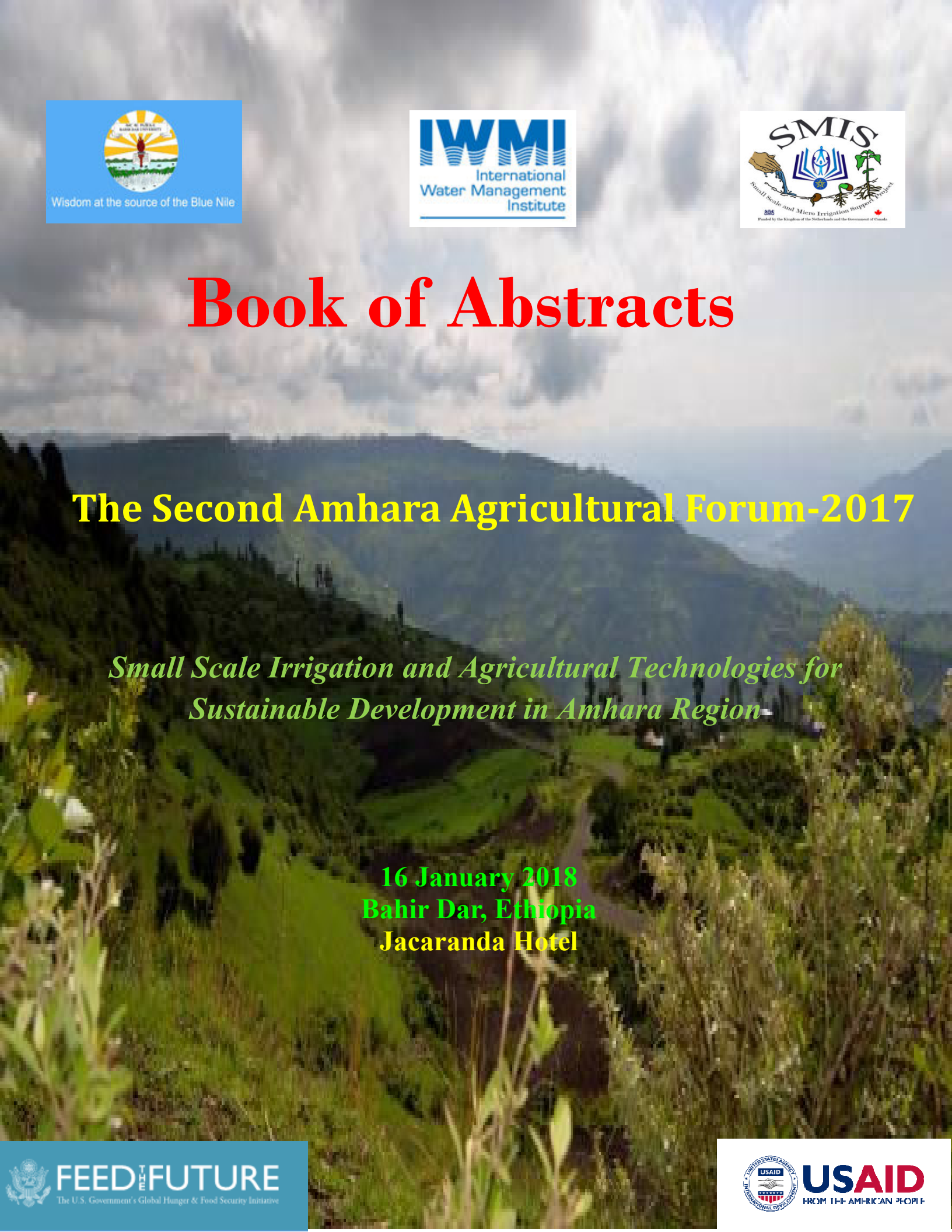

Book of Abstracts

The Second Amhara Agricultural Forum-2017

Small Scale Irrigation and Agricultural Technologies for Sustainable Development in Amhara Region

16 January 2018
Bahir Dar, Ethiopia
Jacaranda Hotel

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

USAID
FROM THE AMERICAN PEOPLE

The Second Amhara Agricultural Forum-2017

Book of Abstracts

Bahir Dar University and SMIS
In Collaboration with IWMI

16 January 2018

Bahir Dar, Ethiopia

Jacaranda Hotel

Edited by
Dr. Seifu A. Tilahun (BDU-BIT)
Dr. Mamaru A. Moges (BDU-BIT)

Wisdom at the source of the Blue Nile

IWMI International Water Management Institute

SMIS Small Scale and Micro Irrigation Support Project

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

USAID FROM THE AMERICAN PEOPLE

Contents

About the Forum

In Ethiopia agriculture led industrialization based economy policy has been employed as an engine for growth. The aim of this policy is to increase the production and productivity of smallholder agriculture to ensure the household level food security and generate capital from export earnings of agricultural products, as well as paving the way for industrial development through supplying adequate, high quality and cheap raw materials for agro-processing sectors. This means that government will increase investments in agricultural development activities, research, extension services, and boost or modernize agriculture for sustainable intensification.

Sustainable agricultural intensification needs strong network between research and extension organizations and agricultural sector. In the context of Ethiopia and the Amhara regional state, the agricultural research and extension system is characterized by a large number of actors in a fragmented and underdeveloped innovation system, resulting in very low national and regional innovation capacities. Farmers are generally viewed as passive recipients of technology. Hence innovative research outputs doesn`t reach to the ground to change the farmers life and remain shelved. Part of the solution is to create a platform such as forums which would connect researchers with different sectors responsible for agriculture and related development.

The Amhara Agricultural Forum (AAF) is an inclusive regional platform that enables all those concerned with the sustainable intensification of agriculture in the Amhara region to bring together and address key regional needs. AAF will provide an open forum for stakeholders across the agricultural spectrum—from researchers and organizations to farmers—to participate in collaborative discussions and actions around the current and future state of agriculture.

