

# Water and Food Security PIRE kickoff conference report

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**PIRE: Taming water in Ethiopia - A collaborative multidisciplinary research to improve human security in a water dependent emerging region**

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## Summary

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The Water and Food Security PIRE team launched its international research collaboration at a kickoff event in Bahir Dar, Ethiopia from July 11-14. The event included: a two-day workshop with presentations and breakout sessions devoted to the key subjects of the project: rain-fed agriculture, irrigation, hydropower, and international teaching and learning; field trips to targeted irrigated and rain-fed communities, an irrigation dam, visits with the Blue Nile Water Institute and the Abay Basin Authority; and meetings with key officials including the regional ministers for education and water resources.

Our kickoff event served as a platform where researchers, university administrators and stakeholders developed an understanding of the project objectives, discussed expectations, and identified opportunities and risks for the collaboration. Specifically, we built consensus on what the project will and will not set out to accomplish. For instance, access to reliable forecast and affordable fertilizer and accurate projections on products' market prices were mentioned as important priorities by farmers, but we clarified that the project can effectively address the forecasting aspect, while the latter could be addressed through collaboration with Bahir Dar University. Importantly, the main stakeholders renewed their commitment and several new local organizations (including notably, the President of Bahir Dar University and community leaders in potential field sites) expressed new commitment to the project. In addition, regional and federal news media outlets gave the project considerable coverage, attending some of the workshop presentation and field visits and interviewing team members.

The report presents the main action items team members will pursue in the near future, summaries of the presentations and discussions from the workshop, and descriptions of the field sites. The list of participants is presented in Appendix 1. The power-point presentations, field notes and photographs collected by the participants during the workshop will be available soon via the PIRE project webpage.

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## Action Items

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### *Funding for Ethiopian social science and engineering partners*

- Develop irrigation productivity proposal for World Bank: Prof. Boris Bravo-Ureta will contact his World Bank project collaborator to ask about using Ethiopia as a test site in place of canceled field site (would fund Ethiopian partners engaged in survey research)
- Develop economy of farming proposal for USAID: Prof. Boris Bravo-Ureta will talk with Mr. Berihun Tefera about this and possibly connect with IFPRI (would fund Ethiopian partners engaged in survey research)
- Strengthen social science training at EIWR by adding two research methods and/or substantive courses to existing tracks at the Institute: Dr Geremew Sahilu is exploring if there is interest among his colleagues at the institute in running a self-study to diagnose the lack of social science training as a problem (would fund some Ethiopian graduate ethnographers to pursue PhDs, but not necessarily their fieldwork expenses)

- Food and water security proposal to Open Society: Dr Abeje Kasegn will consult with food security institute at Addis to see if there is interest in partnering; Liz will coordinate U.S. side (fund either Ethiopian graduate study for ethnographers or a complementary project that would fund fieldwork)
- USAID PEER proposal: from the U.S. side, Prof. Anagnostou will take the lead on this and follow up its progress (would fund data collection, ethnographers, forecasting and surveys)
- USAID HEP proposal to develop a water and agriculture track at EIWR: Dr Jonathan and Dr Geremew Sahilu are working on this and it is currently under review (would fund Ethiopian graduate study for ethnographers)

***Modeling and data collection for forecast-based guidance***

- Test the models and data management systems by Dec 2018 so that the system is ready for operational use by Jan 2019. Oklahoma University will develop WedGIS platform for data dissemination and integrate data collected in situ with the various modeling tools.
- Identify high schools that are within the project area now they we have permission form regional education office to use students for data collection. Mr Berihun Tefera and Prof. Anagnostou are responsible to follow up this task
- Next summer, discuss future actions with Amhara Regional Government Water, Irrigation and Energy Development Bureau in relation to forecasting of Lake Tana level and ground water modeling

***Other relevant activities***

- Invite Bahir Dar University President to visit UConn and formalize the partnership in the framework of PIRE project. Prof. Anagnostou will prepare invitation letter and follow through this task.
- Follow up potential synergy between PIRE and Belmont research team and promote data exchange mechanisms. Bahir Dar discussion with the groups suggests there is more common interest between social scientists of each group than among physical scientists. Efforts to identify overlapping interests should be strengthened and Paul will facilitate the realization of this collaboration.
- Although irrigated and rain-fed communities that are potentially suitable have been identified, the effort to spot corresponding hydropower communities is still fluid. Make concerted effort to delineate this group in collaboration with regional experts. Berihun should lead this effort and can be assisted by Dr Block and Prof. Anagnostou.
- Focus on areas of intervention that are as similar as possible with common denominators between stakeholders, local farmers and researchers. Temptations to address issues that are beyond the scope of the project shall be resisted. Prof. Anagnostou and Dr Holzer can lead these efforts so that the project can stay on track as stipulated in the proposal.

- Coordinate with Abay Basin Authority about infrastructure in the future. Excellent conference hall and guest house facilities are in place and latest research and teaching facilities are housed in this organization. Prof. Anagnostou and Dr Mulat will follow up how best to harness this infrastructure during the project span.

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## Workshop Presentations and Q&A

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This section summarizes the main points of the workshop presentations including some of the discussion that followed the presentations. Copies of the presentations will be soon available through the PIRE project website.

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### I. Introduction: Welcome Address, Opening Address, Keynote Speeches, Project Goals

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***Project Goals: Dr. Prof. Anagnostou, Civil and Environmental Engineering, UCONN, USA***

Prof. Anagnostou opened the workshop informing participants about the project's aim to guide farmers and government agencies in the Blue Nile area providing seasonal projections on weather and agriculture/energy productivity. The overall goal of this international research endeavor is enhancement of crop and energy production in normal years and minimizing losses during climatic extremes. The PIRE research team will address its objectives by researching and developing a detailed understanding of the decision-making contexts recognizing science as human activity and part of the broader culture, understanding the nature of interactions between data producers and through identification of factors that dictate user's response to forecast uncertainty.

***Welcome Address: Dr. Bayile Damte, Bahir Dar University President, Ethiopia***

The President of Bahir Dar University, Dr Baylie, expressed his enthusiasm and support to the proposed project activities and asked researchers to address the challenge of providing useful information on water availability for their crops. He emphasized that information on the rainfall amount alone is not enough to support agricultural decisions; what is most important is how precipitation variability affects agriculture production. He emphasized that the real question is "how do you make that forecast relevant at farmer's level?" Thinking patterns of local farmers is very complex and it is here where PIRE project can make a difference. He reminded participants to think about the single most important knowledge based intervention they have in mind to bring about economic transformation of low income farmers in the Blue Nile Basin and emphasized the commitment of his university to participate and collaborate in the PIRE research framework.

***Opening Address: Nigusu Tilahun, Head, Amhara Region Communication Office, Ethiopia***

Ato Nigusu Tilahun pledged that his office will provide all the required support to the project.

