REPORT

4th "*WATERMAN*" WORKSHOP

"WATER MANAGEMENT AND IRRIGATION"

FOCUS ON GROUNDWATER

December 3rd – 5th, 2007

Mekelle University, Mekelle, Ethiopia

Project number: INCO-CT-2006-031694 6th Framework Programme

Duration: 01/10/2006-30/09/2007 (18 months) Specific Support Action

Coordinator: Dr. Willibald Loiskandl, Universität für Bodenkultur Wien, Austria

Project Website: http://waterman.boku.ac.at

1 Workshop Schedule

2 days Workshop + 1 field trip

December 3rd 2007:

- Opening and Registration
- Keynote speeches
- Presentations
- Group work: *Challenges and opportunities in the utilization of groundwater for irrigation purpose?*

December 4th 2007:

- Field Trip

December 5th 2007:

- Presentations
- Group work: *Evaluating dissemination I:* ***Knowledge gaps / Information needs*** *Evaluating dissemination II:* ***Dissemination formats*** *After Action review*

2 Day 1: Workshop

2.1 Registration

Dr. Nata Tadesse, Ato Tewdrose A. and others

2.2 Introduction

2.2.1 Welcome note by Dr. Dessie Nedaw

Dr. Mulu Byray, vice president for academic and research of Mekelle University, Dr. Getachew, Ato Kiros Negah, deputy bureau chief for water, mines and energy, Waterman partners from BOKU, University of natural resource and applied life science Vienna, Czech University of life science, Cranfield University UK, PELUM from Uganda, Egerten University form Kenya, Hawasa University, Haramaya University, respected guest from UNICEF, REST, Catholic Relief Society, TWWCE, TWME Bureau, WUKO College of Agriculture, farmer representatives, extensive workers, district chiefs and Mekelle University and community,

I would like to welcome you on this first groundwater focused workshop, entitled water management and irrigation with a special emphasis on groundwater on behalf of Mekelle University, Faculty of Science and Technology.

We would like to express our appreciation for coming and say welcome to our beautiful city Mekelle for this special meeting. We in the organizing committee would like to make your three days stay to be more useful, joyful and fruitful.

Once again welcome to Mekelle and Mekelle University.

2.2.2 Opening speech by Dr. Mulu Bayray

Dear distinguished guests, ladies and gentlemen,

It is my privilege to welcome you to Mekelle to attend the 4th WATERMAN International Workshop, which is hosted by Mekelle University. This workshop, which is supposed to discuss on “Water management and irrigation: focus on groundwater” will contribute a lot to the aspects related to water utilization and management particularly for the Tigray region and the country as a whole.

In Tigray region, 35 woredas, 621,000 households or 75% of the total population of about four million is food insecure and seriously threatened by droughts, which hit the region every 3-4 years. Major climatic limitations for agricultural production are erratic

rainfall, unpredictable monsoons, which often combined with intermittent dry spells that regularly threaten the survival of the crops, resulting in reduced production and food insecurity. The variability of annual rainfall is high with 20%-40%. Like in most other regions, though, the amount of rainfall is a matter of concern, the collection, storage and proper utilization is becoming a major concern and demands serious attention.

In order to reduce dependency on large amounts of assistance, the Regional Government four years ago, has geared itself with an ambitious goal to eradicate 88% of the food deficit. It has formulated a “Rural development strategy plan” based on water, agriculture and cooperatives. Water harvesting with ponds and groundwater extraction by shallow wells is one of its main components, which is intended to increase agricultural production during relatively good times and secure crop production during dryer years.

The Regional Bureau of Water Resource Development estimates that “Tigray can potentially irrigate 50,000 ha of land using various water management schemes” which include micro and medium sized dams, river diversions, groundwater exploitation and pumped irrigation. At present the favoured choice is ponds and shallow wells.

The major objective of the water-harvesting program in Tigray is to provide supplementary irrigation to grow staple crops particularly during frequent dry spells that often make harvests fail. Agriculture Extension experts also propose household ponds and shallow wells for irrigation for the production of fruits, cash crops and vegetables, which should help the individual farmer to obtain additional income and meet the household consumption needs.

The idea is to start growing vegetables during the rainy season, and then - with the help of irrigation - extend the growth period into the dry season when crops receive good prices. According to the agriculture experts, vegetable growing with simple bucket irrigation is feasible for plots with size of about 150- 200 m^2 only. Limiting factors are the labour force of the farmer, the availability of water from ponds and the vegetation period of different crops.

Various programs and suggestions, forwarded by the governmental organizations and the experts respectively, their practical application on the ground and their implication should form the major area of interaction during the course of this workshop. Let us further strengthen the idea, from the people, to the people.

I hope at the end of this workshop every one of us will be benefited by sharing experiences. The interactions during the course of the workshop may result in the emergence of many interesting ideas that can provide solution to some of the current problems faced by our people in the region.

At the end, I wish a successful workshop and a nice stay in Mekelle.

2.2.3 Objectives of WATERMAN: Prof. W. Loiskandl

Dear participants, colleagues and friends,

It is a pleasure for me to welcome so many participants to this workshop. For those who are not familiar with the project WATERMAN I will give a brief introduction to the programme. The acronym WATERMAN stands for dissemination of research results in semi-arid and arid ecosystems with a focus on sustainable water management in Ethiopia. The title contains already what WATERMAN is all about.
Dissemination of research results: WATERMAN is a 6th framework program sponsored by the European community in the framework of specific support actions. With other words the aim is to disseminate research results by linking up people. Projects under this umbrella are not research project, but take the available results to bring them to a broader audience. How is this done? A consortium was formed regional and international. Partners are 3 Ethiopian Universities (Hawassa, Halemaya and Mekele) and the Ethiopian Institute for agricultural research. From East Africa are Egerton University from Kenya and the NGO Participatory ecological land use management based in Uganda. One more partner based in Addis Ababa is the branch office of the International Water Management Institute. Finally, we have 3 European university partners, from the United Kingdom, Cranfield University, from the Czech Republic, the University of Life Sciences Prague and from Austria, the University of Natural Resources and Applied Life Sciences, as co-ordinator of the project. The dissemination activities are structured in 4 workshops. The consortium is responsible for the content and each of the three Ethiopian Universities took the task of setting up a workshop in there region, focussing on regional problems and inviting all stakeholder, farmers, regional offices, extension services, NGO`s and academics. I am really happy to see so many farmers.

This is the 4th workshop already and at the end we will have a final symposium in Addis Ababa, Feb. 12th and 13th.
Geographically the focus is on semi-arid and arid ecosystems. The concepts discussed and presented may come from outside Ethiopia from places with similar environmental conditions, but also the Ethiopian results are supposed to be useful for other Sub Sahara countries.
The key feature is of course the sustainable water management. This is supported by the discussions we had at the last symposium in Addis Ababa, where it became very clear to me that the knowledge is present but the implementation needs substantial improvement. I also had the chance to visit Axum University the last days. We went to a micro dam irrigation scheme, which work very successful but even there the management could be improved, for example some areas within the scheme are not used anymore because of over irrigation and hence became wetlands.
With this short overview I will close my introduction to WATERMAN with thanking the organizers from Mekelle University for setting up this workshop and again I like to welcome everyone.

Thank you.

2.2.4 Keynote speech: Dr. Getachew

Distinguished guests ladies and gentlemen,

I would like to welcome you to Mekelle and this workshop, on behalf of the organizers, university community and myself. I am honored to present you a brief report on the general condition of water management in Tigrai region.
As you all know, water management is an old profession as old as human beings themselves. Here in Tigrai, too traditional irrigation has been a practice in some parts of Tigrai for a very long time. As of 1993, modern type of irrigation has been under construction by Bureau of natural resources and environmental protection, CO - SAERT, Bureau of Water resources, mines and energy, REST and others.
In surface irrigation, 54 micro dams, 47 diversion weirs, a number of ponds, more than 40,000 Shallow hands dug wells, and 9 diversion structures for spate irrigation, 5

deep wells and a number of motorized pumps have been constructed to irrigate more than 30,000 ha of land.

The main objective of this workshop is to gather, discuss and disseminate information (research results) about Water Management in the field of irrigation with special emphasis on ground water irrigation.

Different studies are going on ground water potential assessment for irrigation purpose g on Raya Valley, Tekeze Plain on Humera area, and Suluh catchment around Hawzen and Gerealta plains, Adi Shihu and Feleg Hakfo areas.

In Suluh valley preliminary studies has been conducted and the ground water potential could reach from 8,000 to 19,000 ha, though the drilling test wells at shallow depth were dry.

In Adi Shihu and Feleg Hakfo, preparation is going on to drill 10 test wells to develop about 400 to 600 ha of land through pressurized irrigation.

In Humera plains, studies are going on to develop the plain with surface and ground water irrigation. The potential is yet to be estimated as the ground water study is at an earlier stage.

The Raya valley has been under detailed study for assessment of the ground water potential for a very long time since 1994/95. The western part of the valley is already executed and has a potential to irrigate 4,500 to 5,000 ha of land. This part of the valley is at present in a detail design stage by REST.

About 45 boreholes are drilled by REST and 20 observation wells and 18 profile wells have been drilled to identify the distance of interference between wells and to estimate the potential of the area respectively as part of the ongoing study.

The Ministry of Water Resources is currently conducting a feasibility study and detailed design of the whole Raya valley using ground water, including the eastern and central part of the valley. A total of 18,000 ha are estimated to be developed using pressured irrigation from groundwater sources of the Valley.

Ground water is also the main source for domestic use in all parts of Tigrai, in all rural and urban areas. For instance, Aynalem well fields are the main source for Mekelle water supply.

The TWWCE has constructed 1,591 boreholes, of which 154 are deep wells and 1,437 are shallow wells in different parts of Tigrai for domestic use only.

The main problem in ground water irrigation is farmers are not aware about the efficient use of ground water through scientifically designed water wells. They need to

be motivated, encouraged and sensitized to adopt well irrigation by using improved conventional water lifting devices and on-farm water management. The major constraint also appears to be the limitation of farmer's capacity (Both in knowledge and financial) in using ground water for irrigation and so the Government, NGOs or others would need to support the ground water irrigation infrastructure and various incentives to the farmers.

The other critical problem is neglecting the importance of watershed management in relation to surface water harvesting and groundwater development. In case of surface water harvesting, micro dams are being silted up at a faster rate than their designed service life. (Like in Hizati wedi cheber,Adi kenafiz, Mai gassa 1 and others). In case of ground water, the ground water table is declining due to poor water shed mgt. (like in Aynalem well fields).