The 1st Amhara Agricultural forum was conducted on 8 December 2016 and was jointly organized by SMIS, AgroBIG and One Acre Fund. One of the outcomes of the workshop it was to continue the Forum. Hence Bahir Dar University Bahir Dar Institute of Technology has taken the initiative to organize the 2nd Amhara Agricultural Forum with SMIS on 16 January 2018.

The 2nd Amhara agricultural forum is, therefore, the continuation of the previous forum to share project results, plans and research and explore the potential for future collaboration in the Amhara region. The forum will have presentations from a variety of organizations working in Amhara with the topic such as rain-fed and irrigation agriculture, postharvest, agricultural mechanization and agricultural intensification, agricultural inputs, environmental pollution, and watershed Management for food security.

Special thanks to Small scale & Micro Irrigation Support (SMIS), International Water Management Institute (IWMI), and Innovation Lab for Small Scale Irrigation (ILSI) of Feed the Future program of USAID for funding the forum and contribute important research results.

The 2nd Amhara Agricultural Forum Organizers

Dr. Seifu A. Tilahun (BDU-BIT), Dr. Mamaru A. Moges (BDU-BIT) and Frank van Berkom (SMIS)

Implementation of Appropriate Scale Mechanization in Amahra National Regional State

Yonas Mitiku Degu[1], Sisay Gremew Gebeyehu[1], Fentanesh Abate[1], Solomon Tekeste[1], Chalachew Emirie[1]

[1]Bahir Dar Institute of Technology, Bahir Dar University, www.bit.bdu.edu.et
*e-mail: yonasmitiku2000@yahoo.com,

Abstract

The aim of the Appropriate Scale Mechanization Consortium (ASMC) project was to improve the livelihood of smallholder farmers and reduce their poverty. This has been planned through introduction of multifunctional and modular mechanized technologies that are technically, environmentally, and economically appropriate for use by smallholder farmers. ASMC was focusing on sustainable mechanization practices with draft animals and small 2-WD tractors with an emphasis on tillage, seeding, weeding, and shelling technologies for maize that can be readily transferrable to other cropping systems. The scope of activities includes technology development, prototype testing and evaluation, train-the-trainer sessions for local extension and technical service providers. On-farm evaluation and artisan training for local manufacturing and marketing of technologies, tools and custom services were also part of the project. The ASMC has established three Innovation hubs, in West Gojam Zone of Amhara region, to serve as entry point. These innovation hubs are located at Bure, Dangla and Bahir dar Zuriya Woreda. In these innovation hubs, baseline survey has been conducted to assess mechanization challenges and opportunities so as to support the decision making process in prioritizing the key interventions in the area. ASMC intends to conduct participatory research with farmers which are selected from each innovation hub. Training on ASMC, appropriate scale mechanization technologies and the role of gender in agricultural mechanization has been offered at each innovation hub. As part of this project, three different types of maize shellers were developed and currently these shellers are under on station for testing.

Postharvest Loss Reduction in Maize and Wheat: The Case of Grain Drying and Improved Storage

Karta Kaske Kalsa [1,3*], Aynadis Molla[1], Admasu Fanta[1], Solomon Workneh[1], Sadik Jemal[1], Bhadriraju Subramanyam[1,2], Sajid Alavi[1,2], Rizana Mahroof[4], Nigus Gabbiye[1], Merkuz Abera[5], Girma Demissie[3]

[1]Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia
[2]Department of Grain Science and Industry, Kansas State University, Manhattan, USA
[3]Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia
[4]Department of Biological Sciences, South Carolina State University, Orangeburg, USA
[5]College of Agriculture and Natural Resources, Bahir Dar University, Bahir Dar, Ethiopia
*e-mail: kartakaske@gmail.com

Abstract

Food and nutrition security in Ethiopia can be achieved through reduction of postharvest losses of staple cereals such as maize and wheat. Poor handling of those grains at various segments of the postharvest chain contributed to considerable loss of food and income. In fact, improper drying through the traditional storage system prevailing in the country predisposes the grains to insect and mold damages. This work, therefore, was based on development initiative for an integrated research which included on-station and on-farm testing of solar dryer technology and hermatic storage methods in West Gojjam, Amhara regional state. Grain drying technologies which mainly included Grain Pro-Solar Bubble Dryer (SBD) and various locally designed and constructed cabinet dryers were successfully tested for drying of maize grains. In addition, different grain storage methods such as hermetic bags, metal silos and inert dusts were tested under laboratory and farmers' conditions. It was observed that employing such drying technologies reduced insect prevalence in stored grains by reducing the moisture content to the safe storage level within reasonable drying time. Hermetic bags controlled insect population growth in stored wheat and maize. Moreover, mold development was substantially hindered by storing solar dried maize grains in hermetic bags. It was recommended that integrated use of proper drying methods and hermetic storage technologies should be promoted to insure food and nutritional security among maize and wheat farmers in the country.

Economic viability of solar irrigation in Ethiopia

Gebrehaweria Gebregziabher[1*], Amare Haileselassie[1], Nicole Lefore[1]

[1]International Water Management Institute (IWMI), Addis Abeba, Ethiopia, East Africa Office
*e-mail: g.gebregziabher@cgiar.org

Abstract

Data used in this study came from a pilot study of solar irrigation in part of the Rift-valley that can be applicable in other part of the country. Overall result shows that investment in solar irrigation is profitable given that the minimum required land is available. As solar is clean (zero-carbon) energy, the technology is very much consistent with the Ethiopian Climate Resilient Green Economy (CRGE) strategy. However, the profitability of the technology depends on crop type and water delivery system where drip system was found superior than furrow and overhead water application system. Our result also showed that land size matters implying that a minimum land size is required for a viable investment in solar irrigation where the minimum required land size itself depends on different factors including: type of water application system, crop type, discount rate and location. Because access to affordable financing is crucial for smallholder farmers, the microfinance institutions can server as a reliable source of finance than the formal banking system. Moreover, although high initial investment cost is potentially a barrier for smallholder farmers to adopt the technology, cost sharing can be a solution, especially if additional investment is made on drip system because it can increase irrigable land size to about half a hectare. In addition, partnerships between key actors, such as the private sector and rural financial institutions is essential for a positive outcome and sustainability of investment in solar irrigation. While one can argue that commercialization is essential for sustainable market growth, targeted subsidies are needed at early stage till competitive prices are reached. In conclusion, the piloted type of solar pumping system has been analyzed with its scope and limitations.