***Keynote Speech: Dr. Abeje Berhanu Kassegne, College of Social Sciences, Addis Ababa University, Ethiopia***

Dr. Abeje stated that one major milestone of this project is bringing together social and physical sciences into an interdisciplinary team. He highlighted the contribution of social science through its holistic and humanistic approach and the relevance of the social and cultural context for realizing and measuring scientific impact and integrating indigenous knowledge into project design. Development and use of water is a human issue, closely linking the social sciences with the physical sciences.

***Keynote Speech: Ato Abiti Getaneh, Director, Research & Development, Ministry of Water Irrigation and Energy, Ethiopia***

The research and development director of the Ministry of Water Irrigation and Energy, Ato Abiti Getaneh assured participants that his ministry will provide the necessary support to this project. He particularly appreciated the project approach to bring together multiple stakeholders from policymakers to scientists to address the most pressing issue of the time: climate change induced vulnerability. He was happy to see the link between engineering and social science, which is in line with sustainable development framework.

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**II. Thematic Session 1: Rain-Fed Agriculture Practices and Challenges**

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Moderator: Elizabeth Holzer (Project Co-PI, A/Professor, UConn, USA)

Rapporteur: Dr Shimelis Beyene (Addis Ababa University)

***Impact Evaluation of Development Projects: Conceptual Framework and Some Implications for PIRE***

Boris Bravo-Ureta, Professor, Department of Agriculture and Resource Economics, University of Connecticut, USA

In his presentation, Prof. Boris Bravo-Ureta described the logical framework and importance of project impact evaluation and research design (DID, PSM) to accurately identify impacts that are due to project interventions. He finally highlighted the kind of data and indicators that are necessary for impact evaluation.

***Available Data and Products for Agricultural Purpose at the National Meteorological Agency of Ethiopia***

Mr Melese Lemma, Director, National Meteorological Agency, Addis Ababa, Ethiopia

NMA Director Mr Melese described the type of observation systems (manned surface, automatic, upper air, etc.), data acquisition (real and delayed) systems, data management systems (web-based AdVantage Pro); types of data generated (raw, processed, hourly, daily, decadal, monthly, seasonal, etc.) and methods of dissemination (TV, radio, web, bulletin, post, etc.). He noted the current challenges that NMA faces including logistical, human capacity and organizational problems, technical problems of equipment and software malfunction and lack of clarity on data policy.

***Rain fed Agriculture Practice and Challenges: Lessons and Challenges on Disaster Risk Management and Early Warning Information Dissemination (the case of the 2015 drought in Amhara Region)***

Amare Kindie, Deputy Head, ANRS Food Security Coordination & Disaster Prevention Office, Bahir Dar, Ethiopia

ANRS Food Security Coordination & Disaster Prevention Office Deputy Director Amare used the 2015 drought as a case study of successful disaster response in the region. He explained due to late onset and early cessation of the *mehar* rain, Ethiopia experienced the worst drought in 50 years. The eastern part of the region (with 83 woredas) was particularly affected. Different institutions including the private sector were mobilized to alleviate food and water insecurity. In addition to feed provision, food aid and water distribution, several

infrastructure development (road, pond, dams and well construction) were carried out. These interventions were monitored and supervised by various committees and task forces established at different levels, with weekly and monthly meetings and reports. As a result of these interventions, no famine and associated death was reported in this region. Still responses to drought were slow compared to its onset, due to lack of clear early warning indicators prior to the drought. The research proposed by PIRE will be crucial if it can provide long-term climate forecasts to predict disaster events.

### **Q&A**

Dr Semu Moges (for Melesse): Researchers receive data from NMA that are inconsistent and with different outliers. This has significant negative impact on national development. For example unreliable data has led to faulty design, causing culvert being washed away.

Mr Melesse Lemma: Many problems with data quality – missing, workers leave stations, infrequent recording, etc. Solution may be to set more automatic stations. Strong quality control mechanism – training. Awareness raising at community level to protect the equipment.

Dr Abeje Kasseng: Why are fewer stations in lowland areas?

Mr Melesse Lemma: Variability is small over wide area, unlike the highlands

Dr Geremew Sahilu: Farmers may be interested in soil moisture but why not recorded by NMA stations?

Prof. Anagnostou: It might be possible to do so with PIRE project.

Dr Gabriel Senay: What does it take to scale up the 55 gravity dams?

Mr Amare Kindie: Taking lessons learnt from the current dams, we plan (budget) to continue on water harvesting structure next year.

Dr Paul Block: What does it take to be proactive from DM perspective? Monitoring mentioned here are still reactive.

Mr Amare Kindie: Went over the experience they were doing during the 2015 drought. (I did not think Amare got the question clearly).

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### **III. Thematic Session 2: Irrigation Practices and Challenges**

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Moderator: Prof. Emmanouil Anagnostou (Project PI, Professor, UConn, USA)

Rapporteur: Berihun Tefera (Assistant Professor, Bahir Dar University)

#### ***A Reminder: Irrigation Now than Ever in Ethiopia***

Dr Semu Moges, Civil and Environmental Engineering, Addis Ababa Institute for Technology

Dr. Semu Moges argued that Ethiopia has experienced lower productivity largely resulting from drought and related challenges as well as limited application of irrigation. Nevertheless, a significant progress has been made recently in tapping the irrigation potential of the nation. Ethiopia has determined to confront formidable

challenges in improving human security of low income farmers and has started concrete action to reach its goal. In its project areas, UConn/PIRE can make significant contribution in this endeavor by improving prediction, communication and transfer of knowledge. It is also important to integrate forecast-based knowledge with other sectors and systems in the water-food-energy nexus especially by harnessing the storage continuum

### ***Irrigation practices and challenges in Tana Sub basin***

Mr Birlew Abebe (TaSBO)

Mr Birlew provided an overview of Tana Sub Basin biophysical, planned and implemented irrigation activities. He noted the main challenges and opportunities of the modern hydrological and basin information system and weather radar system. The PIRE project is expected to contribute to TaSBO more advanced models and methods to complement existing programs.

### ***Irrigation Practices and Challenges***

Mr Girmachew Addisu (Abay Basin)

Mr Girmachew reviewed the water resource potential of Ethiopia with explanation about rivers, basins and sub basins noting the irrigation potential of Abay River Basin. He identified several challenges: behind-schedule scheme delivery delay, low-performance of schemes, low sustainability, and lack of water shed and environmental management. He also noted lack of technical knowledge and skill, inadequate monitoring, lack of socio-economic market access. At the institutional level there is a lack of integration and coordination. There are also environmental challenges. He recommends IWRM (The Water Balancing Act, Stakeholders Integration, act early to save dams, etc.). It is crucial to consider the water source (catchment), schemes and the beneficiaries (command area) circumstances from design to implementation and evaluation stage.