Hope every participant will consider the above problems as critical issues to develop the surface and subsurface water potential effectively by developing a study which includes an integrated watershed management approach in future water development projects.

I wish you a successful workshop. Thank you

2.3 Presentation –Session I (Morning)

Chairman: Dr. Kassa Amare

Rapporteur: Dr. K. Bheemalingeswara

Presentation 1: **Rational Use of Ground Water, Case Study of PELUM Members in Uganda** Presenter: Ms. Ruth Nabaggala	

Key Words:

- Water conservation and Management, Uganda
- Participatory Ecological Land Use Management (PELUM)
- Integrated Rural Development Initiatives (IRDI)
- St. Jude Family Projects
- Runoff Water Tank and Spring Wells
- Shallow Wells and Rope Pump
- Rainwater harvesting tanks and Jars
- Ecosan Toilet

Content:

- Intervention of Participatory Ecological Land Use Management (PELUM) members, St. Jude and IRDI to promote small scale water management practices using government supported various technologies to access clean and safe water to people. Technologies include deep boreholes, medium depth wells, shallow wells, run off water tanks, spring water wells and rainwater harvesting tanks and jars.
- St. Jude family project mainly involved in promoting activities such as sustainable agriculture, fruit drying and packaging and involved in demonstrating and promoting various ground water technologies such as construction of the run off water tank of about 50,000 l capacity to use during the dry season. So far assisted over 100 families to excavate and construction of tanks where the farmers contribute the labor to dig the pit and St. Jude assists with materials.
- ***Integrated Rural Development Initiatives (IRDI)*** water projects have so far been implemented in three districts of eastern and central Uganda. Kapchorwa, Rakai, Wakiso using natural spring water and construction of shallow groundwater wells, water harvesting tanks and promoting ecosan toilets.
- Spring water wells technology has attracted many community based economic activities like agriculture, local brewing, brick making and eucalyptus growing. They are lined with concrete and water is directed through a pipe so that it is not exposed to run off.
- Many challenges such as long droughts, contamination, break down

of pumps, lack of spares within communities, poor workmanship etc were encountered with shallow groundwater wells. Some of the problems were resolved by using locally manufactured cheaper pumps technologies like, the Rope pump.

- The technology of construction of rain water harvesting tanks is intended to tap rain water and to store water for use in dry seasons particularly in areas where shallow wells are dried up. So far assisted to construct 300 water tanks in the Eastern part of Uganda. Also helped to make water storing jars of about 1500 liters capacity using stabilized soil bricks (SSB).
- Ecosan latrines are constructed on the ground and the waste is treated and used as manure. They are cheap to construct, used for longer periods, highly useful in areas of high water tables, best to avoid groundwater contamination. One of the challenges has been to change the attitude towards use of human waste in gardens.

Discussion:

Many issues were raised during discussion which includes, the transfer of information to farmers, effectiveness of the moringa seeds in cleaning drinking water, management of the run off water tanks, problems encountered with shallow wells with respect to low lying areas and long distances, managing the ponds for both irrigation and drinking purposes, watershed management approach for water harvesting, growth of eucalyptus trees, costs and affordability of water jar and rope pump etc.

Presentation 2:

Sustainable Management of Groundwater Resources: A Case Study in the Weri River Basin, Tigray, Ethiopia

Presenter: Dr. Nata Tadesse

Keywords:

- Groundwater resource
- Sustainable management
- Groundwater policy
- Local bodies intervention
- Weri river basin
- Tigray, northern Ethiopia

Content:

- The need to conduct a systematic study on the groundwater management and management activities that are taking place in the basin and to suggest environmentally sound plans for better development of groundwater and actions for water savings in the basin is highlighted. Sustainable management of groundwater resources is indispensable for better development and optimum utilization of the groundwater resources of the basin and to avoid any adverse effects.
- Groundwater development in the area is being carried out without any management plans and detailed management studies. For example, there is no check on abstraction and also no licensing control.
- Lack of water is not the issue but the absence or poor management. This is mainly due to lack, at the regional level, of efficient groundwater management organization that is well equipped with adequate legislation, funding and infrastructure.
- There is a need to establish an efficient regional groundwater management organization, which can conduct, detailed groundwater management studies of the basin, also effectively implement, and follow the objectives of the national water resources management policy
- New approaches to groundwater development are suggested such as adequate catchment management plan; understanding of the sustainable yield of the basin groundwater sources; approval of drilling must include operating conditions to protect other users as well as the resource in the basin; apart from combined use of groundwater and surface water, conservation of surface water in times of plenty for use in times of scarcity and rainwater harvesting.

Discussion:

The issues came for discussion were, the problems related to water management, the critical problem in water policy implementation in the country, the role of government established basin-wise organizations, possible recommendations on the issue, water balance figures for the basin, water balance estimates for the neighbouring basins, effect of neighbouring basins on water harvesting methods and sustainability, response of farmers in light of the suggested policy problems, role of geology, role of the water bureaus etc.

2.4 Presentation – Chart and Photo Exhibition

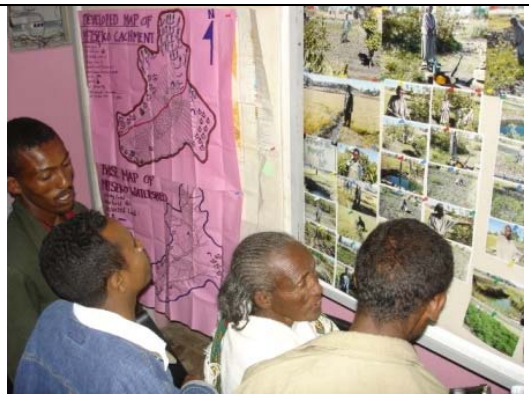
The exhibition was properly organised in the same hall. There were facilitators at each display board to do the presentation. The exhibited material was mainly two types 1) Photo exhibition and 2) Chart exhibition.

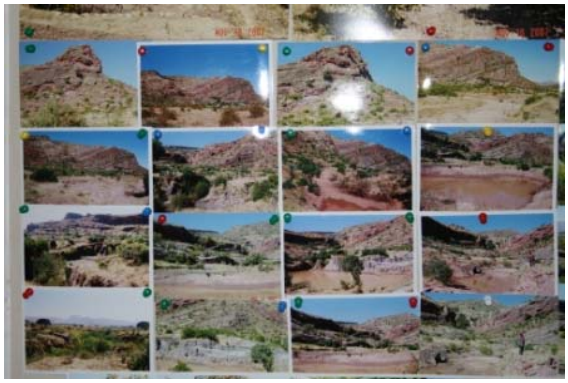
Photo exhibition 1 - Water conservation through ponds, recharging groundwater, pumping shallow hand dug wells water using treadle pump/ motor pump, and irrigating the land through normal/ drip irrigation systems, *Mendae Catchment,* Abrha Asthbha, Tigray region, northern Ethiopia.

Photo exhibition 2 - Water conservation through ponds, recharging groundwater, pumping shallow hand dug wells water using treadle pump/ motor pump, and irrigating the land through normal/ drip irrigation systems, Metseko Catchment, Wukro, Tigray region, northern Ethiopia

Photo exhibition 3 - Irrigation using shallow hand dug well water, pumping of water using motorised pump, irrigation through field canal system and traditional methods, Dengolat area, Tigray region, northern Ethiopia.

Chart exhibition - *"Financial evaluation of shallow well irrigation in Dugda Woreda"*. The poster tried to evaluate the financial viability of shallow well irrigation as promoted by OIDA and highlight the constraints that this kind of investment poses to farmers. The study has identified few problems that hamper the overall performance of shallow well irrigation. It suggests that focus on factors like access to crop inputs, credit provision, marketing information, promotion of cooperation between market actors, and multi cropping etc may improve the performance..






DEVELOPED MAP OF
METSEKO CACHMENT
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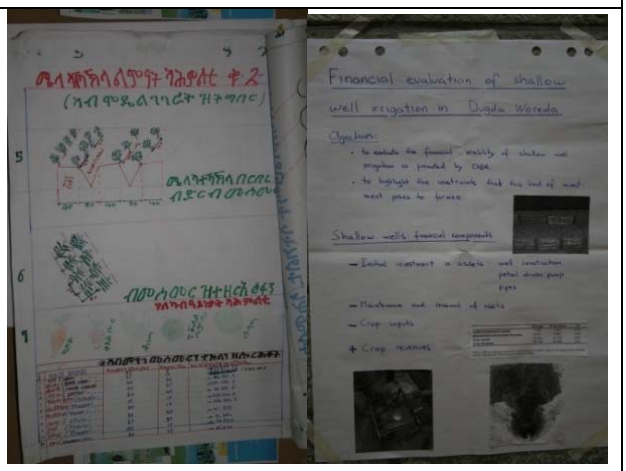

Financial evaluation of shallow
well irrigation in Dugda Woreda
Shallow wells financial components

2.5 Presentation – Session II (Afternoon)

Chairman: Dr. Kurkura

Rapporteur: Dr. K. Bheemalingeswara

Presentation 3:

Aquifer Charatcterisation and hydro-chemical investigation on Raya Valley, Northern Ethiopia

Presenter: Dr. Dessie Nedaw

Key Words:

- Aquifer characterisation
- Hydrogeochemistry
- Water balance
- Raya Valley
- Northern Ethiopia

Content:

- The groundwater potential in Raya valley, mainly the unconsolidated material from geological, hydrological and chemical point of view has been highlighted.
- The recharge to the groundwater as calculated using the water balance method indicate that 129MCM of water is estimated to infiltrate into the groundwater system annually; basin annual rainfall, 779mm=1622 MCM; actual Evapotranspiration, 695mm=1288MCM; surface runoff, 60MCM; lake Evaporation, 15MCM and Evaporation from bare land, 602mm= 130MCM.
- On the basis of field data and existing maps, five hydrolithological units have been classified such as Tertiary basaltic rocks: localized aquifer; Quaternary alluvial: High potentiality; Quaternary colluvial: High potentiality; Quaternary interfluvial: Moderate to high potentiality;

and Quaternary valley center: Low to moderate

- The pumping test data helped to classify the aquifers, on their transmissivity into four types: high potentiality T>500 m^2/day (25% of the area); moderate potentiality, 50-500m^2/day (41%); low potentiality, 5- 50m^2/day (17%) and weak potentiality, 0.5-5m^2/day (17%).
- Ground water flows towards the center of the valley in both major groundwater flow systems Mehoni and Alamata.
- 30 samples have been collected and analyzed for 15 parameters in Ethiopian Geological Survey.
- Groundwater in the study area is mainly of Ca-Mg-HCO_3 or Mg-Ca-HCO_3 type and indicates the influence of silicate minerals of the basaltic country rocks. Electrical conductivity and major ions increase as one move from the highlands towards the center and corresponds with the groundwater flow direction. Few samples show high nitrate and sulfate values. Unlike most natural waters from the main Ethiopian rift system the natural waters in Raya valley are low in sodium adsorption ratio (SAR) value that makes them to be favourable for irrigation. The main danger posed in respect to irrigation is the medium to high values of salinity as evidenced by the conductivity measurements. The hand dug wells are chemically and bacteriologically unfit for drinking without treatment.
- According to this study the groundwater potential of Raya Valley is promising from availability of recharge, existence of favorable geology and chemical composition of the water. The potentiality is particularly high on the western side of the valley where coarse grained alluvial material predominates.