Analysis welfare impacts of adoption of household level irrigation technologies: an example from Ethiopia

Gebrehaweria Gebregziabher[1*], Fitsum Hagos[1], Nicole Lefore[1], Amare Haileslassie[1]

[1]International Water Management Institute (IWMI)
*e-mail: g.gebregziabher@cgiar.org

Abstract

This study explores the impact of adoption of household level water lifting irrigation technologies on poverty reduction using consumption expenditure as a proxy. Data used in this study was from cross-sectional survey of 400 sample rural households drawn from four rural kebeles in Amhara, Oromia and SNNPR regions of Ethiopia. To account for the unobserved characteristics of farm households, that potentially affects their adoption decisions; we employ a propensity score matching (PSM) method to select a comparable group of adopter and non-adopter households. Results of the average treatment effect on the treated (ATT) suggest that adopters of irrigation technologies have significantly higher income than non-adopters, therefore, implicitly, it indicates the positive role of adoption of irrigation technology towards reduced poverty level and improved household welfare. One of the main conclusions that can be drawn from this study is that those who adopt smallholder water lifting irrigation technology have significantly higher consumption expenditure than non-adopters even after controlling for the potential heterogeneity. Moreover, a gender disaggregated poverty analysis shows that the magnitude of poverty reduction is significantly higher among female headed households than male headed households implying that if female household are given equal opportunities, they can perform better and are less poor than male headed household. Likewise, technology disaggregated results show that the degree of poverty reduction depends on the type of technology. Finally, the stochastic dominance test confirms that poverty is significantly and unambiguously lower among households who adopt irrigation technology than those who do not adopt.

Gender and water technologies: Water lifting for household irrigation

Likimyelesh Nigussie[1], Nicole Lefore[1]*, Petra Schmitter[2]

[1]International Water Management Institute, East Africa Office, Addis Ababa
[2]International Water Management Institute, Yangon, Myanmar
*e-mail: N.Lefore@cgiar.org

Abstract

The study was conducted in two kebeles in Amhara region, Robit and Dangeshta to explore the intra-household gender dynamics of uses and benefits of simple water lifting technologies that are installed to produce irrigated fodder, vegetables and fruits in the dry season for increased income and enhanced food and nutrition security. Specifically it focused on domains of gender including: productive and reproductive uses, labour, access to resource, and benefits (including income). All the findings showed that men and women perceive a range of priorities and benefits across household-level irrigation technologies that differ within the household. The five key findings of the study were i) men and women use water from these technologies for irrigation and livestock, while women and children also use the water for domestic purpose, ii) men and women respondents indicated using the simple water lifting technologies have increased their work efficiency due to saved labour and time, iii) men usually have more access to resources compared with women (women especially have limited access to farm inputs and information across technology users), iv) men tend to have more control over resources compared with women, and v) women and men do not necessarily benefit equally from a given technology. With respect to participation in decision making, women appear to have lower influence in decision-making within the household about technology purchases and how to use income derived from these technologies. Women usually sell small volumes of produces and use the income to buy household purchases, while men sell larger volumes of harvest, such as a quintal of produce (e.g., including khat) and use the income either for large investment or saving. A number of findings could inform project design where women are targeted, for example, thresholds for women's control over income, increasing access to information and siting of technologies.

Credit participation, level of demand and adoption of small scale irrigation technologies: case of ILSSI sites in Ethiopia

Fitsum Hagos[1*], Gebrehaweria Gebrezigeaber[1], Nicole Lefore[2] and Amare Haileslassie[1]

[1] International Water Management Institute, East Africa Nile Basin sub-regional Office, PO Box 5689, Addis Ababa, Ethiopia
[2] International Water Management Institute, Southern Africa sub-regional Office, South Africa, Private Bag X813, Silverton 0127, Pretoria, South Africa
*e-mail: f.hagos@cgiar.org

Abstract

Identifying factors that influence adoption of water lifting (WL) technologies, whether access to credit is critical for adoption of irrigation technologies, and identifying factors that influence participation and level of loan are important research questions. This study addresses these questions by using 193 irrigation households and 207 control households from selected sites in three regional states in Ethiopia. The availability of private water sources, years of irrigation experience, proportion of irrigated land and plot distance were important determinants of adoption of WL technologies, both manual and motorized pumps. Another result indicated the mean difference in cost of technologies was significantly different between the irrigation and control households indicating the importance of access to credit, including involvement in revolving fund, for adoption of irrigation technologies. Some household characteristics such as age, sex, educational attainment, asset holding, mainly livestock, credit service provision variables, perceptions of weather risk and climate change influenced participation and level of loan demand. Some village variables like distance to major markets and to microfinance office had important influence on participation and size of the loan received. From the study policy implications were drawn.