### ***Q&A***

Q: Do you have practical examples for different practices of irrigation management such as input-output?

Q: What are the methods for different efficiency management?

Irrigation efficiency is measured in various ways such as land use efficiency, water use efficiency and scheme performance. It was indicated that integration aspect of water resource management presented itself as a very critical challenge, particularly in the past two decades in irrigation management in the region and involvement of beneficiaries such as local farmers were found to be very weak. Thus irrigation measurement criteria mentioned above should be integrated with other management aspects such as awareness creation among farmers, informed decision on the construction of dams, market access should be given proper attention to introduce best water resource management practices in Ethiopia. The question and answer session in this presentation was wrapped up indicating shared plan to be the pathways in which benefit can be realized and the need to implement integration from design to implementation keeping proper balance between environment and development.

Q: How do you integrate your efforts with stakeholders and partners?



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## **Thematic Session 3: Hydropower and Water Management Practices and Challenges**

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*Moderator:* Dr Paul Block (Project Co-PI, A/Professor, University of Wisconsin-Madison, USA)

*Rapporteur:* Dr Worku Mulat (University of Connecticut, USA)

### ***Hydropower and Water Management Practices and Challenges***

Dr Paul Block, Assistant Professor, University of Wisconsin-Madison, USA

Dr Paul Block suggested that the PIRE project should concentrate on short term predications at a scale relevant to farmers in the project area. Statistical figures showed the impact of natural disasters on Ethiopia staggering. Of 10 top disasters striking the nation over a period of three decades, majority were weather and climate related. Of all these disasters, flood was considered the most important factor in terms of human lives where 60 million were affected and 300,000 lost their lives. Thus the major goal of forecasting is to manage risks and disasters proactively and make changes to happen instead of responding to changes reactively. Here limitations of forecast have been acknowledged and the uncertainty becomes more pronounced as the time horizon for prediction recedes into to the future.

### ***Water Resource Management***

Dr Seifu Tilahun (Dean, School of Civil and Water Resources Engineering, Bahir Dar University, Ethiopia)

According to Dr Seifu Tilahun, data from 1973 to 2013 suggested a disturbing landscape change is occurring in the Blue Nile Watershed where cultivated land has expanded at the cost of forest and shrub lands. Efforts to reverse this environmental catastrophe has shown some promise. Nevertheless, watershed degradation is a critical challenge that need to be addressed to ensure sustainability of water resources and agricultural productivity in the Blue Nile Basin.

### ***Water-Food-Energy Nexus: with the perspective of watershed management***

W/o Semunesh Gola (Director, Hydrology and Water Quality, Ministry of Water Irrigation and Energy, Ethiopia)

W/o Semunesh Gola discussed the institutional link between the Ministry of Water, Irrigation and energy and the regional water bureaus. The Ministry has keen interest to use and promote new knowledge produced in relation to forecast technology. It will actively promote its adoption among stakeholder as soon as forecast information is made available through research. It is recognized that water resource management is a key issue for development.

### ***Q&A***

Dr Gabriel Senay, US Geological Survey: “Do farmers own water? If they don’t, where do they turn for permit to use water?”



W/o Semunesh Gola: water permit system exists. Water supply is first priority and a right for everyone, Water is free for everyone in terms of drinking and domestic use. when it comes to irrigation it is in the permit system. If you lose water go to the permit system and management. Even those who are paying for water, the cost is nominal. It is not properly priced.

For farmers whose land plot does not exceed 2 ha, water is free.

Q: What is the relation between states and Ministry of water in terms of water resource management?

A: The ministry works on the regulatory aspect not water development aspect. We integrate the basins each other. When a river system crosses a boundary river becomes under federal system. We integrate the water resource management. If a single river does not cross a boundary water right issues fall within the state boundary. The council which is accountable to the deputy prime minister gives decisions on water rights of river basins that cross state boundaries. If inter basin water transfer is required, this has to be managed at federal level.

Prof. Anagnostou: how can the Ministry benefit from upcoming PIRE project knowledge production?

W/o Semunesh Gola: Scientists should consult us what information we seek prior to launching their research project. Any research conducted based on consensus between scientists and the Ministry is likely to be adopted and implemented thus will have impact on policy decisions. Otherwise your research endeavor is apparently an overproduction that cannot be consumed. Research questions formulated by scientists should reflect the needs of the ministry as well as other stakeholders. This is necessary because the Ministry is the primary user of the knowledge produced has the mandate to check the veracity of the information and its eventual dissemination to other stakeholders.

Q: If we are about to predict drought, will you do something?

A: Yes, if drought is coming we sit down and work out what to do. We plan. For instance, there was drought in the Awash Basin. Stakeholders sat down and worked out preparation. Kokoa dam stopped releasing water based on the drought predictions of last year. If the prediction is coming to us we put different scenarios and save out waters.

Q: Are you working closely with NMA?

A: A brief answer provided was yes, we have close working relationship with NMA. NMA offers seasonal forecast service. Indeed, our first page report is based on their forecast. Nevertheless, forecast service for hydropower generation is still lacking.

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#### **Thematic Session 4: Teaching, Learning and Education: Challenges and Best Practices in International Education**

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Dr Jonathan Mellor (Assistant Professor, University of Connecticut, USA)

Rapporteur: Semu Moges, Civil and Environmental Engineering, Addis Ababa Institute for Technology

***Dr. Geremew Sahlu - Director of Ethiopian Institute of Water Resources (AAU), Ethiopia***

Geremew highlighted the role of foreign partnerships in the history of modern tertiary education in Ethiopia. Even after universities became Ethiopianized in the 1970', graduate education was still done abroad through partnerships and full scholarship supports until the university boom of 1990s. Now some graduate studies are fully owned locally. The partnerships also evolved and into specialized program for example, installing specialized equipment helping to focus research on local issues. Recent examples of such partnership include UCONN-USAID (USA), SIDA (Sweden), DAAD (Germany). The partnerships shifted from providing full scholarships and sandwich graduate studies to short visits and mobility supports for staff. Overall, despite the boom in number of Universities and increased international partnerships, challenges persist in the areas of teaching/research faculty, research facilities, and access to journals, advisors/examiners, maintaining quality of education and unequal partnership. Win-win partnerships and joint education/research in specialized areas are still important to provide research based solutions to the society in Ethiopia.