Discussion:

The discussion was mainly focussed on the reason for high nitrate concentrations in some of the water samples, the reason for non-suitability of many shallow wells for drinking purposes, on soil quality, possible source for high sulphate, lowered groundwater table and high and shallow groundwater table, TDS values and river flow direction etc.

Presentation 4:

Assessment of water and soil quality for irrigation: A case study on hand dug wells and ponds in Gergera watershed, Atsbi District, Tigray, Ethiopia

Presenter: Yeshitela Bekele

Keywords:

- Surface water quality
- Groundwater quality
- Soil quality,
- Salinity-irrigation
- Hand dug wells and ponds
- Gergera watershed
- Atsbi, Tigray, Northern Ethiopia

Content:

- Suitability of hand -dug wells and ponds water and soil for irrigation was highlighted
- The area is mainly rain fed, subsistence oriented mixed crop-livestock production farming system; crops and vegetables grown are maize, potatoes, hot pepper, onion, lettuce and tomato and recently introduced fruit trees like *Avocado, Guava, Banana and Papaya*.
- 70 hand-dug wells and 30 household ponds are recorded. Out of which 10% of the structures were randomly selected for study and 7 hand-dug wells and 3 pond water samples were taken for analysis,
- 30soil samples were collected from the corresponding profile pits for analysis. Hand-dug wells water are of Ca-Mg-HCO_3 type and pond water Ca-HCO_3 type. EC of the hand dug wells water range from 570 to 1358 µS/cm and for ponds from 150 to 695 µS/cm.
- pH of the hand dug wells water range from 7.7 to 7.9 and the ponds from 6.7 to 8.3. SAR values of hand-dug wells range from 0.09 to 0.55 and pond from 0.02 to 0.13.
- 30 soil samples were taken from 0 – 20 cm, 20 – 60 cm and 60 to 100

cm, depths to assess salinity, soil samples from land irrigated by wells water show 17 µS/cm and 1445 µS/cm and pond water irrigated soil 51 µS/cm and 734µS/cm. EC (1:2:5) of water samples is higher than EC (1:2:5) soils. Runoff erodes mineral rocks and other salt constituents that can accumulate into the ponds. The soil has low salinity content. The pH value of hand- dug wells range from 6.5 to 8.0 and pond values from 7.5 to 8.2.

- SAR value of soil related to hand-dug wells ranged from 0.23 to 1.27 and ponds from 0.19 to 0.94.
- According to USDA soil classification, soils of Gergera watershed are normal soils.
- Ponds and hand-dug wells in Gergera watershed are suitable for irrigation without any danger to all crops. Over time soil and water quality assessment is necessary. Water management and utilization local bylaws should be organized by the land users. Community based deep well and series ponds should be adopted. Incentives in the form of training and capacity building. The use of acid reacting fertilizers should be replaced by organic manure and compost. Environmental and health issues should be considered.

Discussion:

The issues came up for discussion are acid producing inorganic fertilisers, organic manure substitution, basis for choosing the soil sample depths, soil salinity with depth, salinity due to water evaporation through capillary action, standardisation of sampling methods, the effect of groundwater conservation on groundwater table, life condition of the farmers and their net income due to harvesting, problems encountered due to water and soil quality, challenges and recommendations in the study area etc.

2.6 Group Discussions and Presentations Session I

Chairperson: Mr. Assefa Kassa

Rapporteur: Dr. K. Bheemalingeswara

Facilitator: Ms. Gayathree Jayasinghe

2.6.1 Reflection so far

An individual task where each participant was asked to take a card and write down ONE thing (take-away) the participant:

- found useful or interesting or
- can use or
- didn't know before or
- will remember months after the workshop.

To get an idea of the participant's perceptions of usable research results that were presented the cards were put up on different flip charts depending on their stakeholder group.

2.6.2 Challenges and opportunities in the utilization of groundwater for irrigation purposes

The participants were divided into five groups. Each group was formed on the basis of members from local action group (Farmers, NGO's, Extension Workers, and Local Government), bridging group (Extension Workers, Local Government, and Water Bureau), and strategy group (Academics, Policy Makers, Water Bureau, Extension Workers, and Local government).

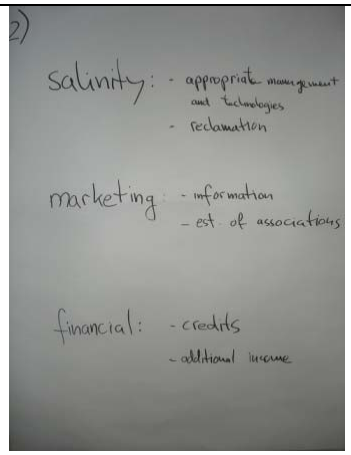
Each group was assigned to discuss the topics and note their comments in the given order:

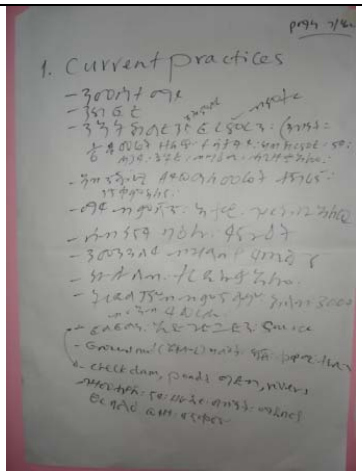
a) What are the current practices in irrigation and groundwater use?
b) What are the current problems on priority basis?

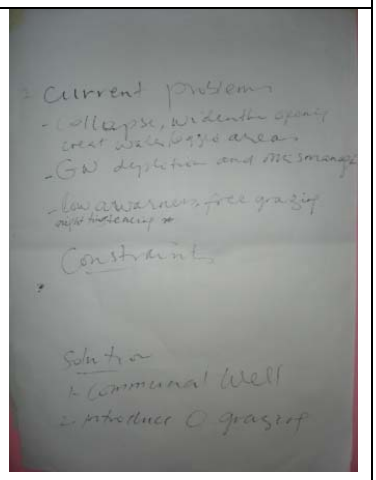
After the discussions, each group has noted the following issues and presented in the plenary:

Group 1	a)	Hand dug wells, ponds, 3 times irrigation (for vegetables and cash crops), used for cattle as well as for drinking, open mindedness for new techniques, adopting groundwater recharge structures, supplementary to rain-fed irrigation, suitability of reduced farm holdings.
	b)	Collapse of walls of hand dug wells, poor site selection for wells and ponds, shortage of groundwater due to construction of closely spaced wells, low quantities of groundwater due to shallow depths, poor irrigation/management methods, and lack of enough trained people.
	c)	Collapse of shallow hand dug well wall should be minimised by providing support in the form of financial or material assistance, skilled people should train the people, optimum spacing of hand dug wells, close monitoring of the recharge structures trenches, check dams etc., common hand dug wells for group of farmers, new irrigation practices

Group 2	a)	Hand dug wells, groundwater used for drinking, cattle and irrigation, check dams, microdams have helped to improve recharge, in some cases water is also being sold, encouraged to take land from others for irrigation, use of motorised and treadle pumps.
	b)	Collapse of well walls, groundwater depletion, mismanagement, lack of awareness to use water resources, stealing of water, free grazing in the night.
	c)	Community wells, stopping of free grazing,
Group 3	a)	Shallow groundwater wells, pumps, treadle pumps, sprinklers, deep water wells and pumps.
	b)	Salinity, marketing, financial problems.
	c)	Reclamation and appropriate management, information dissemination, associations, credit systems.
Group 4	a)	Hand dug wells, ponds, drip irrigation, treadle pump, motor pumps, and using water cane to water trees.
	b)	Fuel costs, pump high maintenance costs, theft, ineffective treadle pump, collapse of well walls.
	c)	Proper training for people, rope pump, drip irrigation, maintenance of pond, check dams through removing silt.
Group 5	a)	Earth dams, open channel irrigation, small stream diversions, ponds, treadle pumps.
	b)	Lack of maintenance, lack of integration, no financial support, technically poor.
	c)	Information dissemination between stakeholders, credit facilities, cost sharing, low cost technology, capacity building and training, government help for maintenance.







3 Day 2: Field Trip

The second day of the workshop has started at 8 A.M in the morning with field visit to Mendae Catchment (Abrha Asthbha, north of Mekelle). After the visit, due to lack of time, the team came back to Mekelle for lunch without visiting Metseko Catchment (Wukro). After lunch, the team proceeded to the next field visit to Dengolat Area, south of Mekelle.

3.1 Mendae Catchment (Abrha Asthbha, north of Mekelle)

The Mendae catchment area is situated near village Abrha Asthba 15 km west of Wukro and about 45 km from Mekelle towards north. Geologically, the area is located in the Mesozoic sedimentary rocks particularly Adigrat sandstone, overlying the Precambrian metamorphosed basement rocks. The rocks show well developed bedding and locally developed fractures and faults. The beds are trending NE-SW and dipping about 30-45^0 westwards indicating groundwater movement through these structures towards west. The alluvial soil cover is thick and at some places more than 10m. The soil color varies from black, red, brown to grey colors.

The runoff following the trend of the faults flows towards southeast. Major activity related to water conservation is being done by tapping the SE flowing runoff. Many ponds have been built at suitable locations to tap the runoff of different streams. These ponds since located on alluvium, they act like percolation tanks to supply water to the shallow hand dug wells downstream. To reduce possible damage to the banks of the water storage ponds, the velocity of runoff has been reduced by diverting their course. Spill ways are also provided for excess water. Trenches and check dams have been built as per the topography and stream characteristics. There are also sediment traps built to reduce flow of sediment downstream so as to reduce siltation problems. Since the alluvium cover is quite thick, the conserved water percolates downstream and recharges groundwater. Thus the shallow hand dug wells are providing water throughout the year and helping the farmers to irrigate their lands three times a year.