Small Scale Irrigation within Water, Energy and Food Nexus Framework in Ethiopia

Abeyou W. Worqlul[1], Thomas Gerik[1*], Yihun T. Dile[2], Jean-Claude Bizimana[3], Jaehak Jeong[1], Petra Schmitter[4], R. Srinivasan[2], James W.Richardson[3] and, Neville Clarke[5]

[1]Texas AgriLife Research, Temple, Texas, USA
[2]Texas A&M University, College Station, Texas, USA
[3]Department of Agricultural Economics, Texas A&M University, College Station, Texas, USA
[4]International Water Management Institute, Yangon, Myanmar;
[5]The Norman Borlaug Institute for International Agriculture, Texas A&M AgriLife Research, College Station, Texas, USA
*e-mail: tgerik@brc.tamus.edu

Abstract

This study presents the nexus of food, energy and water framework in the context of small scale irrigation for vegetable production during the dry season in an irrigated agriculture system in Ethiopia. The study is based on detailed data collected in three sites of the Innovation Lab for Small Scale Irrigation (ILSSI) project in Ethiopia. The sites were Robit, Dangishta and Lemo and detailed field data was collected in 18 households in each site. The field data collected includes crop management (such as irrigation amount and dates, fertilizer rates, tillage practices, irrigation technologies, etc.) and agricultural production (crop yield, biomass, etc.) on tomato, onion and cabbage during the dry season. Four different water lifting technologies – namely rope with pulley and bucket, rope and washer pump, solar pump and motor pump – were used for water withdrawal from shallow groundwater wells. The Soil and Water Assessment Tool (SWAT) and Agricultural Policy Environmental eXtender (APEX) models were used in an integrated manner to assess water resource potential and develop water use efficiency of vegetables, which is a relationship between amount of water applied and vegetable yield. The water use efficiency for each vegetable crops were translated into energy requirement as pumping hours and potential irrigable areas for the water lifting technologies. This integrated approach was found useful to optimize water and energy use for sustainable food production using small scale irrigation. The holistic approach will not only provide a significant contribution to achieving food self-sufficiency, but will also be effective for optimizing agricultural input.

Assessing Potential Land Suitable for Surface Irrigation in un-gauged Basins: Upper Blue Nile Basin, Ethiopia

Getenet Nigusie[1], Michael M. Moges[1], Mamaru A. Moges[1]

[1]Faculty of Civil and Water Resources Engineering, Bahir Dar Institute of Technology,
E-mail: micky_mehari@yahoo.com, mamarumoges@gmail.com

Abstract

For strategic planning and decision making on irrigation-related development projects, systematic assessment of irrigable land and the availability of water resources is imperative. This study was initiated with the objective of assessing the surface water resource and irrigable land potential in Amhara region West Gojjam zone, Jabitehnan Woreda using SWAT model and MCDE respectively. For water resource assessment on ungauged catchment using SWAT model, Lah River's observed flow data were used for sensitivity analysis, model calibration and validation. The result of model performance analysis demonstrated a good agreement between the average monthly simulated and measured values: Nash-Sutcliffe model efficiencies (NSE) of 0.74 for calibration and 0.62 for validation periods. Moreover, the coefficients of determination (R^2), 0.83 and 0.82, were obtained during the same period. The calibrated parameter on the gauged catchment was in turn used to estimate runoff yield of the ungauged catchment. The simulated mean monthly and average annual water yields of the Geray and Debolah Watersheds were found to be 0.98 m^3/s and 0.92 m^3/s and 11.73 m^3/s and 11.1 m^3/s, respectively. To identify potential irrigable land, irrigation suitability factors such as soil type, slope, land cover/use, and river proximity were taken into account. The surface irrigation land suitability analysis indicate that 90.75% of soil , 95.6 % of land cover/use and 95.15 % slope in the study area are in the range of highly suitable to marginal suitable for surface irrigation system. The weighted overlay analysis of these factors gave potential irrigable land among river catchments as Birr and Tikur wuha (7,831.09 ha), Gunagun and Leza (17,658.08 ha), Lah, Geray, Arara, Debolah, Guysa and Silala (20,105.98 ha). Three crops such as onion, cabbage and tomato were selected to grow on the identified irrigable areas, and their gross irrigation demand was calculated by using nearby climatic stations. By comparing gross irrigation demand of irrigable land with available flow in rivers, the actual surface irrigation potential of the study area was obtained as 4,744 ha. In conclusion, the SWAT model can be used to analyse ungauged watershed runoff yield in areas that have similar hydro-meteorological characteristics as those of the Lah Watershed in the region and water should be stored in rainy seasons to irrigate all the irrigable land potential.

Lessons from small-scale irrigated forage production trials: potential of annual oat-vetch mixtures

M. Bezabih[1*], A. Adie[1], D. Gemiyu[2], B. Zeleke[3], M. Blümmel[1]

[1]International Livestock Research Institute, P.O. Box 5986
[2]Southern Agricultural Research Institute, Areka , P.O. Box 79, Areka
[3]Southern Agricultural Research Institute, P.O. Box 79, Hawassa
*e-mail: m.derseh@cgiar.org

Abstract

Seasonal fluctuation in the availability and quality of animal feed has remained the main constraint to higher livestock production in Ethiopia. Irrigated forages can address dry season fodder demand in the country but it was unclear if farmers would allocate scarce land and water resources exclusively for feed production. Trials were conducted in the Southern region to explore irrigated forage production towards improving animal productivity and income of smallholder farmers. Oat-vetch forage mixtures were selected for their adaptability to a wide range of agro-ecologies and soil types, short growth cycle and yield potentials. Initially 87 farmers from Lemo and Angacha districts, selected based on interest and availability of irrigation water, participated in the trials. Each farmer planted irrigated oat-vetch mixtures (seed ratio of 3:1) on 100 m^2 plot of land, and the mixture were subjected to either one-, two- or three-cut management regimes. Total forage biomass yield and nutritional quality were determined. Potential economic gains through feeding the forages to different types of animals (milk/meat) and through direct sales as a cash-crop were assessed through simple ex-ante assessments. Comparisons of the management regimes indicated that, compared to the one-cut management, the three-cut management would increase biomass production by a factor of about 2.3 and widen the time window for fresh forage use with potential harvests after 40, 85 and 120 days. Farmers preferred a two-cut management, clearing the field in time for the main cropping season. On average the oat-vetch mixture contained 12% crude protein on dry matter basis and 59% *in vitro* organic matter digestibility. The yield and forage quality analysis results suggested that planting of 100 m^2 plot with a single-cut would result in either 47.2 kg of meat or 280 kg of milk, assuming that the forage was used for production and not for maintenance purposes. The analysis further showed that the economic return in terms of livestock products would depend on the genetic potential of the animals to which the forage is fed. High yielding animals provide better output from irrigated forage than local animals which have a higher maintenance cost per unit of produce. Irrigated forages were a new departure in the community, but field days and participatory evaluations have generated considerable momentum and several participating farmers increased land allocation from the initial 100 m^2 to 1000 m^2 and more, and new farmers joined the scheme, quadrupling the seed demand. The field trials and feedback from farmers clearly demonstrated that irrigated oat-vetch forages are a very attractive and profitable activity, particularly when the forage is fed to livestock with good genetic potential. Alternatively, forages can be sold as a cash-crop to more specialized and advanced livestock producers owning such stock. Demand for such forages clearly exists in peri-urban milk sheds.