***Dr. Mulunesh Abebe - Vice President, Bahir Dar University, Ethiopia***

Bahir Dar University from its onset is a result of international collaboration. Currently, it has 80 international collaborations of which 10 is with USA institutions. It has 2000 academic and 4000 administrative staff. The total number of students attending regular and continuing education programs reaches 52,000. The partnership with Cornell University in Integrated Watershed Management is one of visible programs in the University. It has produced a number of PhD and M.Sc. students. The research is focused and addresses specific issues and has become the flagship of the University. We are interested in such types of partnerships that contribute to our University by offering short term PhD development, infrastructure development, increased knowledge, institution-based sustainable collaboration. Some of the challenges of partnership from the Universities experience include: lack of clear strategy for forming effective partnership; lack of modalities of partnership; lack of formal institutions for different forms of collaboration; different working systems (e.g. different financial system).

***Dr. Elizabeth Holzer - Sociology Department, University of Connecticut, USA***

Dr. Elizabeth highlighted some of the challenges to international education in the project including challenges of transferring funds, language barriers, and pedagogical differences between US and Ethiopian Institutions and students. Notes that NSF is generally interested to educate U.S. students and will need to continue to find other sources of to support Ethiopian students.

***Q&A***

Liz: Should we also encourage young high school and summer undergraduate students' involvement in the project?

A: There is experience of young students involvement from Addis Ababa Institute of Technology (AAiT) during the USAID based UCOON-AAU partnership. Both Bahir Dar University and (Ethiopian Institute of Water Resources) EIWR have community outreach services and can build on existing programmers and services. There is little interaction with private schools. Largely, the experience of involving young students is

from public schools. however, Bahir Dar University tries to engage in training for private sectors to develop their skills.

Q: Is there university-industry linkage?

A: The linkage exists and promotes skill development and consultancy with all sectors in the country. For instance, the Institute of Textile of the University works closely with the Bahir Dar Textile University and other local and international textile companies in the country.

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## Breakout sessions

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### *Physical sciences*

Participants: Prof. Anagnostou, Birlew Abebe, Dejene, Dr Asegdew Gashaw, Dr. Block, Dr Semu, Dr Gabriel, Dr Emad, Girmachew Addisu

The main focus of discussion was on the models, scales of application and data requirements. Based on this meeting a consensus was reached in that three Ethiopian organizations (NMA, ABA and Bahir Dar University) will contribute *in situ* hydrometeorological data based on sensor networks that are operating under these organizations. These datasets are summarized in the data requirements of slide 4. Based on follow up emails from both NMA and ABA the availability of these data has been confirmed. In terms of models, breakout session participants identified the following resources that are in our disposal:

- A watershed and groundwater model developed by a UConn Post Doc with the help of a research scientist from CEE,
- A crop yield model developed and implemented by a UConn graduate student (Engineering)
- A seasonal forecasting downscaling technique developed by a graduate student in Paul Block's group (UConn will provide the data needed for building the seasonal forecasts)
- A high resolution ET model developed by USGS and supported by a UConn graduate student, Gabriel will play a major role in providing access to this model.
- Implement Agent Based Model using data from Jon's graduate student. Jon will be responsible to follow up this activity.
- Develop an economic model based on Paul's graduate student and IFPRI. Paul Block is delegated to oversee this project.

All these models will be integrated based on a WebGIS platform to be developed by OU. The platform will be handling data (stream flows measurements) uploaded by local high school students and farmers from Ethiopia and disseminate forecasts to Ethiopian stakeholders. It will be able to accept requests by local farmers via SMS or requests using GIS from more advanced users and send tailored forecasts back to the farmers.

The models and data management system will need to be developed and tested by Dec 2018 so that the system is ready for operational use by Jan 2019. The engineering students working on the system will need to collaborate with graduate students from Bahir Dar University and with engineers from ABA. Seifu and

Girmachew can serve as contact persons in the two organizations in that order. These students are expected to be stationed in Bahir Dar for sufficient time testing the models and training local students.

The president of Bahir Dar University and ABA have expressed interest to implement PIRE project models in their computers and train graduate students from that university.

### ***Social Sciences***

Participants: Elizabeth, Boris, Shimelis, Geremew, Jon, Abeje, Berihun, rep from intentional community

The major goal is to create action plan to raise funds for Ethiopian social science collaborators in the UConn/PIRE project.

### **Action items:**

Develop irrigation productivity proposal for World Bank: Boris contact his World Bank project collaborator to ask about using Ethiopia as a test site in place of canceled field site (would fund surveys)

Develop Economy of farming proposal for USAID: Boris will talk with Berihun about this and possibly connect with IFPRI (would fund surveys)

Strengthen social science training at EIWR by adding two research methods and/or substantive courses to existing tracks at the Institute: Geremew is exploring if there is interest among his colleagues at the institute in running a self-study to diagnose the lack of social science training (would fund some ethnographers to pursue PhDs, but not necessarily their fieldwork expenses, which could be paid as translators)

Food and Water Security proposal to Open Society: Abeje will consult with food security institute to see if there is interest in partnering (fund either graduate study for ethnographers or a complementary project that would fund fieldwork)

USAID PEER proposal: Manos will take the lead on this and follow up its progress

USAID HEP proposal to develop a water and agriculture track (Jon and Geremew are working on this and it is currently under review)

Water Productivity in Irrigated and Rain-fed Agriculture in relation to specific scheme in Ethiopia

The overall objective is to measure and analyze Total Factor Productivity as well as water productivity.

Data: Random selection of WAU or farmer Cooperatives. Randomly allocate these to control or treatment. Then select subgroups and proceed to the random selection of farmers to be interviewed. The treatment will be the provision forecast information. The random selection of farms will be done considering farm location (head-tail) with respect to the tertiary canal in order to insure variability in water variability.

Sample size to be determined based on power calculations as well as budget availability. Water delivery needs to be measured at the farm level (needs instrumentation). ET would be calculated at the farm level on a monthly basis during the growing season based on satellite images. One measure of water use could be: Water derived from ET/Total water delivered/applied. Stochastic production frontier models will be estimated to measure and analyze total factor productivity, technical efficiency, water productivity and water shadow values.

***The Economics of Farming Systems under Alternative Water Scenarios with regard to specific Scheme in Ethiopia.***

The objective is the measure the profitability of alternative crop production plans under varying assumptions concerning water availability.

Economic Engineering methods will be used to construct a set of representative farms for different agro-ecological-climatic areas. Simulation techniques are then used to evaluate alternative scenarios. The data to construct the representative farms could be secondary if no farm surveys are implemented or primary if survey data are available. In the latter case, the primary data could be combined with secondary sources.

An additional related activity would be to establish experimental plots on selected farms to measure the impact of recommended management practices, developed by Bahir Dar or other local institutions, compared with actual farm level practices. The farms where the demonstration plots would be established could be consider as leaders and help in working with other farmers. A complementary strategy would be to establish a working relationship with a few larger commercial farms, similar to what is being done in Malawi by the PMIL. In the latter, the larger farms not only provide the land for the trials but also labor and other inputs in exchange for the know-how generated.

