). As well as training in forage and tomato production, farmers will be supported in design of feeding regimes and marketing strategies for increased productivity of forage. In Dangeshita kebele (Dangila woreda), 23 households were selected (11 R&W, 12 pulley) to test the same water lifting technologies, but for the production of onions. In Bochesa kebele (Adami Tulu woreda) 26 households were selected (6 R&W and 20 motorized pumps) for dry season tomatoes. For the Lemo woreda, a joint implementation site with Africa RISING, emphasis is given to fruit trees (apple and avocado) and fodder, with potential for vegetables. ILSSI activities will concentrate in the Upper Ghana kebele, with 7 households (6 R&W, 1 solar pump).

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Ghana: Site selection and intervention planning have been completed for small scale irrigation interventions at three sites in Ghana (Upper East: Zanlerigu and Dimbisinia; Northern: Behinaayili) for four interventions packages. Interventions for all sites include water lifting devices to use with (seasonal) shallow groundwater wells, improved conveyance methods, and irrigation scheduling with water saving techniques/methods. One site will integrate low-cost, locally developed (University for Development Studies) drip devices with existing motor pumps and another with existing rainwater harvesting structures at the homestead/compound that use locally produced clay storage devices.

Tanzania: The sites identified for field interventions in Tanzania include Morogoro Region, Kilosa District: Rudewa; Dodoma Region, Chamwino District; Manyara Region, Babati District: Babati). Babati is also an Africa RISING site. This study will involve two main types of small-scale irrigation technologies, which are water lifting devices and in-situ water harvesting technology. Stakeholders in Tanzania are particularly interested in agricultural water management for rice.

Livestock Fodder: A qualitative tool was developed and focus group discussions were implemented with farmers, project managers and government officials on integrated irrigated crop-fodder in field sites in Ethiopia (Activity 1.2.2.). Selection of sites was finalized for Ethiopia and site specific interventions have been planned for the two sites in Ethiopia where irrigated fodder will be studied have been identified. A process of farmer engagement and selection has been completed in Robit-Bata and 17 as farmers have agreed to participate. An additional 12 farmers have also agreed to participate but with a less intensive data collection procedure. In Lemo-Angacha, another 24 target farmers and 12 control farmers have agreed to participate.

A Livestock Stakeholder Workshop was convened in Tamale, Ghana, in late October to establish a community of livestock stakeholders around small-scale irrigation. The workshop highlighted some of the challenges in applying small-scale irrigated forage in Ghana compared with Ethiopia. ILRI joined a field site selection and planning visit in Ghana during February 2015 and formulated plans to work in two sites, Duko in Northern region and Zanlerigu in Upper East region (also selected by IWMI). Interventions will focus on two areas: small intensive fodder plots under irrigation and planting of *Cajanus cajan*/pigeon pea as a hedge for livestock feed and food grain around existing irrigated plots.

In Tanzania, site selection and intervention planning is ongoing but current indications are that ILRI will work in the current year in Babati district where ongoing Africa RISING activities are already in place. A number of existing irrigation schemes and interventions; one or two of these will be the focus (Activity 1.3.1.).

Ex Ante Analysis using the IDSS: The scarcity of data, for both biophysical and economic modeling, is the recognized challenge for the application of quantitative modeling methods in the developing world; this program is no exception. Several established methods for compensating for detailed data, including expert opinion, are necessary to move ahead. Initial ex ante analyses that employ existing data produce approximate results which improve accuracy as field data become available from parallel elements of the program.

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The present schedule for ex ante analyses calls for these studies to be completed in all four locations in Ethiopia by the end of June. Following this, ex ante studies will move to Tanzania and then to Ghana in the summer and fall of 2015. Similar studies are planned for the collaborations noted in component 0 (above) in the same time frame.

In Ethiopia, data were collected for the two watersheds (Robit and Dangila) in the Amhara region. The methods for individual models and exchange of data and outputs between models will be similar to the procedures developed here. APEX models were constructed using ArcAPEX and calibration for hydrology and crop yield are near completion. A total of 13 small-scale water management interventions were selected that encompass surface runoff management, ex-situ water harvesting technologies, in-situ water managements, and groundwater lifting technologies.