After visiting different structures, the team has visited the irrigated farm lands, cultivated using groundwater from the shallow hand dug wells. The water is pumped using treadle pump to the overhead tank and from which it will be supplied to the field through rubber pipes. In some case these tubes are perforated to carry out drip irrigation. Since the farm lands are small in size varying approximately from 0.5 to 2 ha, water available from shallow wells, seems is sufficient to grow vegetables, fruits and other cash crops. The vegetables include cabbage, green leaves, green chilli, tomato; fruits- papaya, orange, avocado and cash crops- ground nuts, pulses etc.

Since the water conservation program has started only 3-4 years back, the local farmers could see the difference now and before in terms of the benefits from irrigation. They are convinced with the technology and are looking forward to further improve the system so as to increase their returns and drive away the problem of food insecurity for ever.






3.2 Traditional Irrigation Scheme (Dengolat Area, south of Mekelle)

In Dengolat area, the team has visited the farms where the traditional irrigation practices are followed.

The area is situated about 40 km south west of Mekelle. Geologically the area is dominated by the younger intrusive dolerite dykes intruding the Mesozoic sedimentary rocks particularly sandstone, shale and limestone. The village Dengolat is located on the dolerite dyke itself. The dykes show well developed columnar joints and locally developed faults. These are the structures acting as channels for water percolation and accumulation. Chemically, the groundwater in dolerite is expected to be fresh and best suited for irrigation as well as for drinking purposes.

The team has visited a shallow well developed in dolerite dyke. The depth of the well is about 6m. Since, recharge of groundwater water is quite effective, there is sufficient amount of water available in the well for irrigation purposes. The farmer is cultivating more than 5 ha and is interested to extend it further. Water is supplied using motor pump through field channels not pipes. Available modern techniques are not practiced here. Since, the area is backward and so far practicing rain fed irrigation system, use of groundwater for irrigation has become a new trend now, in the area. This change has attracted many farmers to follow suit. From this perspective the present site attains importance.

This shallow well is providing sufficient amount of groundwater, through out the year, to cultivate fruits (avocado, papaya), vegetables (cabbage, tomato), food (Teff, pulses) and cash crops (ground nuts). Major part of the produce is being supplied to the markets of the nearby towns like Mekelle and earning handsome returns.

After Dengolat, on the way to Mekelle, the team has visited a microdam known as Iowa dam. The structure is built in sedimentary rocks mainly limestone with spillways. Siltation is visible in the dam. Many irrigable lands in the upper catchment have been affected by the dam due to submergence. It is supplying water to irrigate land downstream through canal network.

4 Day 3: Workshop

4.1 Presentations –Session III (Morning)

Chairman: Dr. Kassa Amare

Rapporteur: Dr. K. Bheemalingeswara

Presentation 5: **Recharging practices for enhancement shallow hand dug wells discharging in Deberkidane Watershed, Northern Ethiopia** Presenter: Asmelash Berhane	

Key Words:

- Hand dug wells
- Groundwater recharge
- Water recharge practices
- Debrekidane watershed,
- Tigray, Northern Ethiopia

Content:

- Various groundwater recharge practices were highlighted.
- Percolation and Household Ponds, 46 percolation ponds (≥1620 m^3/pond) were constructed in the upper catchments of the hand dug wells under which about 74,520 m^2 will be harvested per year.
- 360 hand dug wells were recorded in the area. Hand dug wells adjacent to the percolation ponds show increased water table by few meters and water is available for the whole year. Additional benefit of percolation ponds is that it minimized the effect of run-off generated from upper part of the catchments on the lower and also limit the development of gully and rill

- Household ponds of clay compacted type were also constructed in the watershed to allow downward percolation. 441 such household ponds is supporting water harvesting of about 0.08 Mm3.
- Grazing Lands improvement, adopting cut -carry system/enclosure and constructions of trenches, plantations of fodder trees like *leucaenia leucocephala, Sesbania sesban* and practicing grass sowing and plantation. Rehabilitation of the land use system has a positive contribution to minimize land degradation through free grazing.
- Catchments and gully treatment, catchment's treatment by physical and biological soil water conservation measures improves the vegetation coverage of the area (AC& plantation). SWC 1147.18 km, averagely, 32 trees/HH MPT's on farm plots were planted (9% fruits, 29% fodder trees, 62% fuel wood and other uses).
- Upper catchments treatment with physical and biological soil and water conservation measures and household ponds construction, grazing land improvement practices by sowing and planting of grasses and trees seedlings for the adoption of cut-carry system were adopted to enhance the recharging of groundwater.
- To maximize the opportunities of the hand dug wells utilization for irrigation, the following recommendation are suggested: Groundwater potential of the watershed should be investigated to overcome the overexploitation of groundwater and to know the maximum limit of abstraction; recharging measures should require due attention by the community to maintain and maximize the discharge amount for the sustainable utilization in the watershed; and integrated watershed management approach should adopt for sustainable utilization of the resources.

Discussion:

Issues rained by the audience during discussion were the compact layers and percolation, rise in groundwater table levels due to recharge, changes observed in the life condition of the people before and after the hand dug wells, water conservation using structures like trenches, challenges of groundwater recharge, reactions of the farmers feel when

they are not the beneficiaries, problems associated with construction of percolation tanks in the upstream and irrigation in downstream, use of geological structures for conservation and enhance recharge, recharge structures in the upper catchment areas where there is no population and with significant population, pumps and other means to help irrigation in the upper catchment areas.

Presentation 6:

How can farm– managed irrigation and water conservation improve food security in Ethiopia

Presenter: Ms. Cara Flowers

Keywords:

- Farmer- managed irrigation
- Water management
- Traditional irrigation strategies
- Water conservation
- Food insecurity reduction
- Irrigation technologies
- Discounted cash flow
- Management and markets
- Livelihood strategies
- Ethiopia

Content:

- Agriculture accounts for 47% of GDP and about 80% of population involved in this sector. Infrastructure wise - 29km road per 1000km^2, 80% of population live in rural areas, 80% of population live in highlands. Currently the land under irrigation is estimated to be approximately 2.5 million ha and most of the unused cultivable (and irrigable) land is inaccessible and malaria-infested lowlands
- Rainfall temporally and spatially variable, 800 - 2000mm/year in highlands, from 200mm to 800mm/year in lowlands and food insecurity

even in good rainfall years and country's GDP shows a correlation to rainfall due to significance of Agriculture sector.

- Though supposed to be free from food aid by 2007, about 8.6 million rural Ethiopians were estimated to require humanitarian food assistance in 2007. Productive Safety Net Programme (PSNP) was aimed to target chronically food insecure.
- Different strategies have been adopted such as inter & intra household food redistribution, livestock sale, income diversification, drawing on social capital, strategy dependent on asset base, complex responses, short-term versus long-term.
- Since, commonly followed classification of irrigation in Ethiopia being > 3000 ha as large-scale, 200 - 3000 ha medium-scale, and < 200 ha small-scale; and at the same time the average landholding in Ethiopia is considered to be about 1ha, with regional average plot size can be as little as 0.5ha.
- The study has considered various technologies that are in practice such as modern river diversion (MRD), motor pump, treadle pump, bucket lift, rainwater harvesting and soil water conservation, and traditional river diversions (TRD).
- Method used in the study is discounted cash flow (equivalent annual costs method) and the exercise is literature based particularly from Annen (2001).
- Many assumptions have been made regarding irrigation budget which included- labour costs, input costs (fertilizer, seeds, pesticides), post-harvest crop losses of 30%, cropping intensity, at the same time without irrigation it is 126%, with treadle pump, bucket lift, RWH & SWC, 150%, with modern river diversion, motor pump and traditional river diversion, 250%.
- Results of financial assessment indicate that net profit (profit minus equivalent annual costs (EAC)) has been maximum i.e.5387 compared to other technologies.
- Limitations in the study include, no accounting for price changes due to seasonal fluctuation, assuming the same cropping composition for each technology, small suite of crops, non-inclusion of transport costs,

assumes market access for crop sale and also assumes no processing.

- So, factors like management, markets, gender, institutions and policies, livelihood strategies and sustainability were considered useful. It is concluded that increased focus on traditional irrigation strategies such as traditional river diversion, selective upgrading of systems, adaptive to the environmental and social terrain, linking irrigation to the wider poverty and food insecurity reduction picture can resolve food insecurity problem in Ethiopia. So, irrigation and water conservation go in hand in hand, do not exist in isolation.

Discussion:

This presentation being more theoretical had attracted queries on many issues. Discussion was mainly focused on selection of the areas for the study and the conclusions are drawn, the methodology followed, selection of land unit as 1 ha and doubtful conclusions, adoption of modern methods over traditional irrigation practices, increased focus, use of motorized water pumps and cost factor, the market sites, their distances and related costs, figures related to irrigated land, groundwater resource potential of different regions and their comparisons, food insecurity even during good times etc.

Presentation 7:

Technical and economic evaluation of treadle pump spray- head irrigation systems for small farm holders at Jimma Zone, Ethiopia

Presenter: Dr. Tena Alamirew

Keywords:

- OARI Treadle pump
- Technical and economic evaluation
- Spray- head irrigation system
- Hand watering can irrigation system

- Potato production
- Small farm holders
- Jimma
- Ethiopia

Content:

- The study has tried to characterise the treadle pump and evaluate technical and economic performance of OARI treadle pump spray-head irrigation system and highlights its performance over conventional hand watering can irrigation system.
- Characterization of the pump was made by field observations, measurements of the pump discharge capacity (lit/sec) and frequency of pedalling (cycle/min) at different suction lifts (m) and operators' weight. The technical evaluation was made by taking application, storage, distribution and water use efficiency. The economic benefit was estimated by calculating the NPV, BCR and IRR.
- The results of characterizing OARI type pressure treadle pump in terms of discharge capacity showed an average of 0.57 lit/sec, 0.51 lit/sec and 0.47 lit/sec by operators' weight of 65 kg, 45 kg and 55 kg respectively. The average pump discharge capacity of 0.75 lit/sec, 0.67 lit/sec, 0.41 lit/sec and 0.22 lit/sec were obtained at 3 m, 4 m, 5 m and 6 m depths of water sources, respectively. This discharge capacity could meet the irrigation requirements of most smallholder irrigators who cultivate less than a hectare of land;
- The system efficiency of the OARI type pressure treadle pump was computed by using the pumps input and output energies in joule per second and a result of 21.92 %, 20.67 % and 17.85 % were obtained by pump operator weight of 45 kg, 65 kg and 55 kg respectively.
- The result of the analysis of irrigation performance measures of treadle pump irrigation system showed that 67 %, 82 %, and 77 % for application, storage and distribution efficiencies respectively as compared to 48 %, 75 % and 59 % of application, storage and distribution efficiencies for hand watering can irrigation method.
- An extra increase of 55.45 qt/ha (about 15.23 %) of potato yield was obtained by adopting treadle pump spray-head irrigation system for

one hectare potato cultivation and also the water applied on treadle pump irrigated potato plots was significantly lower (36.18 cm) than that of the hand watered irrigated plots (51.12 cm). The result of this study revealed that there is an increase of 0.41 ha for every 1 ha of potato cultivation.