***Issues that need to be resolved***

Identify the communities where we will work and where the survey data would be collected. If survey work is to be done, then we need to procure funding. As a first step, we need to prepare a budget for the fieldwork.

Define the farming systems for the different agro-ecological-climatic locations, the agricultural calendar for the various farming systems, and for irrigation vs. rain-fed systems.

Determine a timeline for data collection. As always, both alternatives have pros and cons. However, there appears to be a preference towards option number 1 indicated above.

**PIRE Kickoff conference closing remarks**

Following the breakout sessions, Dr Asegidew Gashaw, Director of the Blue Nile Institute was invited by Dr Semu Moges to make a closing remark. In his speech, Dr Asegidew underlined the importance of the research project to the region and the keen interest of Bahir Dar University and his institute

in particular to forge a strong partnership with the PIRE team throughout the project life. He pledged to prepare his staff and coordinate research in both social and engineering aspects of the project. With this brief remarks he declared the two-day UConn/PIRE kickoff event held at Delano Conference Hall, Bahir Dar was closed on July 12, 2016 at 5:00 pm.

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## Field Visits

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This section summarizes the visits to potential research sites that took place between 13<sup>th</sup> and 14<sup>th</sup> of July 2016.

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### ABA field office, Koga reservoir and irrigation scheme

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Participants: UConn/PIRE team, ABA experts, and ABA night storage managers

7/13/2016

The objective of the field trip was to understand the benefits and challenges of irrigating communities in Koga scheme. The team was introduced to the Koga dam and irrigation management by Girmachew Addisu (senior irrigation and drainage monitoring specialist, ABA). A briefing on the scheme and irrigation water management was provided by Tamene Dagnaw (Scheme Manager) and Habtamu Tamir (director, water resources administration directorate).

Agriculture is the largest economic activity in Ethiopia but the productivity of agriculture here is one of the lowest in the world, making food security a serious problem for a country with a fast growing population (Reynolds, 2013). The Koga Dam is a key project for the Ethiopian government, as a step towards achieving food self-sufficiency at both national and regional levels for a country that has a history of draughts and famine. If this project succeeds, it will be a model for projects to come and proof that dams and water management can bring change to the region, particularly concerning food security (Reynolds, 2013).

**Site description (Koga dam):** Koga dam is located about 21 miles from Bahir Dar and about 4 miles from Merawi town. The dam was commissioned in 2001 and has a reservoir capacity of 3.1 million m<sup>3</sup> of water. Abatneh Ashenif, Nile Basin authority coordinated basin development and protection Directorate Director, informed visitors that the dam is served by 12 canals and has 40 controls where the water use is determined with unions and cooperatives. It took 5 years to complete construction of the dam and has high irrigation capacity although the amount we release so far is below its designed capacity. With the exception of 2015, all farmers were receiving enough water for their plots which is estimated to be 2 ha per household. The reservoir fills every rainy season except 2015 which was attributed to the *El Nino* effect. Reservoir release occurs in September and ends in middle of May. According to Habtamu, the reservoir administrator, when water release stops in May the crop completes its life cycle using the rainy season. Koga is considered a development corridor in the country and there is ample data related to the dam carried out by consultants.

### Q&A

Q: Is operation of the reservoir dependent on weather forecast? Do you know the exact amount you release per plot?

A: Roughly weather forecast is used to make decisions, but the amount of water that has been productive per plot is not known.



Q: Is flooding a problem in operating the reservoir?

A: The reservoir is designed to adjust flow releases through the dam gates and the spillway, hence upstream flooding has never been a problem.

Q: How do you manage water distribution to farmers?

A: Water is released for individual farmers turn by turn. They also make arrangements among themselves to exchange water. We pass on information to let them know about water releases.

Q: Do you make water availability decisions without scientific information?

(The answer provided for this question were not satisfactory, suggesting that water managers can benefit from improved forecast service from the PIRE project).

Contact list of experts working on the Koga dam is provided below:

No	Name	Mobile	Email	Position
1	Simeneh Fitalew	+251918728918	simeneh.2000@gmail.com	Kogga water shed management and livelihood focal person ABA
2	Habtamu Tamir	+251918781822	habite1985@gmail.com	Water resources adiminstration ABA
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### **Closed Irrigation and Open irrigation Community Visit**

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Participants: UConn/PIRE team, ABA experts, and ABA night storage managers, agronomists, water user team leaders, irrigation water user community

7/13/2016

Koga Irrigation Project (Closed Community)

Koga Irrigation and Watershed Management Project is a major government initiated development project in the area with a goal of improving livelihood of farmers through the provision of large-scale irrigation scheme. Both the feasibility and technical proposal for Koga watershed management and irrigation development was conducted between 1992 and 1995 and financed by African Development Bank (ADB). The project started with the construction of infrastructure in 2002 and completed in 2010.

The project is located some 35 km southwest of Bahir Dar within the Koga watershed Mecha Woreda of Amhara National Regional State, Ethiopia at latitude of 11° 10' N to 11° 25' N, and longitude of 37° 02' E to 37° 17' E. The Koga River is a tributary of Gilgel Abay River in the headwaters of Blue Nile that drains to Lake Tana. The reservoir has a capacity to impound a total volume of 83.1 million m<sup>3</sup> of water at full supply level by inundating 18.56km<sup>2</sup> to irrigate 7,000 ha command area. The project has affected seven Kebeles with 5000 households. The overall objective is increasing agricultural production through three harvests per year instead of one. The Koga project area covers an extent of 10,000 ha of which 7,000ha is Irrigation area. The project was also envisaged to improve rain-fed agriculture, forestry, livestock, soil conservation, and water and sanitation on 22,000 ha of the upstream catchment area.

The mission of the NSF research project was described to farmers through translators and local project team members. The farmers appreciated the NSF/PIRE research team for their initiative to improve their life through research. They are keen to cooperate and actively participate in the project. The research team posed several questions to each farmer group (women and men separately). While each research team member may have noted down the discussion from their perspective (social and physical science perspective). One thing that stood out from the irrigated farm field trip was their identification of top risks as market prices and fertilizer prices. Water issue was a lower priority for the community, presumably because they have access to irrigation. Nevertheless, forecasts of irrigation allocation will still be useful, but one has to be very careful not to over-promise, that is, PIRE project may not be able to address the market and fertilizer aspects. However, it will be exciting to explore the agricultural modeling aspects, and look at this in some detail, but the decisions may be more about land allocation and preparation vs what to plant for irrigated farmers. This is in contrast to the rain-fed farmers who face entirely different decisions such as what crops are suitable for the particular rain season.