Baseline ex-ante model simulations were performed for Robit, Dangila and Adami sites in Ethiopia using the SWAT model. SWAT calibration and validation were performed at the Gummera River and Gilgel Abay River gauging stations for calibrating model parameters for Robit and Dangila watersheds, respectively. The baseline ex-ante analysis for Lemmo was delayed pending definition of the exact location of the watershed outlets.

The first scenario used irrigation from groundwater. Ex-ante analysis for vegetable crops using irrigation from shallow groundwater was done at the Robit watershed. The predominant grain crops identified in the area are Teff, Maize, and Finger Millet. The work will continue for the Dangeshita watershed. Similar analyses will be done for Adami and Lemmo sites.

Bio-physical models, APEX and SWAT, together with the socio-economic model, FARMSIM, comprise IDSS integration of complete site-specific recommendations on small scale irrigation technologies. The integrative application of the component models is the key to the success of IDSS. On the bio-physical modeling side, an automatic integration procedure is under development to expedite IDSS calibration and to standardize modeling output with minimum subjectivity in the result. A suite of tools coded in Visual Basic for Application and Python read hydrologic and water quality output from SWAT, process the information for APEX calibration, and then calibrate the APEX model based on SWAT output (Activity 1.1.3.).

### **Component 2: Evaluating impacts, trade-offs, and synergies of small-scale irrigation technologies and practices.**

The baseline survey for Ethiopia is progressing well and farmer field books have been designed and translated into the sites' local languages. Students in Ethiopia have started to collect relevant agronomic, economic, soil and hydrological data. The national partners are now reviewing and compiling existing data from related small scale irrigation projects, particularly for the selected sites. For Ethiopia, options using remote sensing and soil sampling and analysis for our target households' plots are being used to obtain missing data. Crop yield data for target kebeles is also not easily available.

Similar survey and field book layout is planned for Ghana and Tanzania with minor adjustments depending on the agronomic/irrigation activities in the selected intervention sites. Ongoing livestock activities (part of the Africa RISING projects in Ghana and Tanzania) will be useful data sources for populating models. ILRI's staff has collaborated with IDSS colleagues at



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TAMUS and has suggested various data sources in Tanzania and made preliminary contacts between the relevant people (Activity 2.1.1.).

Soil samplings for the intervention sites in the north of Ethiopia were completed and analyzed; some initial issues were encountered with facilities for analysis but are being resolved. Weather stations and other instrumentation for data collections were installed. Students in Ethiopia are collecting relevant agronomic, economic, soil and hydrological data. This will provide the primary and fundamental data to drive the suite of models in the IDSS. Existing data for Ghana and Ethiopia from previous IWMI projects have been shared with TAMUS. A sub-contractor has been identified and terms drafted to fill gaps for data on soils and land use for Ghana.

Collaboration between team partners will help in identifying gaps in data for modelling interventions, particularly on livestock and feed data gaps for each intervention. This is currently underway for Ethiopia and is pending in Ghana and Tanzania (Activity 2.1.2.).

For Ethiopia, the research team made at least three field visits to the various sites. The required equipment, partners and capacity development for establishing the field site interventions were identified and agreed upon with local stakeholders and communities. Where necessary, technologies were modified to meet the needs of farmers. In addition, the equipment for monitoring and collecting data has either been acquired or installed. The suppliers for irrigation technologies and associated monitoring equipment were engaged along with consultants for capacity development in communities.