Lessons from pilot trials with small-scale irrigated forage production in the Amhara Region: potential of integrating the perennial forage Napier grass with Desmodium and Pigeon Pea in cropping systems

A. Adie[1*], M. Bezabih[1], A. Yitayew[2], B.Demeke[2], L. Yeheyis[2], M. Blümmel[1]

[1]International Livestock Research Institute, P.O. Box 5986 Addis Ababa
[2]Amhara Agricultural Research Institute, P.O. Box 527, Bahir Dar
*e-mail: a.adie@cgiar.org

Abstract

Perennial forage crops have multiple functions in addition to their potential as year round supply of good quality forage, although during the long dry season supplementary irrigation is required. A pilot trial was initiated in the Robit Bata district of the Amhara region to explore the potential of perennial forages grown under small-scale irrigation. The trials initially focused on pure stands of irrigated Napier grass (acc.no. 14986), later complemented by trials of Napier grass intercropped with *Desmodium uncinatum* (acc-6765) or two cultivars of pigeon pea (early- ICPL-87091 and late maturing- ICEAP-00557). These forages and combinations were selected taking into account adaptability to the area, species compatibility, their multiple functions and production potentials. Intercropping of Napier with the legume species was intended to improve the quality of the forage produced as well as the fertility and physical structure of the soil. A total of 91 farmers participated in the trials over three years. Forage biomass yield and nutritional quality were analyzed. Potential economic gains from feeding the forages to different types of animals (milk/meat) and direct sale of forages as a cash-crop were assessed through simple ex-ante assessments. Under irrigation Napier grass could be harvested between 6 and 9 times in 12 months with total dry matter yields ranging from 18 to 23 ton/ha/year, average crude protein content of 10% on dry matter basis, and *in vitro* organic matter digestibility of 50%. The yield of Napier increased by 50 and 33% when intercropped with early and late maturing pigeon pea, respectively. The yield increase might be a response to soil fertility improved by nitrogen fixation by the legume intercrop and improvement in the physical soil structure due to hardpan penetration by the deep root system of pigeon pea. The intercropping also resulted in improvement of the crude protein and *in vitro* digestibility of Napier which increased by 39-51% and 4.3-4.5%, respectively. Desmodium proved to be a slow establisher and data did not become available until the 2nd year of the trials but anecdotal evidence suggests good compatibility with Napier grass. Based on local fodder market prices irrigated Napier grass was estimated to have a gross income potential of one hundred and fifty- to two hundred thousand birr per hectare per year. If the value of the intercropped legumes (forage and grain in case of pigeon pea) were considered gross income would be even higher. Farmers evaluated the irrigated forage trials very favorably as shown by increased land allocation (double from the initial 100m^{2}per farmer) and increased number of farmers (from 17 to 91) taking part in the irrigation schemes. The pilot trials clearly demonstrated that irrigated perennial forages can be a viable option for smallholder farmers, competitive with vegetable crop production and perhaps - as suggested by preliminary anecdotal evidence - even Khat production.

Response of onion irrigation water use and yield to conservation agriculture under different irrigation scheduling in sub-humid region of Blue Nile basin

Sisay Asres[1], Schmitter Petra[2], Manuel R. Reyes[4], Tammo S. Steenhuis [3], Seifu A. Tilahun [1]

[1]Faculty of Civil and Water Resources Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia
[2]International Water Management Institute, Yangon, Myanmar
[3]Department of Biological and Environmental Engineering, Cornell University
[4]Sustainable- Intensification Innovation Lab, Kansas State University

Abstract

Water for irrigation during the dry monsoon phase is limited for small holders in the Ethiopian highlands. We investigated whether integrating conservation agriculture with irrigation practices can increase water use efficiency and yield under critical water shortage conditions. In 2016 an experiment was established in western Amhara irrigating Adama Red Onion *(Allium cepa L.)* variety under local practice and conservation agriculture. Three treatments were applied: conservation agriculture (CA) with irrigation scheduling using estimated crop water requirement needs (CA-CWR); conventional farming (CT) with irrigation scheduling using the same crop water requirement estimates (CT-CWR): and conservation agriculture (CA) with farmers' indigenous scheduling practices (CA-FAS). The first two treatments were conducted on a plot subdivided into CA (no tillage with mulch) and CT (tillage with no mulch) subplots and replicated 17 times; whereas the later was conducted on a full mulched plot and replicated 17 times. Differences in irrigation water use efficiency, yield, and leaf area index (LAI) were measured. Average depth of irrigation applied during initial, development, bulb initiation and late stages were 136, 218, 120 and 42 mm respectively for CWR scheduling and 160, 215, 141 and 37 mm respectively for CA-FAS scheduling. Results revealed that onion yield was highest under CA-CWR (20.9 t.ha^{-1}) followed by CT-CWR (15.6 t ha^{-1}) and CA-FAS (12.5 t ha^{-1}). Similarly, irrigation water use efficiency (IWUE) was highest under CA-CWR (4.01 kg.m^{-3}) and lowest under CA-FAS (2.37kg.m^{-3}) treatment. It shows that IWUE of CA-CWR was 25% higher than CT-CWR and 40% higher than CA-FAS. Difference in IWUE values between CA-CWR and CT-CWR was caused by higher soil moisture retention in response to grass mulch cover whereas the lowest IWUE values under CA-FAS was assumed to be associated with higher irrigation water application during initial stages of onion (lower yield response). In conclusion, these initial experiments indicate that grass mulching can increase yield and save water. Additional research is undergoing in the same plots to confirm these initial results.