The farmers' responses to how they compare the irrigated communities (themselves) to the neighboring non-irrigated communities was very clear from both men and women. Their children are relatively well fed, they are well dressed, and they even rent dormitories in towns and send their kids to better school. They have money in banks and they are generally well off than the non-irrigated community (rain fed). One of the reasons is they produce at least twice a year. The main challenge the irrigated communities have is lack of market access and low prices due to the interference of middle men merchants in the market chain. They don't have direct access to markets; as a result, they are obligated to sell to middle men with low prices. This lack of sustainable market access significantly affected their income even at the time good harvest in the country. The NSF team asked farmers questions about the importance of seasonal prediction and early warning system issues. The question was, if the research team comes up with a new prediction tool and provides advance information about how much water will be in the Koga reservoir in each season how do they get benefited from it. The farmers' responses were prompt and unambiguous – they wouldn't have wasted their energy and resources to prepare and plough the land only to be told to cut their farming land by half due to drought induced water deficit. If they were informed early one that drought is setting (that there would be less water in the reservoir), they wouldn't have wasted their energy and resources. In addition, the farmers expressed their concern in the 'irregular reservoir operation policy' as presented in their own words. They described that sometime they have cases of plenty of water returning to the river and in other time they face water shortage around the boundaries of the irrigation scheme. The farmers concluded that if they can get advance information sometime in July or beginning of August (few said even in June) about the status of water availability, they can be part of the decision to determine the size of the farming plots, type of crop and water use without wasting their efforts. The

farmers were asked the selection of fertilizer – they were not so much enthusiastic about it. They said, they receive the same type of fertilizer at all the schemes at extra-ordinary cost. They have little choice on the type and amount of fertilizers. They are rather worried on the increasing cost than the type and amount of fertilizer they use.

### **Discussion with women group**

Women who came to the meeting were mothers. They expressed their regret for they are not born at this time when they see all their daughters are attending school.

Although there might be other contributing factors, irrigation appears to have contributed in improving the standard of living. Accordingly, some claim they are saving cash in the bank and have improved housing conditions. Nevertheless, women involvement in irrigation activity is limited. It is still largely the domain of men when it comes water use decisions. In general, women are not actively involved in

**Management and use of irrigation.** This is clearly the case when one considers the fact that there was just one young woman who is represented in the committee. How is selection made to represent women group? Women responded to this question saying that they were there in the meeting because they were told to do so. That is how officials order the community to participate in any meeting.

What is the word they use to describe forecast? It appears women do not know much about it but they generally think it is a natural phenomenon they have very little control over it. Despite they fail to name what a forecast is they are willing to use any future forecast information available to them.

Regarding to the question where the rain comes from, two opinions prevailed. A lady with tattoo who is older than the rest of the group said she has no clue about it. But younger ones have some sense of rain and its origin. They said through observation of clouds in the sky, they can predict the coming of the rain.

When asked if they are willing to participate in science and allow their school age children to participate, their response was positive: they are willing to participate. During the meeting, everybody was seating around the building using the raised platform as a seat and in the shed. We have noted that all women were seating near each other why? That is culture. Women are comfortable to seat with fellow women. It is difficult for a woman who has a husband to seat next to a gentleman; she prefers to seat close to another woman. Except one woman in the meeting, most of them are within their 20s. Do you have a sense of how many they were? Probably 7 or 8. What else should we remember? (Dr Elizabeth Holzer)

(Dr Abeje Kasegn) We asked them “What plans do they have if they get more water through irrigation?”

One of the things they would do is to grow more onion and sell at better prices and improve their income. Because of lack of sufficient water access, they are forced to grow potato and wheat that do not attract good prices.

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## **Visit to Open Rain-Fed Agricultural Community**

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**7/14/2016**

### **Awra Amba (open rain-fed agricultural community)**

This community is located in Gindenewur watershed about 38 miles North of Bahir Dar town with elevation 1892 m above sea level and a size of 766 ha. The community has approximately 500 members and was founded in 1960s by its visionary leader called Dr. Zumra Nuru. Zumra (Honorary Doctor), who revolted against the unfair labor division between the sexes. The community has unique religious and burial practices that put it at odds with nearby communities, but it has thrived nonetheless. Land is communal, but each member of the community has the right to own livestock and supplement his income. Environmental degradation is rare unlike adjacent land masses. For the aged and sick members, they provide pension scheme. Zumra expressed the willingness of his community to use scientific information to improve their livelihood and open to progressive ideas provided that there is no intent to lead them in a direction they are not willing to go. Unlike conventional Ethiopian communities, they are willing to embrace formal science. Therefore, the community is a good candidate to test adoption of new mobile-based weather forecast data and also to participate in citizen science for collecting hydro-met parameters.

Bahir Dar University has recorded detailed hydrological and weather data in the area including 40 piezometers, 40 soil moisture probes and 5 rain gauges. Data were collected for a period of three years (2012 through 2014), but these stations are temporarily suspended monitoring due to financial constraints for field work. This may be an opportunity to initiate new round of monitoring for PIRE project.

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## **Visit to Open Irrigated Agricultural Community**

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**7/14/2016**

### **Chihona Block Command Area Water user association**

Team members had a good discussion with an excellent group of farmers. Particularly, Ato Hunegnaw was very reflective, measured and thoughtful. Responding to a myriad of questions from farming practices to climate information, to market access, they seem to understand the benefit of scientific information and are willing to cooperate. But their issues are too many and climate information is only one of many to be addressed.

As it is commonly known, agriculture obeys Liebig's law of the minimum where one of the key limiting inputs will determine the overall outcome. Thus, our research may have to take into consideration the following points: (1) identify the major limiting factors in the study region, (2) layout an experiment to quantify the contribution of climate information in water management decision and improved productivity.

When we go to the specifics, the farmers certainly see the benefit of climate information for land preparation, fertilizer and other chemical applications, weeding etc. For example, farmer differentiate between dry plowing vs wet plowing depending on crop type. Corn field is apparently plowed when soil is dry but *Teff* field are plowed under moist or wet soil moisture conditions. Knowing short term rainfall forecast can be beneficial for such planning purposes.

Furthermore, issues related to irrigation scheduling and duration (cut-back approach) seem to be based on a broad guidance that does not seem to vary by crop or soil type. Issues on market access, information on appropriate fertilizer type and prohibitive costs seem to be a huge challenge that need to be overcome. These issues will remain confounding factors in measuring the positive impact of improved climate information. From the field visit it was observed that the potential hazard associated with fertilizer use and chemicals for pests and weeds and their impact on their water resources and health seem to be unknown.

**General comment:** Real problems that threaten agricultural productivity mentioned by the community largely fall beyond the scope of UConn/PIRE project. This include market linkage problems, agricultural inputs and selected seeds. However, expert support and forecast services were also indicated to be in great demand by the community and hence the project can address these concerns during its implementation phase and take this factor in to account when trying to measure the impact of forecast technology on improving livelihood of target communities.