- The economics of cultivating one hectare of potato has resulted a NPV Birr 47,064.61, BCR of 1.67 and IRR of 672 % at 10 % discounting rate under treadle pump irrigation method. Similarly, in hand watering irrigation method, a NPV 5,184.27, BCR of 1.06 and IRR of 545% were obtained.
- On the basis of results, it is suggested that the treadle pump as it stands now needs two person to operate- one pedalling and the other person watering. But this could be used in conjunction with drip sets and low head sprinklers, creating a smallholder pressurized irrigation system.
- Currently manufactured pumps by Rural Technology Research Centres and local manufacturers lacks precision. Further refinement of construction process should be made before selling it to farmers. Extension and development agents should first themselves be convinced and get trained before they take up pumps distribution.
- Use of shower-head helped in the uniform distribution of water in the field. Hence this shower-head should be made as an integral part of the system.

Discussion:

Various issues highlighted during the discussion were, two different irrigation treatments, factors having impact on better production, functioning of the pump, its frequency and cost, problems encountered while working with the pumps and generation of groundwater depth-wise data, types of pumps available in the market and comparative data on the efficiency of different pumps and problems related with each type of pump, production Treadle pump in Ethiopia in collaboration with universities and industry etc.

4.2 Student Discussion

Chairman: Dominik Ruffeis

Rapporteur: Helene Rieckh

To get to know each other better everybody introduced himself in a more detailed way. (Study area, years of study, etc.) A discussion on the four major topics followed.	

Question 1: What benefit do you have from participating in this workshop?

- established networks and platforms
- additional information to classes (practical examples)
- feather education

Question 2: What opportunities and chances does the workshop have for you?

- link between different stakeholders
- get to know people for possible jobs after studies

Question 3: Suggestions for improvement (workshop setup)?

- more graphics in the presentations (related to the concern that the farmers couldn't follow the presentations)
- holding the conference in Tigrinia (the local language)
- more practical demonstrations
- showing small movies, cartoons
- some little items for the farmers to take home with them as reminders (photos, pictures, cartoons)
- more interaction between farmers with and without the knowledge

Question 4: What problems do you face during your studies?

General problems:

- no introduction of the different ethnic groups of Ethiopia (different habits)
- lack of budget

Problems related to studies:

- mainly theoretical and no practical courses
- lack of skilled staff
- limited facilities in the laboratory
- limited access to computers and internet (restricted access, maintenance)
- only 3 fieldwork trips each for 2 weeks
- no financial support for fieldwork – lack of awareness of the costs in other departments

4.3 Group Discussions and Presentations Session II

Chairperson: Mr. Mebrahtom G/kirstos

Rapporteur: Dr. K. Bheemalingeswara

Facilitator: Ms. Gayatree Jayasinghe with active support from translators and pertners from Mekelle University and BOKU

The participants were divided into four groups. First two groups comprising researchers, local government, NGOs, water bureau, policy makers and other two groups only the users.

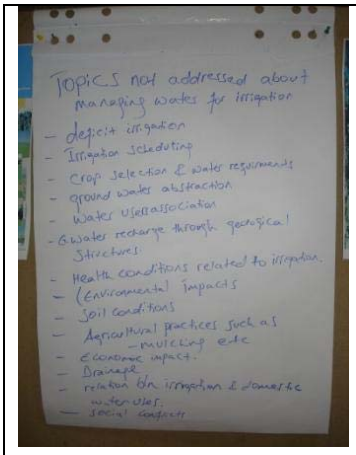
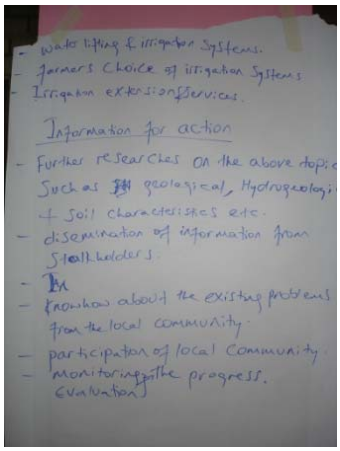
4.3.1 Group Discussion Session – "Evaluating dissemination I: Knowledge gaps / Information needs"

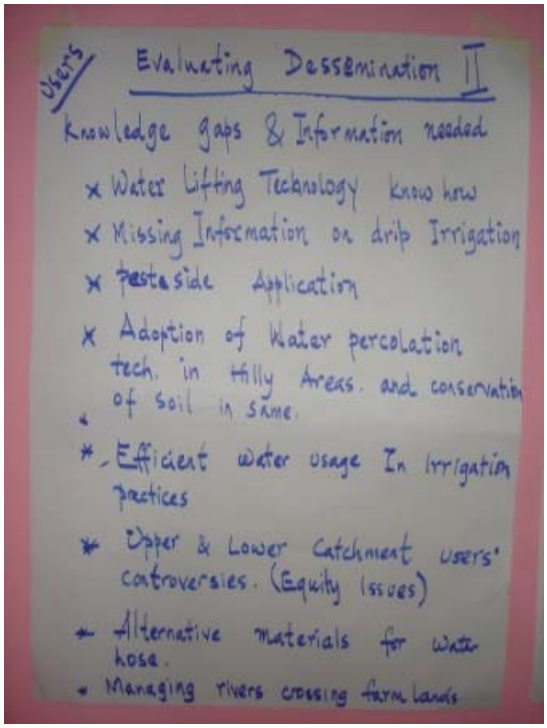
Round 1

All the groups were assigned the task of addressing the question ***"Is there anything that you still need to know in relation to managing water for irrigation that you DIDN'T find in the workshop? What information do you still need that would enable you to take action?".***

Following are the gaps identified and presented by Researchers and Users.

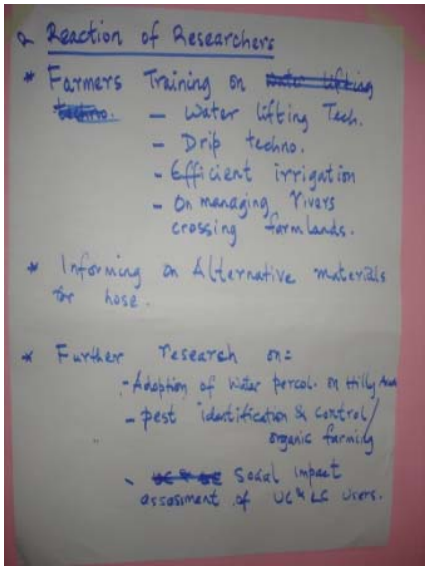
Topics not addressed or need some more attention ***Researchers***	
Group I	• Deficit irrigation • Irrigation scheduling • Crop selection and water requirements • Groundwater abstraction • Water associations

	• Groundwater recharge through geological structures • Health issues related to irrigation • Environmental impacts • Soil conditions • Agricultural practices such as mulching etc • Socio- economic impact • Drainage • Relation between irrigation and domestic water uses • Social conflicts due to water sharing (equity issues) Further researches are needed on the topics such as • Geological, hydrogeological and soil characteristics • Methods of dissemination of information to different stakeholders, • Know the existing problems from the local community and provide solution • Participation of local community • Monitoring and evaluating the progress
Group II 	• Water lifting and irrigation systems, • Farmers choice of irrigation systems, • Irrigation extension and other services • Economic feasibility of water pumps- its size, type and fuel used, • Selection of crops at different watersheds such as swampy, low moisture etc, • Studies for policy makers about land and water management, • Studies on surface and groundwater –resource potential, • Some more elaboration on – micro-dams, underground water tanker, springs, RRWH, ponds • Watershed management approach, • Low cost appropriate technologies need to be studied well

Important gaps during workshop and information needed as per Users	
Group I  	• Water lifting technology, • Drip irrigation, • Pesticide applications, • Adoption of water percolation techniques and soil conservation in hilly areas, • Efficient water usage and related irrigation practices, • Equity issues related to upper and lower catchment users, • Suggestions on alternative materials for water hose pipes, and Management of river crossing farm lands.
Group II	• Lack of communication between researchers and extension workers and beneficiaries • Poor market access • Supply Vs demand • Water utilisation efficiency by laws and policies

Round 2

Groups switch stations. User group moves to the flip chart of the researcher group and vice versa.

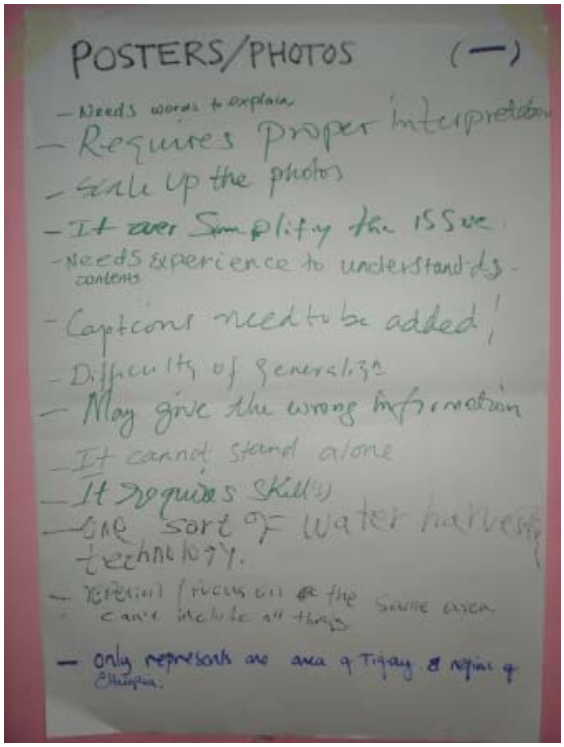
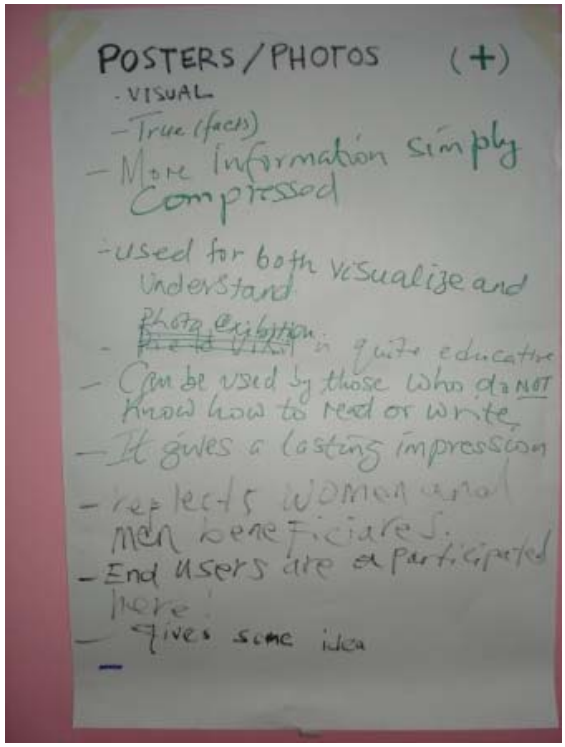
<table>
<tr><td colspan="2">Researchers
(Given the information gaps identified by users, A) What information do you think is missing from that presented during the workshop to help action in irrigation and groundwater? B) What are you able to provide now? C) What requires research?)</td></tr>
<tr><td>Group I
 
