WHaTeR

Water Harvesting Technologies Revisited: Potentials for Innovations, Improvements and Up scaling in Sub-Saharan Africa

Project funded by the European Commission
Under the 7th Framework Programme
Project No. 266360

Multi-stakeholders workshop proceedings I

Identifier	WHaTeR_D14.3
Date	11 March 2013
Class	Contractual deliverable
Responsible partners	SearNet
Annexes	
Distribution	PU
Overview	

Table of Contents

List of Tables

List of Annexes

1 Introduction

Stakeholder interaction and communication during project planning and implementation are crucial activities and co-define the ultimate success of a project. Likewise, effective dissemination of project results is essential for making a real and measurable impact. The WHaTeR project has included two work packages (WP) to address communication (WP3) and dissemination (WP14) to a wide target audience. These include - the EU, African policy makers, local and national stakeholders, the scientific community and beneficiaries. The WP 14 on dissemination aims at informing the general public and stakeholders in Europe and Africa about the project aims, activities and findings. The WP also concerns gathering stakeholder inputs and perceptions on water harvesting technologies and associated policies serving as feedback to action researchers. WP 3, on the other hand, aims at assessing conditions for stakeholder interaction and communication and where necessary, improving the situation for enhanced uptake of water harvesting technologies, first in the case study project sites and then in other sub-Saharan Africa countries.

During the year 2012, SearNet in collaboration with Sokoine University of Agriculture (SUA), Arba Minch University (AMU), INERA and University of KwaZulu, organized a first series of four stakeholders' workshops in the case study countries (Burkina Faso, Ethiopia, South Africa and Tanzania). This synthesis report summarizes the proceedings of the first series of workshops.

1.1 Objectives of the workshops

The overall aspiration of this initial set of multi-stakeholder workshops was to present the WHaTeR project to the entire principal stakeholders in the case study countries and gather feedback, in addition to, generating inputs for the RTD activity plan and implementation. Particular workshop objectives have been classified by the individual WHaTeR partners based on the needs and demands of stakeholders in the respective case study countries.

The workshop organized by SUA had a specific objective to deliberate on project outputs and come up with a robust plan of action for upgrading the target water harvesting technologies under the RTD component of the project.

The specific objective of the Ethiopia workshop was to appraise different national and local stakeholders on the project, identify the major gaps and challenges in water harvesting technologies and prioritize areas of focus for the RTD activities. The workshop was also aimed at identifying and exploring areas of synergy with the CLARA project (Capacity-Linked water supply and sanitation improvement for Africa's peri-urban and Rural Areas), a sister FP7 project working on urban water supply and sanitation in Arba Minch. The participants toured the case study site (Konso) to assess water-harvesting systems in practice.

In Burkina Faso, the specific objectives of the two regional stakeholders' workshops were: to inform the stakeholders on the goals and activities of the WHaTeR project and secondly to set a strategy that can lead to better impact of the project in the different regions.

In the case of South Africa, the national workshop comprised several explicit objectives aimed at addressing both the RTD needs of the project, as well as, deliberating on future plans for stakeholders' interaction and communication. These consist of: to establish to what extent rainwater harvesting has been taken up in South Africa, and how one might monitor and evaluate the uptake; determine what the opportunities to expand this are, and what constraints limit the uptake of rainwater harvesting; identify technical enhancements/ advancements in the field and how these might be up- and out-scaled to meet targets;

discuss possible future research and developmental needs, and promote networking and information exchange among researchers in the sector.

1.2 Participation at the workshops

The national partners in the case study countries in close consultation with SearNet chose a wide range of stakeholders to be present at the workshops primarily depending on their possible influence on implementation of the WHaTeR project at national, as well as, local project site levels. In this first round of workshops, the preparation together with implementation of RTD activities was a very critical factor in selecting stakeholders and beneficiaries.

Photo 1: Participants during group discussions in Same, Tanzania stakeholders' workshop (Photo by Alex Oduor)

Table 1: WHaTeR Multi-stakeholders workshops held in 2012

Country	Dates	No. of participants	Stakeholder category
Burkina Faso	29 October 20 November	47	Local and national government officials, NGOs, researchers, academia, media and farmers.
Ethiopia	26-30 September	32	Local and national government officials from Ministry of Agriculture - MERET programme, media and farmers
South Africa	6-7 December	19	Academia, researchers, NGOs
Tanzania	11-14 April	40	Local government, parastatals, NGOs, academia, researchers, media and farmers.