In Ethiopia, the research team (IWMI, ILRI, AMU, and BDU) met with communities multiple times in Robit Bata, Dangila, Lemo and Angacha. In Robit kebele (Bahir Dar-Zuria Woreda), two water lifting technologies (i.e. Rope and Washer (R&W), improved pulley (bucket) system) are being implemented/field tested for dry season irrigation to produce tomatoes; 23 farmers were selected (11 for R&W and 12 pulley). An additional 23 farmers were selected to grow irrigated fodder (i.e. 12 R&W and 11 pulley). In addition to the training in forage and tomato production, farmers will be supported in design of feeding regimes and marketing strategies for increased productivity of forage. In Dangeshita kebele (Dangila woreda), 23 households were selected (11 R&W, 12 pulley) to test the same water lifting technologies, but for the production of onions. In Bochesa kebele (Adami Tulu woreda) 26 households were selected (6 R&W and 20 motorized pumps) for dry season tomatoes. For the Lemo woreda, a joint implementation site with Africa RISING, emphasis is given to fruit trees (apple and avocado) and fodder, with potential for vegetables. ILSSI activities will concentrate in the Upper Gana kebele, with 7 households (6 R&W, 1 solar pump).

Intervention technologies (pulley, rope and washer, solar and other pump; modified conveyance systems) were installed in most of the intervention sites in Ethiopia; installation is underway in those sites not covered before the end of March. The project identified issues with the technologies for women, and therefore developed a modified conveyance system to reduce labor for women and increase participation in the project and uptake of the technology.

The lack of credit access is a major constraint to irrigation development, so potential sustainable solutions were considered. The microcredit context and institutions were assessed and options were identified to provide credit to farmers for technologies across multiple seasons with shared risk. IWMI chose to work with existing institutions and organizations in the microcredit sector so as to ensure increased capacity and greater likelihood of sustainability after project closure. IWMI developed sub-agreements with three credit organizations/cooperatives already working in

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the intervention site areas. Consultations were held with key stakeholders to identify the most suitable arrangement for credit. IWMI also worked with the credit providers and the technology manufacturers to facilitate purchase of suitable technologies at a fair price. IWMI then provided seed money for the purchase of the technologies for year 1, with the repaid funds to become a revolving fund for irrigation technologies specific to those areas. The repayment and subsequent use of repaid funds will be monitored throughout the project period. Options and opportunities for credit arrangements in Ghana are in the process of being examined.

A data collection protocol has been developed for assessing costs and benefits of irrigated forage production. The protocol allows collection of data on costs of inputs (labor, seed, livestock, etc.) and returns from outputs over a multi-year timetable and allows a simple cost-benefit assessment to be performed. Data has been collected according to the protocol among 42 target and control farmers in Lemo-Angacha and data are currently being digitized. Field tests of irrigated forages have not yet started in Ghana and Tanzania pending selection of study sites (Activity 2.4.1.).

Forage interventions have now been established in the Robit Bata site and their establishment in Angacha is imminent. Field tests of irrigated forages will start in Ghana by May 2015 but have not yet started in Tanzania pending selection of study sites.

Feed assessments have been conducted using the Feed Assessment Tool (FEAST) in selected Africa RISING field sites in Ghana and Tanzania. Further FEAST/Techfit assessments will be conducted in Ghana and Tanzania once site selection is finalized. In Tanzania, the FEAST and Techfit will be conducted in Kilosa, Mvomero and Babati districts. A FEAST assessment has been conducted in Robit Bata and at Angacha and posted in ILRI's digital document repository (Activity 2.4.2.).

Data for the economic analysis has been collected in Ethiopia (Activity 2.4.1.). Analysis is pending and will be completed during the next reporting period (Activity 2.4.3.).

Irrigated forage intervention trials are being established in Robit-Bata and Lemo-Angacha during Year 2. Thirty-six target farmers (24 for intensive data collection, 12 for limited data collection) were initially recruited in Robit-Bata and another 36 farmers (24 target, 12 control) in Angacha have been recruited. In Robit-Bata, forages have now been established although the number of participating farmers has dropped to 17 following some drop-outs. Research agreements have been signed with Amhara Regional Agricultural Research Institute (Robit Bata) and Southern Agricultural Research Institute (SARI) to facilitate the forage interventions and develop the feeding and marketing strategies associated with them. A parallel agreement with IWMI to oversee data collection on hydrological and agronomic aspects (via Bahir Dar University) has also been signed.