</td><td>A) Farmers need training on -
• Water lifting techniques,
• Drip techniques,
• Efficient irrigation techniques, and
• On managing river crossing farm lands.
B) Information on alternative material for hose pipe used for water supply
C) Further research is suggested for-
• Adoption of water percolation on hilly areas,
• Pest identification and control,
• Organic farming,
• Social impact assessment of upper & lower catchment users.</td></tr>
<tr><td>Group II</td><td>A) Research Institutions, Universities and other organisations can combinedly involve in face to face discussions and planning
B) Information may be provided on
• Marketing
• Cooperatives
C) Further research is suggested for
• Economic modelling studies
• Socio-economic studies
• Impact on down and upstream irrigation</td></tr>
</table>

Users (Given the information gaps identified by researchers, ***are these really gaps? Would these points help action? OR should the researchers be providing different information/ knowledge?***)	
Group I	• Fertiliser provision • Pesticides and insecticides • Capacity building • Market conditions • Spacing and population size of seedlings • Expert recommendations for site selection of wells • Expert suggestions for selecting and identifying seeds • Soil nature and different suitable crops
Group II	• Low cost, easy to maintain pumps to draw water, • Suitable methods to use water upper catchment, • Suggestions on suitability of soil for different crops, • Selection of seeds and suitable crops in low moisture conditions, • Information on policy issues for better water management, • Additional information on micro-dams, underground water tanker, springs, RRWH etc,

4.3.2 Group Discussion session - evaluating dissemination II: Dissemination formats

The participants were divided into 5 groups. Each group was asked to write their positive and negative experience during the workshop and in general, on 4 information dissemination formats. They were also given the opportunity to suggest alternative dissemination formats in which they would like to receive information. Flip chart stations were prepared for each of the four dissemination formats as well as one for discussion around alternatives. The five groups work stations were- a) Posters and Photos; b) Print; c) Demonstrations and Field visits, d) Oral presentations; and e) Others. Each group had 10 minutes at each station before moving to the next.

a) *Posters* and Photos (Visuals)

<table>
<tr><td>(+) Pros</td><td>(-) Cons</td></tr>
<tr><td> 
</td><td> 
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<tr><td>

- True and factual information
- More information simply compressed
- Used for both visualization and understanding
- Photo exhibition is quite educative
- Can be used by those who do not know to read or write
- It gives a lasting impression
- Reflects both women and men beneficiaries
- End users are participated here
- Gives some idea

</td><td>

- Needs words to explain
- Captions need to be added
- Requires proper interpretation
- Scale up to the photos
- It oversimplify the issue
- Needs experience to understand its contents
- Difficulty of generalization
- May give the wrong information
- It can not stand alone
- It requires skills
- One sort of water harvesting technology
- Repetition/ focus on the same area and do not include all things
- Only represents an area of Tigray region of Ethiopia

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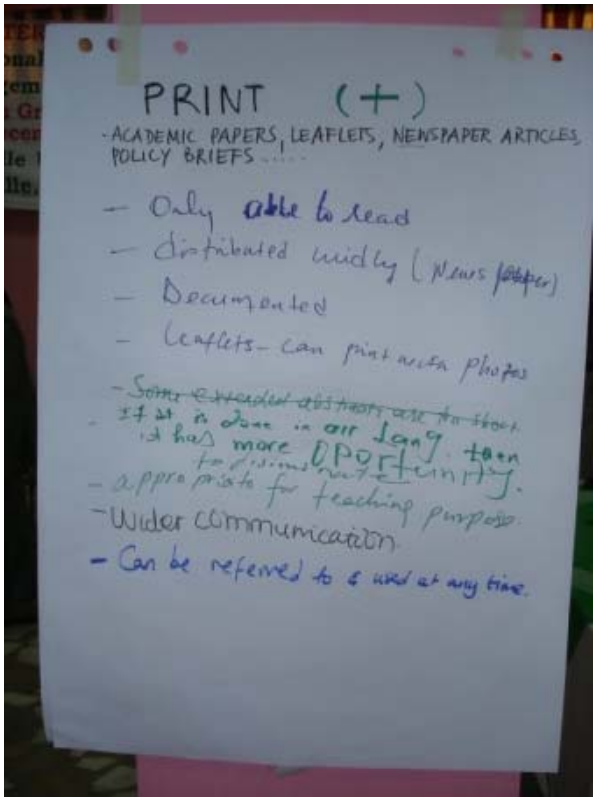
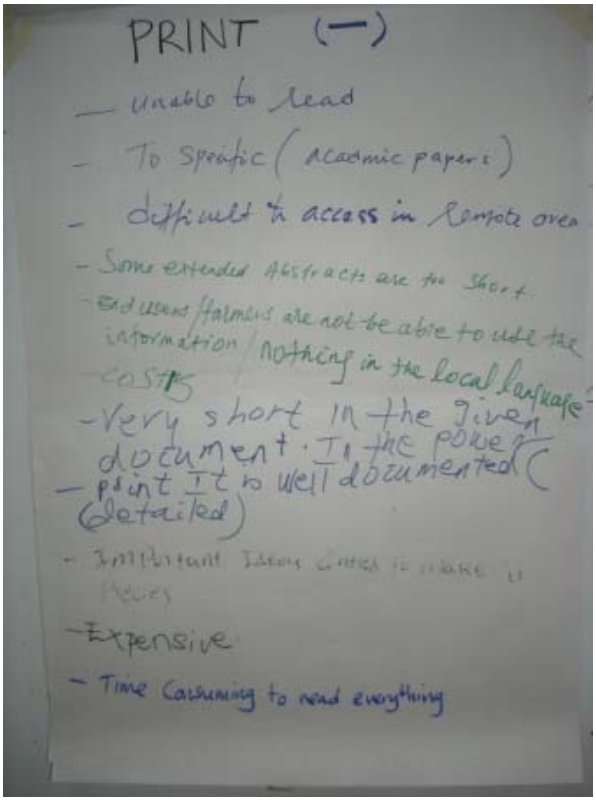
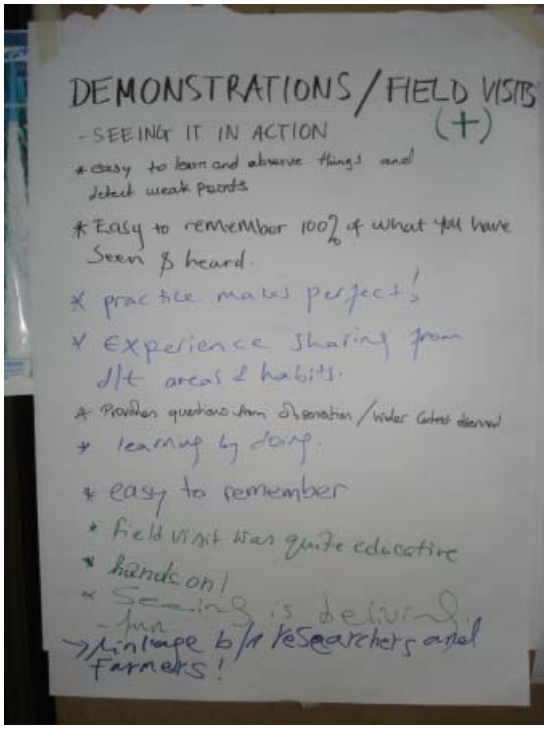
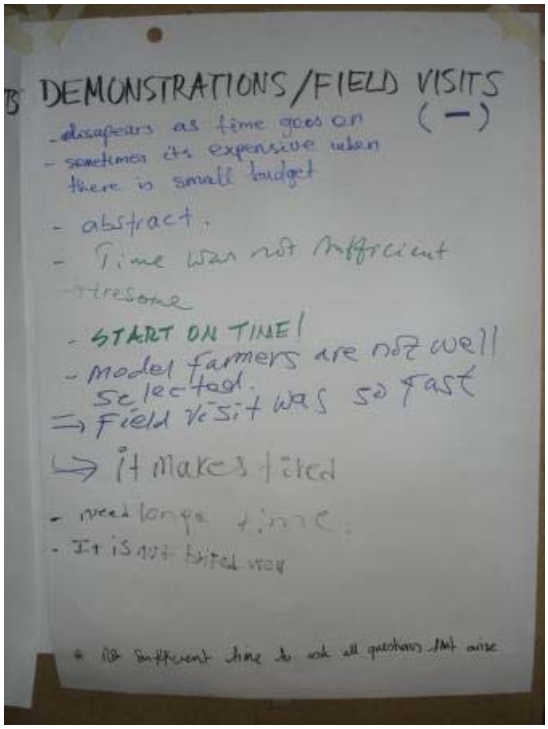
</table>