Participants or stakeholders were drawn largely from local and national government, researchers, academia, non-governmental organizations, the media and local farmers. More details are provided with regard to the actual composition of stakeholders per country.

Tanzania: The workshop in Tanzania was organized in the Same, a district where the RTD activities will be carried out. The participants included farmers, village and ward leaders from the research villages, Same district officials dealing with planning and implementation

of agricultural development plans, Zonal Irrigation Office, Ministry of Agriculture and Food Security (MAFC), local NGO, (SAIPRO), and international NGO (OXFAM International). Other participants were from academic and research institutions (Sokoine University of Agriculture (SUA), University of Dar es Salaam, and Mbeya Institute of Science and Technology (MIST)). SearNet also attended as part of the workshop coordination team.

Burkina Faso: two workshops were organized in Burkina Faso: one in the western region (Bobo-Dioulasso including the Péni project site) where 25 participants attended and one in the central-western region (Koudougou including the Siglé project site) where 22 participants attended. The participants comprised representatives of the local administration, the technical extension services, agricultural research institute, the farmers' organization and the village community. The chief of the district and the mayor represented the local administration in their respective region. In addition, representatives of the extension services of the ministries of agriculture, livestock and environment and sustainable development at regional, provincial and district levels attended the workshops. INERA represented the research institutions, whereas the village development committee ("CVD") represented the village community. Finally, two farmers from each project site were invited to represent the farmers involved in the RTD activities.

Ethiopia: AMU combined national and local stakeholders including beneficiaries of WHaTeR the project sites during the stakeholders' workshop held in Arba Minch. The 32 participants of the workshop came from different institutions including WHaTeR project partners from VUA and SearNet, local stakeholders from Alaba agricultural office, Family Health International (FHI) Ethiopia, Konso agricultural office, Ethiopian Evangelical Church Mekane Yesus (EECMY) Konso branch, WFP/MERET project, Konso water resources office and beneficiary communities from Alaba and Konso areas.

South Africa: UKZN invited 19 participants mainly from the academia, research institutes and the local NGO" Ecolink". The Water Research Commission (WRC) hosted the workshop. According to participants who attended the workshop, WRC is the most relevant institution for coordinating future national meetings on water harvesting given their proven experience in research, documentation and dissemination within this disciplinary field.

1.3 Major conclusions

The Table 2 below summarizes the major workshop conclusions. In the case of Tanzania, Ethiopia and Burkina Faso, nothing but water harvesting technologies to be addressed during the RTD activities was considered during the workshops. The suggestions on how the major constraints will be addressed during the project implementation are summarized. The case of South Africa is different in that a wide range of WHTs was assessed and major potentials proposed with a national level outlook.

Table 2: Major constraints, potentials and conclusions

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
Tanzania	Ndiva system	• Conveyance losses along channels • Siltation of Ndiva and canals • Inequitable distribution of water to a marked degree downstream users • Agronomic practices to enhance productivity	• Construction of lined canals to reduce wastage of water on conveyance • Installation of infrastructure for water allocation and measuring the amount of water flowing • Construction of silt traps to minimize the amount of silt deposition in the Ndiva and canals • Design of an efficient and equitable water distribution system • Advice on alternative high value crops • Infield interventions to reduce water losses and improve water use efficiency • Better land uses (e.g. mulching, terracing etc) • Training of farmers on simple techniques on how to estimate crop water requirements.
	Spate irrigation	The waterways and irrigation canals are either eroded or silted	• Construction of silt traps to minimize the amount of silt deposition along the canals • Reinforcement of the major canals, particularly in high-