The foundation for this activity in Ghana has been laid through a Livestock Stakeholder Meeting in Tamale in late October and participation in a field mission in Feb 2015. Groundwork in Tanzania has been laid through appointment of a research technician to be based in Morogoro who will oversee this work. In Tanzania, ILRI is seeking a partner with which to collaborate in implementing interventions. The current proposal is to work with Mabuki Research Station, Mwanza who are leading the forage research program in Tanzania (Activity 2.4.4.).

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**Component 3: Identifying key constraints and opportunities to improve access to small scale irrigation technologies.**

The major part of this effort will occur later in the project after initial farm family surveys, field studies and ex ante analyses have been conducted. In year two, the effort is directed to development and initial application of methods to identify constraints.

The Texas A&M University System (TAMUS) team and International Food Policy Research Institute (IFPRI) team had a second meeting at TAMUS on the modeling approaches for the ILSSI project on October 31, 2014. Discussions specifically focused on the deliverables and modelling/data task allocation and collaboration between the two teams. Since then, the SPAM baseline data of Africa for the year 2005 was delivered to TAMUS. The FARMSIM model was also provided with the price demand elasticities used in the IFPRI DREAM simulations.

The collection of socioeconomic and biophysical data is included in sub-agreements for household surveys in Ethiopia. Biophysical data collection has begun in Ethiopia.

A focus group discussion (FGD) checklist has been developed and applied in Lemo-Angacha and Robit-Bata. Transcripts of FGD's will be used to assess constraints to small scale irrigation uptake. The tool will also be applied in Ghana and Tanzania sites once selected (Activity 3.1.2.).

IWMI consulted with farmers on constraints to access small scale irrigation in Ethiopia intervention sites. Immediate constraints included: costs of technologies and access to credit; labor requirements related to conveyance of water in the field, particularly for women; past failure of irrigation in one site (Robit Bata) due to low quality equipment and lack of maintenance/repair. IWMI therefore added elements to the technology packages for credit and developed modified, low-cost conveyance systems to use with water lifting devices, and training for target farmers and local artisans on repair and maintenance.

**Component 4: Capacity Development and Stakeholder Engagement and Dialogue**

The community of practice meeting on the SWAT model has been scheduled for September 2015 in Addis Ababa.

Plans are underway for Sokoine Agricultural University to host the first IDSS training workshop in July 2015. Early plans are emerging for the Ghana workshop in the fall of 2015.

Engagement with farming communities in Robit-Bata and Lemo-Angacha has proceeded well. The project has been introduced and volunteer farmers have been recruited for interventions and have begun implementing interventions in Robit-Bata. Engagement with farmers at community level with inclusion of local government was completed to ensure technologies and crops in the interventions are demand-driven. Community level savings and loan cooperatives were also engaged and integrated into the field interventions (Activity 4.2.6.).

Focus Group Discussions have been held in Lemo-Angacha and are underway in Robit-Bata (Activity 4.2.7.). Three key issues emerged from the FGD's in Angacha. Firstly, farmers noted



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that supply of planting materials for forages would be a major constraint to forage establishment. Secondly, farmers indicated that they would strongly benefit from technical training on forage establishment, management and utilization. Finally, participants pointed to market linkages as a key issue to be dealt with in establishing successful irrigated forage in Angacha. Seed supply and market linkages were also highlighted as key issues in Robit Bata (Activity 4.2.8.). The working paper on small scale irrigation and gardens was edited and prepared for printing and sharing (Activity 4.2.9.).

Training for farmers and local stakeholders (extension, Bureau of Agriculture, savings and loan cooperatives) on technologies (including repair) was implemented for field sites in Ethiopia to help ensure uptake and sustainability given concerns of farmers from past failed irrigation projects (Activity 4.1.5). Training materials for financing small scale irrigation were developed to support upscaling of trainings to other projects and countries. Training materials were also developed for wetting front detectors on the interventions.

IWMI has shared the project and initial experiences as a national coordinator of an agricultural water management/irrigation platform in Ethiopia (operated under the auspices of the Ministry of Agriculture) as part of on-going engagement for eventual upscaling (Activity 4.2.5.). In addition, IWMI has shared the results of initial research on irrigated homestead gardens at national level in Ethiopia as part of a working group across development partners and also with donors investing in home gardens (Activity 4.2.5.). The related publication/knowledge product completed was the “Review Paper on ‘Garden Kits’ in Africa” (IWMI working paper 162), which was a featured product by IWMI and promoted for broad exposure and dissemination.