Evaluating Water Productivity and Crop Coefficients of Cabbage Crops under Conservation Agriculture with Drip Irrigation System in Robit Kebele

Nigues F.[1], Seifu A. Tilahun[1*], Abdu Yimer[1], Tewodros T. Assefa[2], Manoj K. Jha[2], Manuel R. Reyes [3]

[1]Faculty of civil and water resource Engineering, Bahir Dar Institute of Technology, Bahir Dar University
[2]Department of Civil Engineering, North Carolina A & T State University, North Carolina,
[3]Sustainable Intensification Innovation Lab (SIIL), Kansas State University, Kansas, USA.
*e-mail: satadm86@gmail.com

Abstract

Water is scarce resource and the growing competition for water will reduce its availabilities for irrigation. The need to meet the growing demand for food production using less water is an option. In areas where crops have to be irrigated with limited water resource, saving the amount of water lost by evaporation and deep percolation is important. This study was made to investigate the effect of conservation agriculture on water saving over the conventional tillage. The experiment was conducted in Robit using 4 farmers plots by growing cabbage using drip irrigation. Each plot was divided into two treatments of conservation agriculture (CA) and conventional tillage (CT). The experiment was conducted during the dry season from November 2016 to February 2017. In the experiment, amount of irrigation water used, crop coefficient, total crop yield, water productivity and water use efficiency were determined and estimated. The average irrigation water used by CT was 385mm/season, which is higher than the average water used in CA treatments, 318mm/season. T-paired test showed that there was a significant difference on the amount of water used between the two water management system (P=0.0076). The seasonal crop coefficient values of cabbage at each growing stage were estimated and the values for CA and CT were 0.67and 0.71 in initial stage, 0.89 and 1.02 in development stage, 0.97 and 1.19 in mid stage and finally 0.72 and 0.84 in late stage respectively. Significant statistical difference in crop coefficient values at development stage, mid stage and harvesting stage were observed at 5% significance level. The average Cabbage yields obtained during the irrigation season in this experiment were recorded as 21.2 and 22.6 t/ha for CT and CA respectively with on significance difference. The irrigation productivity and irrigation efficency were however has a significant difference (P=0.005 and P=0.0134) between the two treatment. In conclusion, from this study, CA has saved water by 18% from CT by reducing the crop coefficient and has given a 7% greater yield than CT through better irrigation productivity and irrigation efficiency.

Estimating the actual evapotranspiration and deep percolation in irrigated fields of Lake Tana Basin floodplains, Ethiopia

Abebech Abera[1,2*], Seifu A. Tilahun[2], Tena Alamirew[3], Enyew Adgo[4], and Jan Nyssen[1]

[1]Gent University, Department of Geography, Gent, Belgium
[2]Bahir Dar University, Bahir Dar Institute of Technology, Bahir Dar, Ethiopia
[3]Water and Land Resource Centre (WLRC), Addis Ababa, Ethiopia
[4]Bahir Dar University, College of Agriculture and Environmental Sciences, Bahir Dar, Ethiopia
* e-mail: abiti.abe@gmail.com

Abstract

Field experiments were conducted on onion and maize crops grown from December 2015 to May 2016 in small irrigation schemes called Bebeks and Shina found in the Lake Tana floodplains of Ethiopia. The major components of field water balance during irrigation season such as deep percolation and actual evapotranspiration were predicted using a numerical model, Hydrus-1D, and a bucket type water balance model. For this study, experimental fields were selected along a topographic transect to account for soil and groundwater variability in both schemes. Three onion fields were selected in Bebeks where onion was dominantly produced during irrigation season. Six fields were selected in Shina where onion and maize crops (three for each crop onion and maize) were dominantly cultivated during the season. Irrigation volumes were measured using V-notches. Irrigation depths (400 to 550 mm) were calculated, and daily groundwater levels were monitored manually from piezometers installed in the fields. The soil physical properties (texture, *FC*, *PWP*, *BD*, and *OM*) were measured at each horizon to derive model input parameters. Soil hydraulic properties (residual and saturated moisture content, saturated hydraulic conductivity, parameters related to: pore size distribution n, air entry α and pore connectivity *l)* were derived using KNN pedotransfer functions for tropical soils and fitted using Retention Curve Program for Unsaturated Soils, RETC. The field water balance results by both models (Hydrus and simple water balance) were comparable. The seasonal actual evapotranspiration estimated by Hydrus and water balance models ranged from 320 to 360 mm for onion and from 400 to 470 mm for maize. The seasonal deep percolation estimated from both models was 12 to 41% of applied irrigation and with this flood irrigation management; the deep percolation was very high in reducing the available surface water resources by feeding the groundwater. Pumping the groundwater for irrigation is fairly more expensive than using the available surface water for present farmers' capacity like in the study area. Implementing precise irrigation and water saving practices that minimize deep percolation, minimizing surface water evaporation from the reservoir by scheduling irrigation skipping the hottest months and reducing unproductive excessive consumptive use are required to achieve the growing food demand with the available water. When less detailed information is available, the simple water balance model can be an alternative to predict deep percolation and actual evapotranspiration.