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
			impact areas like along bends. • Installation of gabions to raise the head of runoff water from the gully into the main canals • Design and construction of a permanent intake in the runoff gully to enable easy removal of silt depositions when necessary • Construction of intakes using the gabions technology.
Ethiopia	Spate irrigation	• Salinity and siltation • Water loss and water logging due to improper water use at Segen irrigation site • Lack of recorded meteorological, river discharge, soil type and water quality data for aiding during design of the irrigation systems	• Provide technical support to improve spate irrigation designs and increase water productivity • Provide extension support to address the salinity and siltation challenges • Conduct research on the impacts of upstream water harvesting interventions on downstream stakeholders for conflict management
	Community and household ponds	• Site selection • Construction and management • Danger of flooding due to climatic change	• Integrate local knowledge on ponds with newer innovative technologies and upgrade the traditional ponds to facilitate rapid uptake rather than introducing a new system • Improve the approach in promoting household ponds. The top-down approach has been detrimental to sustainability
	Watershed management approach	• Land degradation and food insecurity • Uptake and upscaling of watershed management approaches	• Map stakeholders and identify clear actors in watershed management and promote strategies for asset generation • Strengthen networking by creating alliances amongst governmental, non- governmental organizations and donors • Promote research to scale up good initiatives such as watershed management and ground water recharge

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
Burkina Faso	Mechanized Zai associated with stone bunds Soil bunds associated with plowing along contour with grass strips	• Inadequate capacity to handle WHTs • Limited access to equipment and inputs • Poor communication	Capacity building: • Training on new technologies • Training of technicians (using mechanized zaï, combination of techniques) • Training of farmers in the mastery of techniques • Information/sensitization • Study tour for the exchange of experiences • Monitoring and evaluation • Support and advice • Training local artisans to manufacture the mechanized tool for constructing Zai • Visits at the local level. Improve access to equipment: • WHaTeR to conduct training of local artisans to manufacture equipment (mechanized zaï) • Government to grant equipment for rainwater harvesting • WHaTeR, DRAH and municipal council to facilitate the creation of farmers organization and link with MFIs to access to credit (warranting) • Provision of information / raising awareness amongst project farmers and provision of techniques for rainwater harvesting Communication: • Identify the key audience for WHaTeR dissemination activities as different stakeholders and actors will require different means of dissemination (by radio, policy briefs, etc).

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
			• Pay more extra attention to the dissemination of the findings at village level and create awareness of rainwater harvesting techniques. • Consider also dissemination and communication channels like markets, mosques, churches, towns to reach farmers and subsistence farmers
South Africa	Roof water Micro-catchment Macro-catchment Floodwater	Socio-economic • There is a perception that small-scale agriculture is 'backward' and indicative of poverty. This tends to foster a survivalist rather than an innovative approach to adopting various agricultural systems. • There are social and cultural dynamics within groups, and traditional beliefs and practices that act as a 'drag' on the uptake of innovative systems. This includes gender dynamics and a general lack of involvement and urbanization of the youth. • There are constraints to the amount of time that can be spent in the field. This limits what can be practically achieved. • It is thought that the rollout of social grants in South Africa is causing a decline in small-scale agricultural production. Simply put, people are receiving income from an alternative source, so they don't have to farm.	• Once people see and experience the benefits of RWH, this will enhance uptake, upscaling and out scaling. • Project design needs to ensure sustainability and value adding beyond the project lifespan. • There are opportunities to develop new models for and systems of extension - "barefoot" extension – involving local champions. • Start with local people that have an interest and a passion for agriculture and RWH. • Promote institutional and organizational change at a scale that ensures long-term support for adoption of WHTs, as well as, upscaling and out scaling. In this context develop rewards and local incentive systems. This would include farmers' days, prizes and infrastructure supply (limit handouts). • Strengthen property rights and security of tenure to promote investment in systems. • Strengthen national policy in support of RWH. • Establish models to demonstrate benefits and costs (economic/social/environmental).