#### **Discussion with Yewuha Abat (father of water) traditional irrigators**

Bered traditional irrigation scheme is located around 30 km from Bahir Dar and about 1 km from Merawi town. The Bered diversion system is the only irrigation structure that is made of concrete in the area. It was built with the help of the Amhara development association. Their water is diverted from the Bered River. A number of grafting of various fruits is taking place in this scheme. There are 7 committees and 69 members in this scheme. Meeting takes place every September and members contribute money to sustain the irrigation activity. Water is distributed on weekly basis for members. If one of the members breaks the law, for instance, deliberately sabotages the crop planting activity of another farmer, he will be penalized. Three copies of the bylaws are submitted to the *Woreda* authorities and thus the law is official. They have no access to modern forecast information service and rely on indigenous knowledge to recognize the arrival of a rain through watching the formation of clouds and wind directions. If modern forecast service are provided, they are willing to implement the information.

**General comment:** These group of farmers seem to be very enterprising in making the best of out a diverted stream to grow fruits and seedlings through a grafting technique. Their main concern seems to be limited access to water. Their irrigated area extent depends on the supply provided by the diverted stream. They are willing to invest/allocate more land to store the summer rains/runoff for use during the dry season. This requires land for reservoir(s) and a pumping/canal infrastructure.

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## Interviews with Potential Collaborators

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This section reports on interviews with potential collaborators, primarily key officials whose offices provide important resources or audiences for PIRE

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### Abbay Basin Authority (ABA)

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7/14/ 2016

The PIRE team met with Mr. Yewondwosen Mengistu the Director General of ABA who expresses the keen interest of his organization to build hydro-climatic geodatabases for the Abbay basin. They are in their early stages transitioning to new offices and developing a comprehensive IT system for data and information management. Following the round table discussion, the NSF-PIRE team was invited by its Ethiopian counterparts to visit the new building equipped with modern facilities such as conference hall (finishing work), laboratory spaces, offices, a new hydrological and basin information center equipped with state-of-the-art computer servers as well as guest houses. From the brief visit and discussion with the ABA personnel, the team has noted that ABA conference hall, guest houses and laboratory facilities constitute an excellent infrastructure that could be used by PIRE project in future visits including hosting workshops and meetings, and conducting research and training activities.

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### Amhara Regional Government Water, Irrigation and Energy Development Bureau

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7/14/2016

The bureau head delegated his deputy who welcomed the team. In the end the following areas of interest were identified as common denominator between the PIRE team and the water, irrigation and energy bureau: (1) We can look at our ability to predict Lake Tana level in response to seasonal and inter-annual variations; (2) PIRE project can develop ground water modeling provided that the bureau provides us with data; (3) Bahir Dar and AAU students may collect data; (4) Future actions will be discussed next summer here in Bahir Dar. Two hydropower units, namely, Tis Abay and Tana Beles were discussed during the meeting. Tana Beles is working by water transfer from Lake Tana. There are 18 boreholes that are serving water demands of the community. Participants inquired whether climate change is affecting Lake Tana where the answer was an astounding yes. Typical example mentioned to corroborate this claim was the drought of 2015 where the Lake depth was too shallow in some regions and seriously impeded navigation.

Prof. Anagnostou briefly described the PIRE project with particular emphasis on the forecasting part. The primary objective of forecasting is data provision associated with crop yield. Some of the forecasts are at longer time scale. Downscaling of information and modeling will be developed in the framework of the project. Agriculture and hydrological data will be obtained from the bureaus and made available for use after analysis. Farming community involvement, mechanism of adoption will be assessed. Rain fed agriculture: fairly detailed modeling of temperature forecast and surface water modeling. We also will consider high school teaching. The bureau representative told us that ground water pumping costs are staggering and has to be subsidized by the government. In answer to the question of whether depletion of ground water a problem in the Nile basin, he said that last year it was a problem. The boreholes have to stop pumping for about 4 hours to recharge. Normally they are operated for 16 hours a day.



Q (PIRE): Thus modeling should emphasize on surface water except we may consider both in special circumstances. Do you measure the chemical and bacteriological quality of the water?

A: Yes, we do. At times we find iron content of 35% and the boreholes have to be abandoned. Unless blind casing is made, shallow wells are liable for bacterial contamination from nearby sources.

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## **Amhara Education Bureau**

**7/15/2016**

The PIRE team raised the idea of using high school students to collect simple hydrological data. He asked the group what benefit the schools will get in return so that your proposal to use our students for data collection is justified. It was explained that students will gain scientific data collection experience, cultural exchange between the research team and students, as well as promotion of citizen science among school community were some of the tangible gains from the collaboration. Simple hydrologic measurements, soil moisture and may be done once in a week. We will train two three students for the same job. The director gave his full support for the project and the following consensus points were recorded: (1) There are close to 400 schools to choose from. Identify the schools by Woreda and Kebele that are located in the project area. Once we select *Woredas*, zones and *Kebeles* the ministry will provide us with the list of schools in that region; Berihun is tasked to follow up this action item; (2) Plan your field work from September until the end of the academic calendar to avoid summer vacation (we need them during dry season and will schedule our activities according); (3) Help the schools involving in your project to have access to electronic/digital library.

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## **Meeting with Bahir Dar President and University Officials**

Participants: Prof. Manos Anagnostou, Dr Baylie Damtie, Dr Mulunesh Abebe, Dr Gabriel Senay, Mr Berihun Tefera, Dr Desalegn Mola, Dr Embiale Beyen, Dr Gedif , Dr Fikreselam Gared, Dr Semu Moges, Dr Shimelis Beyene

7/13/2016

The President expressed a strong interest to engage his university in the PIRE project by: (1) engaging faculty from engineering and social sciences; (2) engaging graduate students funded by Bahir Dar university; (3) supporting travel expenses for short visits of Ethiopian faculty and student to UConn; (4) supporting UConn faculty willing to visit and teach at Bahir Dar university contributing lab space and data through the Blue Nile Water Institute. In return he asked for knowledge and technology transfer; he requested that we make an effort to implement the forecast models developed in the framework of PIRE in Bahir Dar university computers. He also proposed the establishment of a Weather Radar Training Center in collaboration with NMA. Apart from advising students and teaching a course, Dr. Baylie Damtie is very interested in specific projects especially mapping groundwater potential and flow directions that incorporate social scientific investigation because he sees it as more likely to change behavior in a productive way. He is committed in supporting a student and



collaborating with the PIRE group on this and others. The Bahir Dar University President will be invited to UConn to formalize and concretize these collaborations.