**A. Issues or concerns encountered during the reporting period**

The Ebola outbreak in West Africa, and the associated restriction on travel to Ghana, led to delay in finalizing site selection and engagement with local government and farmers to identify participating households. This delay in turn will create some delay in installing technologies in Ghana, as the dry season technologies can only be installed at the end of the rainy season in October 2015. Activities will be put back on schedule if possible.

The timing of the surveys in relation to interventions has presented some challenges. Surveys should not be implemented during periods of high agricultural activity or periods where roads are not passable. Moreover, information on survey locations needs to be known in advance before survey companies can be selected because location is an important component of the survey budget.

The field research team encountered some reluctance from farmers in Robit in Ethiopia to participate even after they had volunteered to be part of the project following extensive consultation. The farmers in the area grow khat and are reluctant to invest in activities or use land that will take away from khat. They also expressed concerns about the water lifting technologies, as they had seen water lifting technologies fail in earlier projects. In addition, local government stakeholders in the area demanded financial support from the project. The response was to engage the technology manufacturer to provide a warranty for the water lifting technologies; IWMI facilitated training on repair and maintenance. In addition, some constraints

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have been encountered in ensuring participation of women in the trainings in Ethiopia. The participants for trainings are contacted by cell phone, but most women do not have cell phones so the message only goes to the males. An alternative to cell phones will be used in the future to ensure that women are informed about trainings to enable them to participate. The current low level of engagement of women in the project is considered as a key issue; field research and focus group discussions will be used to identify the reasons for low participation and the incentive to increasingly integrate more women into the project.

In one site in Ethiopia, the introduction of rope and washer created disruption to water supply for domestic use. Intra-household roles for water collection and use include children obtaining water for domestic use, but some children are unable to use the rope and washer technology, and therefore are unable to collect water for domestic use. There does not appear to have been a change in intra-household roles with the introduction of the technology. An adaptation is being considered to enable younger children to use the rope and washer or by-pass the technology to fulfill their household role with respect to water. A social scientist will also engage with the community to better understand and mitigate the negative effect of the introduction of irrigation technologies on the household.

Finding input data for the IDSS remains a challenge. Quality of the data is often poor and scarce. IWMI's efforts to implement the field sites, make agreements and start the data collection process have helped.

### **B. Data Sharing and Dissemination**

The ILSSI website is undergoing substantial revision and expansion. Relevant publications from this and related studies are being added. ILSSI has presented seminars to USAID and to meetings of the Feed the Future Innovation Laboratory Director's Council... A review article on irrigation in garden kitchens was prepared and distributed by IWMI.

A poster was presented at the Southern Agricultural Economics Association (SAEA) in Atlanta Georgia on the use of IDSS applied to the Fogera Woreda in Amhara region in 2013 under the sponsorship of the Gates Foundations. The poster described the utility of the IDSS approach being used in the ILSSI project to evaluate the adoption of agricultural technologies.

Spatial data (e.g. DEM, soil, and land use) were processed and subsequently shared with the project partners. A user's manual for QSWAT was prepared and will be publicly available on the SWAT website. Example datasets for the QSWAT model are prepared and will be publicly available. A conceptual paper on the application of "integrated decision support tools" will be submitted to peer-reviewed journal.

### **III. Human and Institutional Capacity Development**

#### **A. Short-term training**

The ILSSI/IDSS training workshop was held in Bahir Dar, Ethiopia, 2-6 February, 2015. The School of Civil and Water Resources Engineering, led by Dr. Seifu Tilahun, was the principal organizer and host. The Geospatial Data & Technology Center under the direction of Birhanu Gadif, and the Blue Nile Water Institute, headed by Goraw Goshu, supported the workshop by giving students and employees the opportunity to participate, and providing the monetary support (cash) for the venue. Of the 80+ people pre-registered for the event, 73 attended and successfully completed the 5-day training. The first day provided the participants with an overview of the IDSS and the individual models (FARMSIM, SWAT and APEX). Days two through four provided the participants with the opportunity to delve deeper into the individual models. On day five, a case study of the Robit Kebele was presented as the integrated results of the individual models and illustrating capabilities of the IDSS.