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
		• There is uncertainty about what motivates farmers to adopt or not to adopt new practices. • There appears to be a high level of social equity in rural traditional settings – is this an opportunity or a constraint? • Donor dependence and, with this, a lack of initiative slows the uptake of new ideas • Financial – lack of tenure/security significantly limits investment and borrowing options Biophysical • Enhancement of water harvesting needs identification of requirements for each type of rainwater harvesting - tin roofs for roof water harvesting, suitable soils for infield rainwater harvesting, etc. • In this context, a land suitability evaluation framework, which can be matched to the environmental conditions where it is applied, seems to be within reach of this project. • There is a need for better models that can be applied in specific circumstances, as examples, runoff vs storage ratio; plant density; improvements to SAPWAT3 -	• Consider the entire value chain, particularly markets, when analyzing factors that may affect adoption. • Consider investing in other infrastructure such as fencing which will act in support of RWH systems. • Promote RWH in areas where the return is more visible or significant – focus on drier areas where improvement will be more obvious. • Bring in young farmers and establish systems through which the experienced farmers can mentor less experienced farmers. • Identify approaches, models and examples that illustrate success and that make RWH systems attractive. • Focus on individuals rather than groups, voluntary uptake – leads to ownership and success. • Use successful individuals as leaders, innovators and "shepherds".

Country	WHTs addressed	Major constraints	Major potentials and Conclusions
		RWH/crop water/irrigation model. • Knowledge management and dissemination (or lack thereof) • There is the need to differentiate between RWH technology and the role of agronomic practices. • There is a need, to better understand, the possible cumulative effects of RWH on catchments • There is a general lack of knowledge amongst communities and target groups.	

2 Summary of proceedings

2.1 Tanzania

The Tanzanian two-day multi-stakeholder WHaTeR workshop conducted from the 11th to 14th April 2012 at the Elephant Hotel in the Same District was the very first one to be administered and was thus looked upon as a pace-setter, where lessons learnt would be used to plan or improve consequent workshops in Burkina Faso, Ethiopia and South Africa. The process of organizing the workshop was anchored on three key elements, i.e., review of WP12 tasks, using these tasks to identify relevant stakeholders and finally, conducting the workshops. The Same District Commissioner with the support of the District Agricultural Development Officer officially opened the workshop. Three presentations were made. Alex Oduor, representing SearNet was requested to provide highlights of the WHaTeR project to workshop participants. This was followed by a presentation from Dr. Fredrick Kahimba who introduced the participants on WP12. Prof. Mahoo made a presentation on the existing WHTs in the study area of the Makanya catchment.

2.1.2 Research & Technology Development (RTD) issues for WP12

There are two main technologies spearheaded by Sokoine University in the Makanya catchment. These include the Ndiva WH system as well as spate irrigation. Dr. Fredrick Kahimba presented the RTD objectives for WP 12 that include:

- To conduct a literature review on - Existence and current use of WHTs, evidence of evolution of technologies and adoption, and technological improvements of WHTs and upstream-downstream effects
- To identify successes, constraints, and opportunities of the WHTs and propose technological improvements
- To improve on-farm WHTs using PAR approach with involvement of key stakeholders including farmers, NGOs, District Council, etc)

Participants later deliberated on the major challenges and opportunities for the selected technologies.

2.1.4 The Ndiva system

These water harvesting systems are reinforced concrete-based reservoirs built on rock catchments to trap runoff water oozing from springs located upstream. Five Ndivas were identified in the Bangalala area namely: Ndimuka, Nkunguru, Manoo, Kinyang'a and Muchikatu. The site to be improved is the Nkunguru micro-dam. Farmers and village leaders from Bangalala who participated during the workshop chose this site. The choice was based on both the large number of people and the size of the area it serves.

These Ndivas get filled up during the night, and the stored water is utilized for irrigation during the day. However, users identified a number of challenges during the workshop. These include: loss of water along conveyance channels, siltation of the Ndivas, equitable distribution for users downstream and agronomic practices to enhance productivity. To mitigate these challenges, the following suggestions were noted following discussions with the community:

- Construction of lined canals to reduce wastage of water on conveyance
- Installation of infrastructure for water allocation and measuring the amount of water flowing
- Construction of silt traps to minimize the amount of silt deposition in the Ndivas and canals
- Design of an efficient and equitable water distribution system
- Advice on alternative high value crops
- Infield interventions to reduce water losses and improve water use efficiency
- Better land uses (e.g. mulching, terracing etc.)
- Training of farmers on simple techniques on how to estimate crop water requirements.