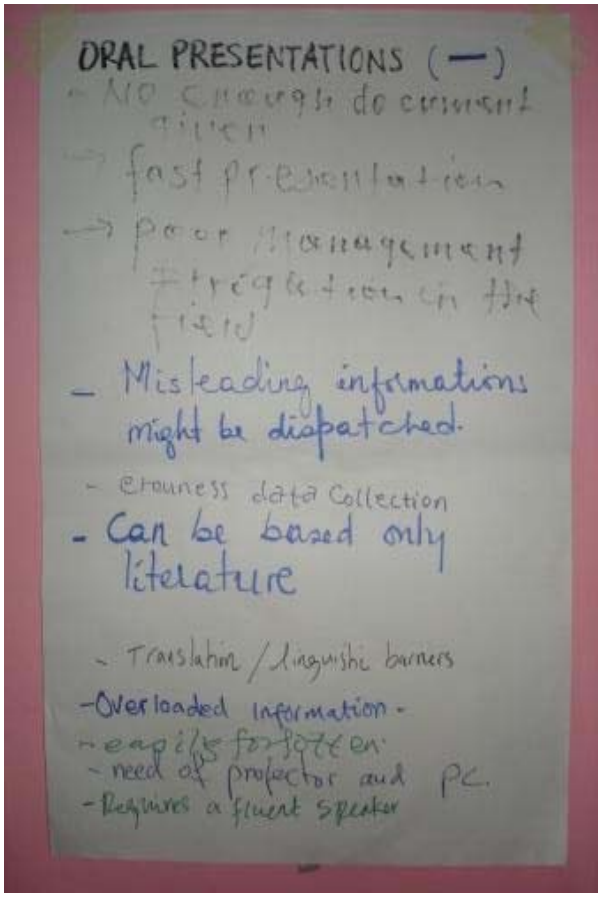
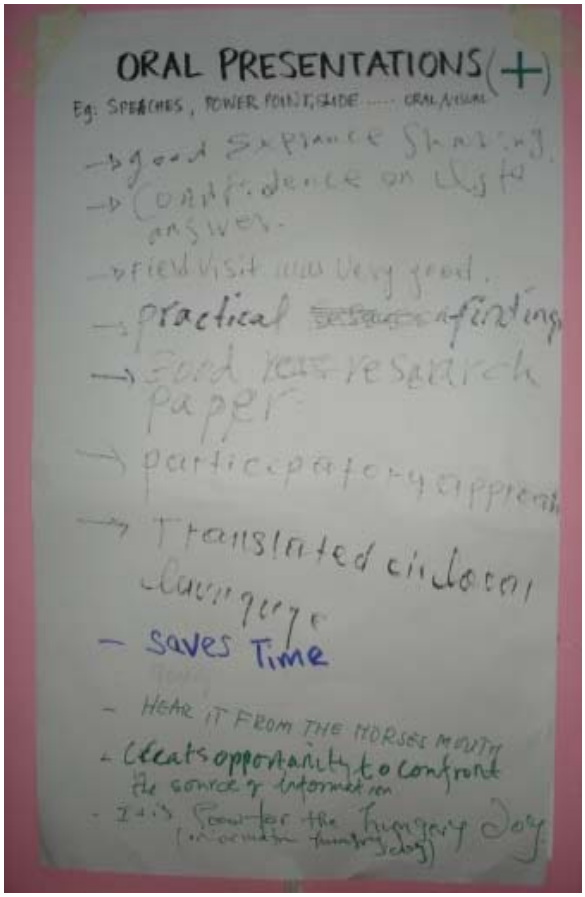
b) Print (Academic papers, Leaflets, Newspaper articles, policy briefs…..)

(+) Pros	(-) Cons
	
• Wide distribution and communication • Only able to read • Documented • Leaflets can print with photos • If it is done in all languages then it has more opportunity for dissemination • Appropriate for teaching purpose • Can be referred to and used at any time	• Many are unable to read • Very specific like academic papers • Difficult to access in remote areas • Some extended abstracts are too short • End users/farmers are not be able to use the information as nothing is in the local language • Expensive affair • Information is short in the document while well documented in power point • Incorporation of important ideas to make it more precious • Time consuming to read everything

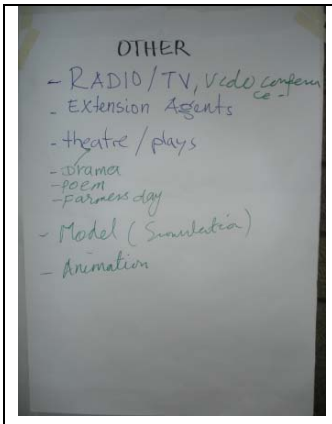
c) Demonstrations and Field Visits

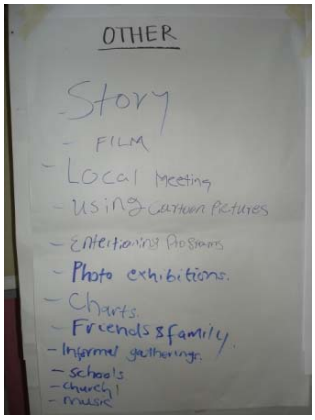
(+) Pros	(-) Cons
	
• Seeing it in action and seeing is believing • Easy to learn and observe things and detect weak points • Easy to remember 100% of what you have seen and heard • Practice makes things perfect • Experience sharing from different areas and habits • Provokes questions from observation/ wider context observed • Learning by doing • Easy to remember • Field visit was quite educative and good • Linkage between researchers and farmers	• Disappears as time goes on • Sometimes it is expensive when there is small budget • Abstract • Time was not sufficient • It is tiresome • Should have started on time • Model farmers selection not upto the mark • Field visit was so fast • Briefing in the field was not good • The questions could not be asked due to lack of time

d) Oral Presentations *(Speeches, Power point, slide….oral/visual)*

(+) Pros	(-) Cons
	
• Good experience sharing • Confidence on question to answer • Practical findings • Good research papers • Participatory approach • Translation into local language • Saves time • Hear it from horse's mouth • Creates opportunity to confront the source of information • Good for the information hungry people	• Documents provided are insufficient • Fast presentations • Misleading information might be dispatched • Erroneous data collection and presentation • Can be based only on literature • Translations/ linguistic barriers • Overloaded information • Need of projector and PC • Easily forgotten • Require more fluent speakers

e) Others *(information dissemination by any other means)*





Story
Film
Local meetings
Using cartoon pictures
Entertaining programs
Photo exhibition
Charts
Friends and Family
Church
Informal gathering
Schools
Music
Radio
TV
Video conference
Extension agents
Theatre / Plays/ Drama
Poems

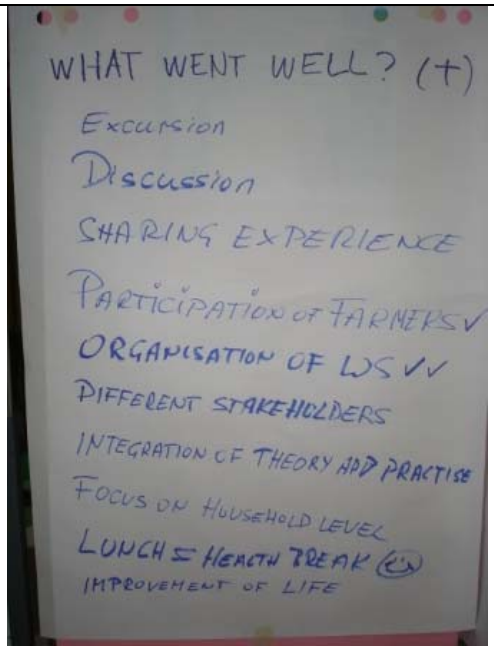
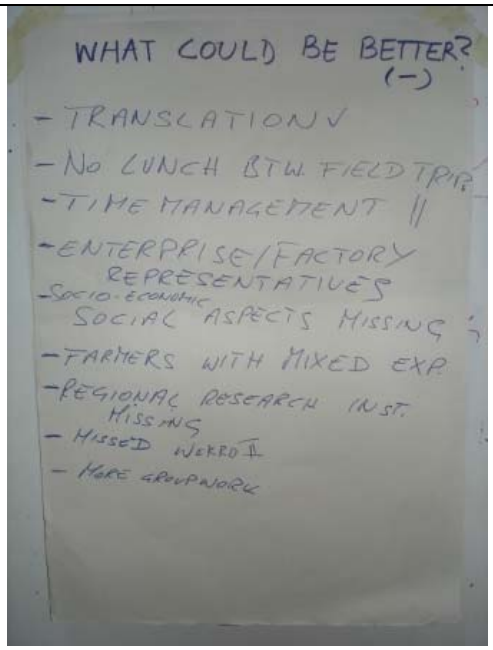
4.4 Evaluation of the Workshop

4.4.1 Topics covered

- Appropriate water conservation technologies and management.
- Experiences of PELUM members, St. Jude and IRDI from Uganda particularly on runoff water tanks, spring water wells, rainwater harvesting tanks and jars, rope pumps and ecosan toilets and on women participation
- Sustainable management of groundwater resources and related national policy issues on surface water and groundwater
- Some of the successfully adopted recharge practices such as percolation ponds, house hold ponds, trenches, grazing land improvement, plantations etc and impact on socio-economic conditions.
- Groundwater resource assessment and quality issues related to irrigation and other purposes.

- Soil quality in relation to runoff pond water and groundwater and soil salinity increment and possible impact on crop production
- Characterization, technical and economic evaluation of treadle pump and its use in small scale irrigation/ for farm holders
- Treadle pump spray head and hand watering can irrigation systems, their comparison with production rates e.g. potato production
- Farmer managed irrigation and food insecurity in Ethiopia
- Water conservation, food insecurity reduction and traditional irrigation strategies
- Irrigation technologies, livelihood strategies and marketing

4.4.2 Outcome of participatory "After Action Review"

(+) What went well	*(-) What could be better*
• Field excursion visits were organized well. They were quite educative • Discussion in groups in session I and II were very good keeping the mixed composition of the groups in view • Sharing of experience • Participation of farmers has been very unique • Workshop has been organized very well • Participation of different shareholders • Workshop tried to integrate theory and practice well • Focus on household level is a welcome step • Lunch and health breaks were according to the schedule with good food supply.	• More translations would have been better • There should not have been lunch between field trips because of which missed Wukro field visit • Time management needs some improvement • Presence of enterprise/ factory representatives • Socio-economic issues are missing, should have included in discussions. • Farmers attending the workshop have mixed experience, many of them might not have extracted the best from the workshop • Regional research Institutes are missing, should have attended • Group related work should have been more
	

5 Final remarks about the workshop and Way Forward

5.1 Final remarks about the workshop and the way forward by Prof. J.F. Schneider

1. *Main Tasks of WATERMAN:*
   - Networking, building Knots between the different Networks
   - Knowledge Transfer / Capacity Building
   - Awareness Building / Dissemination
2. *Four Workshops and Symposium*
   - Kickoff Addis
   - Awassa
   - Alamaya
   - Haramaya
   - Mekelle

   + *Symposium Addis February 12/13, 2008*
3. *Workshop 4, Mekelle*
   - Sandwich: Theory – Practice – Theory
   - Theory not only theory but
   - Presentations, Discussions, Group work, Plenum
   - Three types of Presentations:

     -General overview/ external experiences (Ruth, Cara,..)