Biological and mechanical techniques to increase infiltration in rainfed agriculture of the Ethiopian highlands

Habtamu Muche[1*], Misba Abdela[1], Petra Schmitter[2], Prossie Nakawuka[2], Seifu Admasu Tilahun[1], Tammo Steenhuis[1, 3], Jennie Barron[2], Abera Adie[4], Michael Blummel[4]

[1]Faculty of Civil and Water Resource Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Ethiopia
[2]International Water Management Institute, Yangon, Myanmar
[3]Biological and Environmental Engineering, Cornell University, Ithaca, USA
[4]International Livestock Research Institute (ILRI)
*e-mail: habtamu.100@gmail.com

Abstract

In the degrading Ethiopian highlands, after years of continuous cultivation, a hardpan to a depth of 50 to 60 cm has been formed due to plugging up of the large and continuous flow paths with sediment laden water that has infiltrated into the soil. Breaking the restrictive layer can be done either mechanically (e.g. *Berken* plough, *mattock*) or using strong rooted covered crops (e.g. *Pigeonpea and Radish*). However, limited studies are available in Ethiopia that assess the opportunities and challenges between the mechanical and biological treatments within rainfed agricultural system. Five plots with subplots of five different tillage treatments were setup in Robit Watershed. The treatments were (i) no-till (NT), no ploughing; (ii) conventional (CT), plots tilled three times using oxen driven *Maresha*, (iii) deep (DT), manual digging up to 60 cm using a *mattock*; (iv) *Berken* tillage (BT), plots tilled three times using an oxen driven *Berken* plough and (vi) Biological (Bi-T), tap rooted *pigeon pea* grown on plots tilled similar to CT. Soil physical parameters (e.g. penetration resistance, bulk density) were measured before tillage treatment and after the cropping season. During 2016 and 2017 rainy period, runoff, soil loss, and crop productivity were measured from plots of each treatment. In addition, agronomic variables such as plant height, yield, residual biomass and root depth were collected. Results showed that the average runoff was reduced by more than 50% and 30% due to the BT and Bi-T, respectively, as compared to CT. After crop harvesting, soil penetration resistance was lower than tolerable limit (2MPa) up to depths of 40 cm in plots *Berken* plough was used while no difference was obtained for the plot with pigeon pea. Infiltration capacity also increased from 115.2 (NT), and 120 (CT) to 187.2 (Bi-T), 242.4 (BT), and 261.6 mm hr^{-1} (DT) ($p<0.01$). Higher crop root length was shown under *Berken* plough and deep tillage treatment, and more than 2.0 and 1.2 times higher than that under CT, respectively. Grain yield results under BT and Bi-T were higher than other tillage treatments. BT resulted the highest water productivity (*WET*=1.01 kg-m^{-3}) followed by Bi-T (*WET*=0.8 kg-m^{-3}. The average highest and lowest nitrate depletion was 19.5 and 5.6 kg N ha^{-1} in NT and DT plots, respectively. The highest labor hours (i.e. for the aggregation of ploughing, fencing and weeding) were observed under NT (3058 hr-ha^{-1}) and lowest were 2066 hr-ha^{-1} in BT plots. Therefore, adoption of mechanical techniques in the Ethiopian highlands could improve the sustainability of rain fed agriculture through enhancing the water availability in the soil.

Improving watershed management practices in humid regions

Fasikaw A. Zimale[1], Seifu A. Tilahun[1], Tigist Y. Tebebu[2] Christian D. Guzman[2], Linh Hoang[4], Elliot M. Schneiderman[4], Eddy J. Langendoen[3], Tammo S. Steenhuis[2]

[1] Faculty of Civil and Water Resources Engineering, Bahir Dar University, Bahir Dar, Ethiopia
[2] Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY, USA
[3] New York City Department of Environmental Protection, Kingston, NY, USA
[4] United States Department of Agriculture Agricultural Research Service, Oxford, MS, USA

Abstract

In many parts of the world, watershed management practices have been extremely effective. However, implementation of soil and water conservation technologies in the humid African highlands, while beneficial in the short term, was remarkably unsuccessful in the long term. Insights from community knowledge perspectives have revealed that alternative methods are needed. Although conservation practices are designed to conserve water in semi arid areas, safely draining excess water is needed in humid areas. The objective of this paper is to review current watershed management approaches used in humid regions as exemplified by those used in Ethiopian highlands and then based on these findings propose more effective practices. Although current government sponsored practices primarily protect the hillsides, direct run off is generated from areas that become saturated on valley bottoms near rivers and on specific parts of the hillsides with degraded soils (or with highly permeable surface soils) and with perched water tables on slowly permeable horizons at shallow depths. In these areas, direct run off is increasing with deforestation and the soil degradation, demanding additional drainage ways that evolve in the form of gullies. Therefore, watershed management interventions for erosion control should prioritize revegetation of degraded areas, increasing sustainable infiltration, and rehabilitating gullies situated at saturated bottomlands.

Spatial and temporal variation of nutrient availability in the Lake Tana, upper Blue Nile Basin

Aron Ateka[1], Fasikaw A. Zimale[2], Feleke K. Sishu[2], Tchathom Maglwa[3], Djahini Kokou[3], Petra Schmitter[4], Tammo S. Steenhuis[5], Seifu A.Tilahun[2,*]

[1] Bureau of Water Resources, Irrigation and Energy, Bahir Dar Ethiopia;
[2] Faculty of Civil and Water Resources Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia;
[3] Laboratory of Sanitation, Water Science and Environment, University of Kara, Togo;
[4]International Water Management Institute, Yangon, Myanmar;
[5] Departments of Biological and Environmental Engineering, 206 Riley Robb Hall, Cornell University, Ithaca NY 14853 USA
*e-mail: satadm86@gmail.com