SWAT: Introductory SWAT and advanced SWAT training was presented by Yihun Dile. . 38 individuals attended the training over the five days, three were females and the remainder (35) were males. Most of the participants are faculty staff in the largest Universities in Ethiopia (e.g. Bahir Dar University, Addis Ababa University, Jimma University, Arba Minch University, and Haramaya University). Some of the participants are M.S. and Ph.D. students in these universities. There were also participants from research institutes and sector offices. The introductory SWAT training covered data preparation (e.g. building database, spatial data projection, weather generator, etc.), watershed delineation, HRU definition, implementing ex-ante interventions, and model simulations. The introductory SWAT used the publicly available QSWAT (QSWAT uses QGIS-Quantum GIS). The advanced SWAT training covered sensitivity analysis, uncertainty analysis and model calibration and validation. The advanced SWAT uses SWAT-CUP sensitivity analysis, uncertainty analysis and calibration tool. Both introductory SWAT and advanced SWAT trainings were based on a dataset at the Robit watershed. The new QSWAT interface was well received by most participants. Even those who previously used ARCSWAT were pleased with some of QOSWAT's added features.

APEX: The APEX workshop had 21 participants (4 women and 17 men); 9 of these were faculty members at different universities, 8 were graduate students and 4 were either researchers or extension agents. The APEX workshop was divided into three components: 1) an introductory-theoretical part; 2) a hands on section where participants familiarize themselves with the WinAPEX interface; and 3) a section for model evaluation and demonstration of the APEX-CUTE (Calibration and Uncertainty Estimator) tool. The participants responded well to the instructors as they participated in the hands-on exercises and queried the instructors with highly relevant questions.

FARMSIM: There were 14 participants in FARMSIM training workshop among whom 13 were males and 1 female. FARMSIM training workshop outline was as follows: 1) Introduction to the concept of risk, 2) Use of EXCEL and SIMETAR to analyze risk; 3) Fundamentals of statistics and econometrics to estimate risk; 4) FARMSIM model overview; and 5) Data source and entry in FARMSIM. The final day was dedicated to a hands-on exercise where a “virtual farm” in Bahir Dar Zuria was simulated assuming the adoption of an irrigation technology. Overall the

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students showed a lot of interest in knowing the details and using the FARMSIM model to analyze risk surrounding the adoption of agricultural technology on a farm. Dr. Jean-Claude Bizimana was the workshop trainer.

***B. Long-term training***

Post-doctoral fellows have been placed in IWMI, SWAT, and APEX locations. An Ethiopian master's degree candidate is scheduled to begin training in at Texas A&M in the summer of 2015, after an extended effort to obtain his visa. The IWMI a Ugandan post-doctoral fellow continues to work on the project. The post-doctoral fellow attended training on integrating gender into research to strengthen the gender cross-cutting element in ILSSI (Activity 4.1.6.). Sub-national institutions have been engaged at both woreda and kebele levels in Ethiopia (Regional Bureaus of Agriculture) (Activity 4.2.5.).

Several graduate students currently enrolled in degree programs at Bahir Dar University (8) and Arba Minch University (5) have been engaged through the project and are being supported and mentored to undertake field work and write theses/dissertations to meet their degree requirements. One Ph.D. student will join the project in Tanzania. In Ghana, one Ph.D. student is planned to join the project, and M.S. students are currently being identified. For Tanzania and Ghana the number of post-graduate students directly involved in the field interventions is expected to increase. At NCA&T, an Ethiopian will begin Ph.D. Spring 2015 and an African-American M.S. student. Both will work on research problems related to ILSSI objectives.

***C. Institutional capacity development***

The inaugural national Ag Water Management Platform meeting was held in January in Addis Ababa. IWMI informed the meeting that ILSSI is contributing to the overall work of this new initiative.