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### **PIRE and the Belmont group meeting**

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**PIRE and Belmont project PIs/co-PIs:** Prof. Manos Anagnostou, Dr Paul Block, Prof. Benjamin Zaitchik, Dr Belay Semane, Prof. Detlef Mueller-Mahn, Prof. Gianni Gilioli, Prof. Andrea Sciarretta

7/15/2016

The main goal of the meeting was to exchange information on the objectives and general methods of each project focusing in the Blue Nile basin, and to understand how each group could take advantage of these synergies in any strategic way. In the round table discussion we explored synergies by coordinating research activities between the two groups. It is noted that both PIRE and Belmont are planning to work in the Koga irrigation scheme. Thus, it is critical to develop an understanding on how to implement the projects to avoid duplication. For the farm-level data collection efforts two alternatives were discussed: (a) implement a similar survey in different areas of Koga. The surveys would have some common modules while other modules would be targeted specifically to the needs of the respective projects; and (b) implement the same survey jointly and create synergy between the two research groups. Although common interest prevails in collecting and sharing data, both groups have indicated that there is funding constraint to support extensive survey in the project area. There is a potential for strong synergies between the PIRE and Belmont projects, and makes sense for each to track the other a bit. Paul Block will handle this task. The social science parts should be shared, but expectations for coordinated surveys, etc. are low as each team is really after different objectives (For instance, Belmont is more about social understanding and change and requires less participants, PIRE is likely to go for larger household survey type data understanding farming practices and decisions.)

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## Media coverage

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The UConn/PIRE kickoff conference received considerable media attention from both regional and federal mass media outlets. Interviews were made for both US and Ethiopian researchers as well as stakeholders. Both English and Amharic languages were used for the interview and many of these were broadcasted live on national TV stations. UConn/PIRE team used the occasion to inform viewers UCONN and PIRE commitments towards realizing water/food and human security in Ethiopia and the value they placed in knowledge transfer and cultural exchanges between the peoples of the United States and Ethiopia. Further information can be obtained from the following links:

**Web Links of the news:** Ethiopian News Agency:

- July 12, 2016: <http://www.ena.gov.et/index.php/economy/item/5593-2016-07-12-22-13-51>
- July 15, 2016: <http://www.ena.gov.et/index.php/economy/item/5704-2016-07-15-23-18-05>
- July 18, 2016: <http://www.ena.gov.et/index.php/component/k2/item/5766-2016-07-18-20-15-41>

## Appendices

Conference pictures:



Flight to Bahir Dar



First day conference at Delano Conference Hall, Bahir Dar (7/11/2016)





Partial view of PIRE kickoff conference participants at Delano Hotel, Bahir Dar (7/11/2016)



Dinner at the Lake Tana shore, Bahir Dar





**Traditional music in Bahir Dar**



**Picture with Dr Zumra, leader of the Awramba community (7/14/2016)**





**Visit to an Ethiopian family (7/14/2016)**



**UConn/PIRE team discussion with the Belmont project group, Delano Hotel Conference Hall (7/15/2016)**





**Breakout session (7/12/2016)**



**Koga Dam visit (7/13/2016)**





**Discussion with irrigation community**





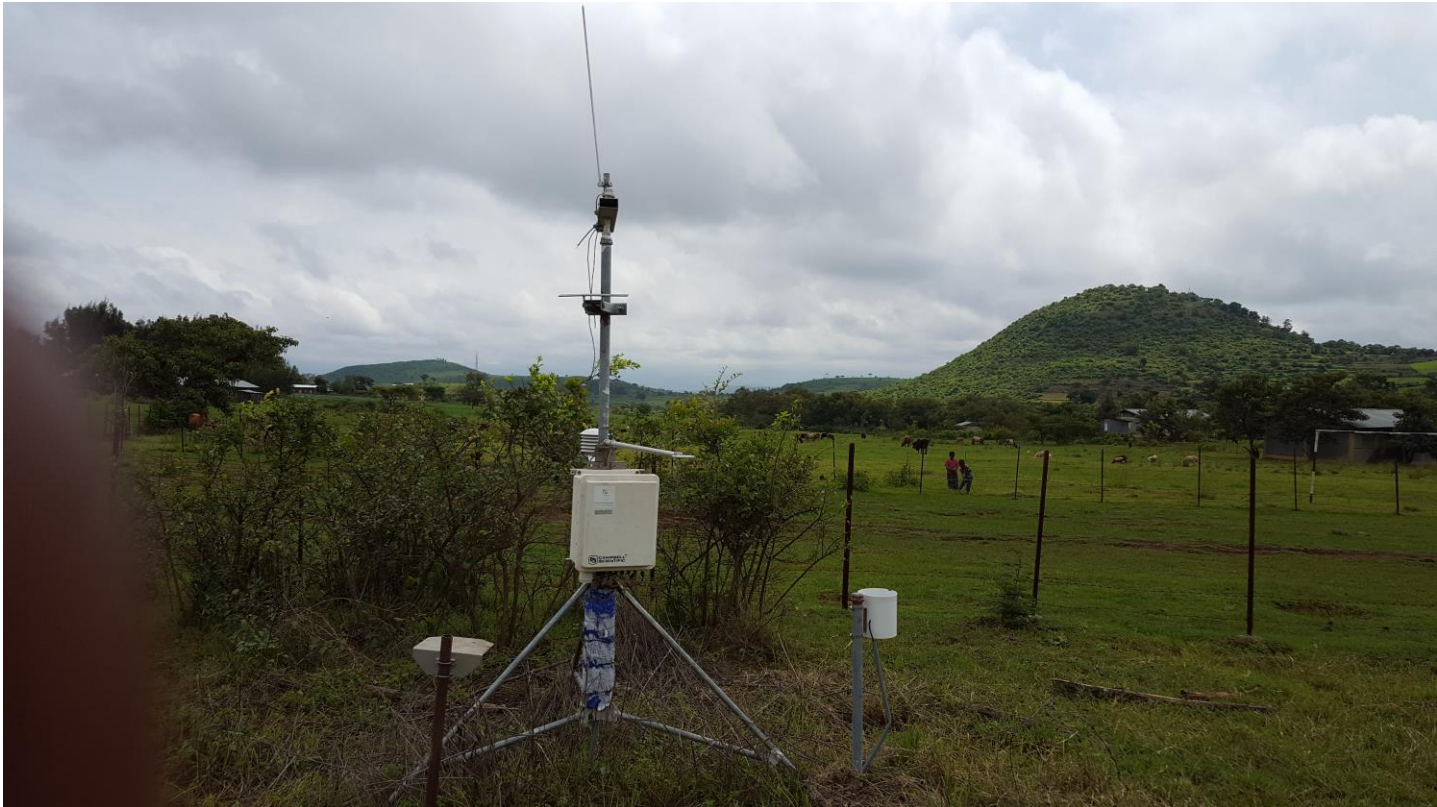


**Village effort to diversity income using traditional water use**



**Rain-fed agriculture visit**





A meteorological station at one of the rainfed agricultural sites.

**UCONN/PIRE kickoff conference participants list, July 11-14, Bahir Dar**

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