Photo 3: A section of the Ndiva storage structure (left) and a silt trap (right; Photos: Alex Oduor)

2.1.5 Spate irrigation system

This water harvesting is practiced on the lower sections of Makanya catchment where the slope of the land is tremendously reduced to allow for spate irrigation. The group from Makanya identified Suji Kitivo and Wandea canals of the spate irrigation scheme at Makanya as very important in terms of associated area covered and need for intervention given their poor status. Suji Kitivo is the longest canal measuring more than 4 km while Wandea serves the largest number of people and farms. Since only one canal can be improved by the project based on the available funds, a decision was made to focus on Wandea canal.

Following the massive amount of runoff generated in the catchments mentioned above, the waterways and irrigation canals are either eroded or silted. To mitigate these challenges, participants visiting Makanya agreed on the following points for possible actions by the community:

- Construction of silt traps to minimize the amount of silt deposition in the canals
- Reinforcement of the major canals, particularly in high-impact areas like along bends.
- Installation of gabions to raise the head of runoff water from the gully into the main canals
- Construction of the permanent intake in the runoff gully that is well designed to enable easy removal of silt depositions when necessary
- Construction of intakes using the gabions technology.

Photo 4: Canal for conveying spate water to the irrigation fields in lower Makanya catchment (Photo by Dr. Fredrick Kahimba)

2.1.3 Field visit

SUA and SearNet conducted a field excursion on the 13th of April. The aim of the visit was to share ideas with selected beneficiaries on methodologies for RTD interventions and specify the contribution of the village, the project and Same District Council towards implementation of the RTD activities. The team also had an opportunity to inspect existing conditions of the WH infrastructure, and discuss areas that required interventions with farmer groups.

Two sites were visited:

1) A catchment near Bangalala village in the Same district where participants were introduced to a community group that manages a number of Ndivas for allocating water to members growing vegetables.
2) A site in Makanya where spate irrigation is being practiced.

After the visits, SUA and Same District officials had a post mortem meeting to deliberate on what was observed.

Photo2: Discussions during the field visit to Micro dam in Bangalala village, Same District

2.1.6 Way forward

Following the meeting held by SUA and Same District officials, it was agreed that the project should put emphasis on mitigating water losses along the conveyance canals through canal alignments and repair of the water distribution systems and gates. Agreements were made on the following:

- That the community contributes labour for collecting and ferrying construction materials site, as well as cleaning and reshaping of the canals ready for alignment.
- The District will provide expertise for the survey works, design of the canals and gates, and monitoring of the rehabilitation works, while WHaTeR project procures all the materials needed at the site.
- The group leaders of the water users and village leaders will be responsible for the day-to-day supervision of the RTD activities, as well as, assisting in procurement of materials.
- A follow up visit to the proposed technologies improvement/intervention sites (Nkunguru micro-dam and Wandea canal) addressed issues such as what construction task will be carried out and who will be responsible for what. It was agreed that stones, sand and aggregates, all materials readily available in the area, are to be supplied by the villages. Purchase of cement, reinforcing metal and payments for skilled labour would be the responsibility of WHaTeR project.
- Detailed maps of the Nkunguru micro-dam and Wandea canal sites to be produced using GIS tools. SUA and the technical staff from Same District Engineer's office will jointly carry out the survey. Technical designs of the planned improvements to be prepared by the Same District Engineer. Based on the designs, bill of quantities will be prepared and ultimately the costs of different requirements obtained.
- Activities at both Bangalala and Makanya villages were agreed upon for all the stakeholders in respect to survey and mapping, technical designs, community mobilization, procurement of materials, supervision and report writing.

2.1.7 Workshop outcomes

- Among the first outcomes of the multi-stakeholder workshop is that participants gained a better understanding on how SUA chose and prioritized the technologies for RTD activities and how in events to come stakeholders and beneficiaries can be involved in their management.

- Participants understood the available budget and how these budgets were to be spent in conformity to the implementation plans, i.e., especially for research and development infrastructure(s), and that there is a need for other stakeholders to contribute to the implementation course
- Coverage of workshop proceedings on National TV by ITV (Tanzania's Television Station) and footage presented to WHaTer website as a YouTube product.