Abstract

Lake Tana is becoming more eutrophic that currently resulted in more than 50000 ha of the Lake covered by water hyacinthes. To understand the main cause leading the degraded water quality, the spatial and temporal physico-chemical water quality of Lake Tana was investigated from 143 spatial water samples collected in August 2016, December 2016 and March 2017. Water samples were analyzed for total nitrogen (TN), total phosphorous (TP) and Chl-a, pH, Secchi Disk (SD), EC and temperature. Spatial map of all parameters were done by inverse distance weight interpolation. Except temperature and TN all water physical parameters were high in dry period. The pH of the lake ranged from 7.1 to 8.9 with the lowest value observed in rainy season and highest in dry period. The mean nitrogen concentration (8.96 mg L^{-1}) was highest in rainy season when runoff and sediment from contributing watersheds were high and low in dry period (0.1 mg.L^{-1}). The decrease of TN was associated with the occurrence of water hyacinth (*E. crassipes*) and duckweeds in North East part of the lake whilst their presence was low in the South West and TN was marginally high. In opposite, the mean TP and Chl-a values were 0.15, 0.18 and 0.21mg.L^{-1} and 2.2, 13.6 and 21.4 µg.L^{-1} in August, December and March respectively. These have shown an increasing trend from wet to dry season. The correlation of TP with lake water depth and SD was negative (-0.4), in all sampling period. These negative correlations indicated that, the increasing trend of TP is likely due to mixing of water as a result of wind induced re-suspension of sediment from the bottom. This increase in TP concentration has resulted for increasing of Chl-a with a magnitude of above three fold from the Chl-a measurements conducted before 14 years. The recent bloom of *E. crassipes* is likely due to the loading of nutrients from upland agriculture indicating for need of best management practices on non-point source inputs from agricultural land.

Schedule for the Second Amhara Agricultural Forum-2018

16 January 2018 Jacaranda Hotel, Bahir Dar, Ethiopia

No.	Time	Activities	Speaker/Responsible	Facilitator	Reporter
1	8:00-9:00	Registration	BDU-SIMS	BDU-SMIS	
2	9:00-9:10	Schedule and about the symposium	BDU-SIMS		
3	9:10-9:20	Welcoming Speech	BDU		
4	9:20-9:30	Opening Remarks	ANRS-BoANR		
5	9:30-9:45	SMIS presentation	Frank van Berkom (SMIS)		
6	9:45-10:00	IWMI presentation	Amare GS (IWMI)		
7	10:00-10:30	**Refreshment and Poster presentations**			

Parallel Session-1- @Jacaranda Hotel: Hall-1				**Parallel Session-2- @Jacaranda Hotel: Hall-2**			
No.	**Time**	**Presentations**	**Speaker/ Responsible**	**Presentations**	**Speaker/ Responsible**	**Facilitator**	**Reporter**
1	10:30-11:00	Agricultural Transformation in Amhara Region: Experiences and Lessons	Ambassador Wuletaw G.	Assessing Potential Land Suitable for Surface Irrigation in un-gauged Basins: Upper Blue Nile Basin, Ethiopia	Getenet N.	BDU-SIMS	Anwar A. & Dessalew W.
2	11:00-11:20	Progress of Appropriate Scale Mechanization Consortium (ASMC) Project	Yonas M.	Lessons from small-scale irrigated forage production trials: potential of annual oat-vetch mixtures	M. Bezabih		
3	11:20-11:40	Postharvest Loss Reduction in Maize and Wheat: The Case of Grain Drying and Improved Storage	Karta K	Lessons from pilot trials with small-scale irrigated forage production in the Amhara Region: potential of integrating the perennial forage Napier grass with Desmodium and Pigeon Pea in cropping systems	Abera A.		

4	11:40-12:00	Economic viability of solar irrigation in Ethiopia	Gebrehaweria G.	Response of onion irrigation water use and yield to conservation agriculture under different irrigation scheduling in sub-humid region of Blue Nile basin	Sisay A.		
	12:00-12:30	Discussion	**TBA**	Discussion	**TBA**		
	12:30-1:30	**Lunch @ Jacaranda hotel**	**BDU-SIMS**	**Lunch @ Jacaranda hotel**	**BDU-SIMS**		
5	1:30-1:50	Agricultural intensification and irrigation experience in Amhara region	ANRS-BoANR	Evaluating Water Productivity and Crop Coefficients of Cabbage Crops under Conservation Agriculture with Drip Irrigation System in Robit Kebele	Nigus F		
6	1:50-2:10	Analysis welfare impacts of adoption of household level irrigation technologies: an example from Ethiopia	Gebrehaweria G	Estimating the actual evapotranspiration and deep percolation in irrigated fields of Lake Tana Basin floodplains, Ethiopia	Abebech A.		
7	2:10-2:30	Gender and water technologies: Water lifting for household irrigation	Likimyelesh N.	Biological and mechanical techniques to increase infiltration in rainfed agriculture of the Ethiopian highlands	Habtamu M.		
8	2:30-2:50	Credit participation, level of demand and adoption of small scale irrigation technologies: case of ILSSI sites in Ethiopia	Fitsum H.	Improving watershed management practices in humid regions	Fasikaw A.		
9	2:50-3:10	Small Scale Irrigation within Water, Energy and Food Nexus Framework in Ethiopia	Abeyou W.	Spatial and temporal variation of nutrient availability in the Lake Tana, upper Blue Nile Basin	Aron A.		
	3:10-3:50	Discussion	**TBA**	Discussion	**TBA**		
10	3:50-4:10	**Refreshment and Poster presentations**					
Both Sessions in One Main Hall for Joint Summary and Closing							
11	4:10-4:50	The way forward	ANRS-BoANR/ARARI		**BDU-SMIS**		
12	4:40-5:00	Closing remarks	Mamaru T. (SMIS)		**BDU-SMIS**		
13	5:30-8:00	Dinner and Networking at Jacaranda Hotel	BDU-SMIS		**BDU-SMIS**	*Hotel Dining hall*	

Wisdom at the source of the Blue Nile

IWMI International Water Management Institute

SMIS Small Scale and Micro Irrigation Support Project

The Second Amhara Agricultural Forum-2017

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

USAID FROM THE AMERICAN PEOPLE