The application of FEAST by national partners (SARI, ARARI) is building capacity to analyze livestock feed issues in smallholder systems. The application of focus group discussion methods by the same partners is building capacity on farmer engagement approaches.

The Ethiopian Ministry of Environment and Forestry (MEF) is interested in using the SWAT model for assessing the water resources and soil erosion status of the country. The ministry is responsible in writing the state of the environment report for Ethiopia. They aimed to apply SWAT in three pilot watersheds, and integrate the findings into the state of the environment report. MEF approached SWAT team for possible capacity development training for its staff.

Staff from Bahir Dar University, Addis Ababa University, Arba Minch University, Jimma University, Mekele University, and Haromaya University participated in the SWAT workshop.

**IV. Technology Transfer and Scaling Partnerships**

Other USAID projects are being engaged through field interventions in all three countries. There are overlapping sites with Africa RISING planned for each country (Lemo, Ethiopia; Babati,

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Tanzania; Duko, Ghana). The cost of instrumentation for data collection is being shared across the projects to enhance efficiencies in all countries. In Tanzania, IWMI is proactively exploring the linkages and synergies with the USAID's iAGRI (Prof. David Kraybill, Ohio State) program. Initial discussions have also taken place with The World Vegetable Center in Tanzania and Ghana relating to their current work under Africa RISING.

IWMI has engaged with a platform on kitchen/backyard gardens (USAID funded, Tufts University) in Ethiopia and the sub-region and shared initial research (including publication). In addition, IWMI has shared information with the PASIDP in Ethiopia, which also has a component on homestead gardens. A number of framing discussions around scaling out and expanding technologies or sites into new areas with iDE at both corporation and country levels relating to Ethiopia have been initiated.

Irrigated forage (oats/vetch mixtures) coupled with ruminant fattening is generating farmer interest in Lemo/Angacha and farmers are increasing the irrigated area devoted to this technology following trials in Year 1.

## **V. Future Work**

IWMI will continue to work with partners in Ethiopia to collect data for interventions and watershed for all sites. An assessment of gender and intra-household water use and roles/responsibilities will be undertaken. Monitoring and follow-up on trainings for credit arrangements will be implemented, while supervising and capacity development for students (theses, publications) will continue. National partners will be engaged on the progress of the project since the June 2014 annual meeting in Ethiopia.

In Ghana and Tanzania, assessment and planning for collection of data (including equipment) on sites will also be undertaken; instruments for measurement and data collection for biophysical data will be procured and installed. An assessment of existing data and data gaps will be made. The technologies for dry season irrigation will be procured and where appropriate installed for use in the next dry season. A needs assessment for capacity development will be undertaken for technologies and any associated credit arrangements, and plans for capacity development will be formulated. In Ghana, initial assessments indicate that land user rights are seasonal and dry season farmers do not invest in non-moveable irrigation technologies; therefore, seasonal shifting tenure arrangements will be assessed and preliminary solutions identified through desk research and focus group discussions.

For livestock-fodder, plans are to build on the work already done in Ethiopia and expand with similar approaches in Tanzania and Ghana. For Tanzania and Ghana, this will involve finalizing intervention options, conducting focus group discussions with farmers, conducting livestock feed diagnoses with FEAST, conducting cost-benefit analyses of proposed interventions and introducing preliminary interventions with a small group of target farmers in each country. In Ethiopia the work started in Lemo/Angacha will be continued and we are extending the work to Robit-Bata.



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The key IFPRI activity in the next reporting period will be to produce baseline SPAM results for Ethiopia at a finer resolution of 1 km. This is the key input for TAMUS's SWAT and APEX models. The socioeconomics team will publish the review paper on irrigation-nutrition-health linkages and will proceed with analyzing the Ethiopia data as well as finalize contracts for survey implementation in Ghana and Tanzania.

The ex-ante SWAT analysis for Dangisita site will start in April. The baseline and ex-ante analysis for the southern sites of Ethiopia will be continued. Modeling will be initiated in Tanzania and Ghana. FARMSIM analyses will be completed on schedule at the four intervention sites in Ethiopia (Robit, Dangeshta, Lemo/Angasha and Adami Tulu).