     -Situation Tigrai Watersheds (Nata, Tena, Dessie,)

     -Specific Problems and Solutions (Yeshitela, Asmelash,..)
4. *Important Exchange between:*
   - Academics
   - Local Leaders / Stakeholders / Decision Makers
   - Farmers, Students and specially the females
   - (NGOs, Private Sector)

   + *All of us have learned!*
5. *Result is encouraging:*
   - Improvement in communication
   - Improvement in understanding
   - Improvement in efficiency

- Mistakes and drawbacks are here to learn
  (Artificial recharge can result in water logging)

6. *Future Needs and better Understanding:*
   - Reaction of Aquifers to Artificial Recharge
   - Role of Capillary Fringe Zone
   - Simple Instrumentation for Measurement and Monitoring
     -Local Rainfall
     -Evaporation
     -Water Level Fluctuation
     -Capillary Rise /Infiltration Rates
     -Permeability / Transmissivity
7. *Thanks from the Steering Committee of WATERMAN*

5.2 Closing Speech by Prof. W. Loiskandl

It was a pleasure to address you in the opening session and now it is an honour for me to be invited to officially close this workshop. It was a pleasure to be here in Mekelle and also was provided with the opportunity to attend very informative fieldtrips.

Professor Schneider provided a summary of the workshop already therefore after this long session I will keep my closing remarks short. Of course not everything was addressed but I feel that the workshop could in bringing people together. I hope this was not a single event as Haleka Gebreslassie Gebru was saying in his remarks to the workshop and we have put a seed into the ground which may be very prosperous.

At the end of this workshop I like to send thank all participants for coming and the active involvement and especially the farmers also for the cordial welcome at their homes. My gratitude also goes to the translators, without them this workshop would not have been so successful.

Last but not least I like to thank the organizers for hosting this workshop. I just name to persons Dr. Nata Tadesse and Dr. Dessie Nedaw for all those who were standing behind the screen. From the feedback it is very clear that the organisation was appreciated very much by all participants.

With this I declare the workshop as closed and I wish you a save journey wherever you have to travel and a good harvest in future.

Thank you all.

6 Annex

6.1 List of the Participants

	Name	Instituation
1	Prof. Jean F. Schneider	BOKU, Austria
2	Prof. Willibald Losikandl	BOKU, Austria
3	Mr. Dominik Ruffeis	BOKU, Austria
4	Ms.Helene Rieckh	BOKU, Austria
5	Mr. Trufat Hailemariam	BOKU, Austria
6	Prof. Svatopluk Matula	Czech University of Life Sciences (formerly Agriculture)
7	Dr. Tim Hess	Cranfield University, UK
8	Mr. Javier Fernadez	Cranfield University, UK
9	Ms. Cara Flowers	Cranfield University, UK
10	Dr. Mulu Bairay	Mekelle Universty
11	Dr. Dessie Nedaw	Mekelle Universty
12	Dr. Nata Tadesse	Mekelle Universty
13	Dr. Kindeya G/Heiwet	Mekelle Universty
14	Dr. Niguise H/Weine	Mekelle Universty
15	W/o Tsega G/Kirstos	Mekelle Universty
16	W/t Tgist Areaya	Mekelle Universty
17	Ato Mebrahtom G/Kirstos	Mekelle Universty
18	Ato Asefa Kasa	Mekelle Universty
19	Ato Tewdrose Alemayehu	Mekelle Universty
20	Dr. Kasa Amare	Mekelle Universty
21	Dr. Behemaligeswara	Mekelle Universty
22	Dr. Kurkura Kabeto	Mekelle Universty
23	Ato Amanueal Gebru	Mekelle Universty
24	Ato Yeshtla Bekele	Mekelle Universty
25	Ato Asmelash Berhene	Mekelle Universty
26	Mulugeta Dadi	Awassa University
27	Asegid Cherinet	Awassa University
28	Shimelis Assefa	Awassa University
29	Alemayehu Muluneh	Awassa University
30	Dr. Tena Alamire	Haromaya University
31	Dr. Benedicat Mutua	Egerton University, Kenya
32	Ms. Gayathree Jayasinghe	IWMI, Ethiopia
33	Dr. Akica Bahri	IWMI, Ghana
34	Ms. Ruth Nabaggala	PELUM, Uganda
35	Getachew Girmay	REST, Mekelle
36	Yemane G/her	REST, Mekelle
37	Yemane	Water Beuro, Mekelle
38	Dr. Gatachew	Water Work &construction Enterprise, Mekelle
39	Ato Luele Fessha	Unicef, Mekelle

40	Genet Tadesse	Agricultual Bureau of Wukro
41	Mehari Gebremedhin	Agricultual Bureau of Wukro
42	Mekonnen Teferi	Agricultual Bureau of Wukro
43	Muuz Berhane	Agricultual Bureau of Wejerat
44	Kiros Tadesse	Agricultual Bureau of Wejerat
45	Aradom Kidanu	Agricultual Bureau of Wejerat
46	Yeshitila Bekele	Technical College of Wukro
47	Tsegereda Ayalew	student, Mekelle University
48	Endalu Tadelu	student, Mekelle University
49	Ermias Admasu	student, Mekelle University
50	Fesehaye Misghina	student, Mekelle University
51	Abraham Bairu	student, Mekelle University
52	Ato Mehari G/Medihen	farmer (Wukro)
53	Ato Mekonnen Teferi	farmer (Wukro)
54	W/t Genet Tadesse	farmer (Wukro)
55	Ato T/Haimanot Nirai	farmer (Wukro)
56	Ato Tareke Teka	farmer (Wukro)
57	Ato G/Yesus H/maryam	farmer (Wukro)
58	Ato Fiseha Gebru	farmer (Wukro)
59	Ato Teklecheale Zegeye	farmer (Wukro)
60	Ato H/Slasie Gebru	farmer (Wukro)
61	Ato H/Maryam Alemayo	farmer (Wukro)
62	Ato Micaile Gidey	farmer (Wukro)
63	Ato Ayalaw Heyanta	farmer (Wejerat)
64	Ato Kiros Tadesse	farmer (Wejerat)
65	Ato Hailu Tesfay	farmer (Wejerat)
66	Ato Heleka Bairay Tesfay	farmer (Wejerat)
67	Ato Kelali Berhenu	farmer (Wejerat)
68	W/ro Mebrahtey Meresa	farmer (Wejerat)
69	Ato Hagos Heilu	farmer (Wejerat)

6.2 Time Table

4th WATERMAN Workshop

MEKELLE UNIVERSITY, Mekelle

"Water Supply and Integrated Water Resource Management- focus on groundwater"

Date: 3rd - 5th of December 2007

Venue: Mekelle University, Mekelle, Ethiopia

Agenda:

Day 1: December 3rd Morning Session	
8:30 – 9:00	Registration
9:00 – 9:10	Welcome note by Dr. Dessie Nedaw,Dean FST
9:10 – 9:20	Opening speech by Dr. Mulu Bayray, AVPAR
9:20 – 9:30	Objectives of WATERMAN by Prof. W. Loiskandl
9:30 – 9:45	Keynote speech by Dr. Getachew
9:45 – 10:00	Introduction of Participants by themself
10:00 – 10:30	Break
10:30 – 10:50	**Presentations:** *Chairman: Dr. Kassa Amare* *Rapporteur: Dr. K. Bheemmanlingeswara* **1. Rational Use of Ground Water, Case Study of Plenum Members' Water Project in Uganda** by Ms. Ruth Nabaggala (Intergrated Rual Development Initiatives)
10:50 – 11:00	Discussion
11:00 – 11:20	**2. Sustainable Management of Groundwater Resources: A Case Study in the Weri River Basin, Tigray, Ethiopia** by Dr. Nata Tadesse (Mekelle University)
11:20 – 11:30	Discussion
11:30 – 12:30	Chart and Photo exhibition
12:30 – 14:00	Lunch break
Day 1: December 3rd Afternoon Session	
14:00 – 14:20	**Presentations:** *Chairman: Dr. Kurkura* *Rapporteur: Dr. K. Bheemmanlingeswara* **3. Aquifer Charatcterisation and hydro-chemical investigation on Raya Valley, Northern Ethiopia** by Dr. Dessie Nedaw (Mekelle University)
14:20 – 14:30	Discussion
14:30 –14:50	**4. Assessment of water and soil quality for irrigation: A case study on hand dug wells and ponds in Gergera watershed, Atsbi District, Tigray, Ethiopia**

	by Yeshitela Bekele (Mekelle University)
14:50 – 15:00	Discussion
15:00 – 15:30	Break
15:30 - 15:35	Introduction by facilitator (Ms. Gayathree Jayasinghe)
15:35 - 15:45	Group session – Reflection so far
15:45 – 16:30	Group discussion – ***Challenges and opportunities in the utilization of groundwater for irrigation purposes*** Groundwater and Irrigation: What are the current practices/issues/problems?
16:30 – 16:40	Stretch your legs
16:40 – 17:20	Group presentation
17:20 – 17:35	Discussion

Day 2: December 4th Excursion (whole day)	
	Field Excursion to three different Sites
8:00 – 11:30	Mendae Catchment (Abrha Asthbha) Metseko Catchment (Wukro)
12:00 – 13:00	Lunch at Mekelle
13:00 – 18:30	Traditional Irrigation Scheme (Dengolat Area)
18:30	Return to Mekelle

Day 3: December 5th Morning Session	
8:30 – 8:50	**Presentations:** *Chairman: Dr. Nata Tadesse* *Rapporteur: Dr. K. Bheemmanlingeswara* **5. Recharging practices for enhancement shallow hand dug wells discharging in Deberkidane Watershed, Northern Ethiopia** by Asmelash Berhane (Mekelle University)
8:50 – 9:00	Discussion
9:00 – 9:20	**6. How can farm– managed irrigation and water conservation improve food security in Ethiopia** by Ms. Cara Flowers (Cranfield University)
9:20 – 9:30	Discussion
9:30 – 9:50	**7. Technical and economic evaluation of treadle pump spray- head irrigation systems for small farm holders at Jimma Zone, Ethiopia** by Dr. Tena Alamirew (Mekelle University)
9:50 – 10:00	Discussion
10:30 – 10:30	Break
10:30 – 10:35	Introduction by facilitator (Ms. Gayathree Jayasinghe)
10:35 – 12:30	**A**: Group session - evaluating dissemination I: **Knowledge gaps / Information needs**
	B: Student Discussion Chairman: Dominik Ruffeis, Rapporteur: Helene Rieckh
Day 3: December 5th Afternoon Session	
14:00 – 15:00	Group session - evaluating dissemination II: **Dissemination formats**
15:00 – 15:30	After action review
15:30 – 15:45	Final remarks about the workshop and the way forward by Prof. J.F. Schneider
15:45	Closing Speech by Prof. W. Loiskandl