2.1.8 Conclusions and recommendations

- Tanzania organized one multi-stakeholder workshop that combined the objectives of identifying stakeholders as well as introducing them to the WHaTeR project and agreeing on implementation of RTD activities. In future workshops, partners should adhere to the protocol developed by WP3 for WPs 9, 10 and 11 and 12 so as to create uniformity in the structure of reporting. SearNet should lead the process of guiding partners on the method laid down in the protocol. This will make it easier for WHaTeR to compile the workshop proceedings.
- On RTD with specific reference to the Ndivas, a major area of concern is siltation. The reservoirs are still filled up with silt despite farmer using on-stream silt traps. SearNet has gained extensive knowledge on the use of off-stream silt control mechanisms in runoff ponds and could share their experience with SUA.
- With regard to spate irrigation, what clearly emerged is that there is a need to encompass GIS so that the entire hydrological aspect is mapped and runoff quantified. The improvements in the planning of the system using the watershed-based approach would result in the better management of the irrigation system.

2.2 Ethiopia workshop

The first evening before the start of the workshop, Arba Minch University (AMU), the implementing agency of both EU-funded FP7 projects WHaTeR and CLARA, hosted a welcome dinner for all participants at the Tourist Hotel. It was during this dinner that participants mingled freely and got to know each other in a rather informal atmosphere. The following day (i.e. on 29th September 2012 at 0830 hours), participants reported for registering for the workshop at Arba Minch University. In his welcoming speech, the president of AMU, Dr. Feleke Woldeyes praised the European Union for entrusting the university with the task of implementing both projects. He stated the importance of addressing water and land degradation, and that it was a development priority in the country's strategic framework. The president reaffirmed the university's commitment to fulfilling the objectives of both the WHaTeR and CLARA projects. He emphasised the need to synergize both projects and to gear activities towards tackling pertinent issues within the project sites. The president then declared the workshop officially opened.

Following the welcome speech and the official opening of the workshop, Mr. Ermias Alemu of AMU chaired a joint session between WHaTeR and CLARA projects. As this session was primarily for information exchange, the two project coordinators Drs. Denyse Snelder and Guenter Langergraber of WHaTeR and CLARA respectively, each presented a short project brief after which Maimbo Malesu chaired a discussion session.

2.2.1 Synergy between CLARA and WHaTeR

As both projects are dealing with water, hosted by the same institution (AMU) and manned by the same staff, it would be easy to build synergy around conducting joint staff and student research; organizing joint symposium and dissemination forums; linking water harvesting and sanitation activities of CLARA to urban agricultural production e.g. horticulture. In addition, appropriate soil and water conservation coupled with proper utilization of human waste could boost agricultural production. The recycling of soil nutrients from rural areas through crops consumed and excreted by urban dwellers is one area the two projects could collaborate. However, participants expressed doubts that farmers would be easily convinced to accept the use of human urine and faeces for agricultural production. The participants noted that sensitization and promotion of the use of domestic wastes for agriculture would be required.

2.2.2 Field visits to CLARA and WHaTeR project sites

In order to enhance understanding of the two projects, the participants were taken to CLARA sites within Arba Minch city and WHaTeR sites for RTD activities in Konso. CLARA has a demonstration site at which composting is carried out using a combination of vegetation and human waste (urine and faeces). The project has set up an association through which promotion of composting technologies is being tested and promoted within the city. Participants noted that by creating linkages with tourist lodges and restaurants that produce large volumes of kitchen and human waste, composting technologies could be scaled up for urban agricultural production.

The Agriculture office together with EECMY, a local NGO, jointly facilitated a field trip to the AMU-WHaTeR project research sites on spate irrigation and micro-catchment basin in Konso. The sites are situated 90 km from AMU. Farmers abstract water from the Yanda River via an intake and use it for spate irrigation. The river intake structure, which is still under construction, has serious erosion along the banks. This problem could be arising from the inappropriate location of the intake as well as its design. The RTD activities will thus focus on conducting further research so as to help farmers resolve the problem. The irrigation water is delivered through an unlined irrigation canal that also has serious erosion along the sides of its banks. At the farm plot level, farmers divert water to their farms using stones, boulders and wood. This method is not effective as the peak flood eventually erodes the banks of the diversion. The farmers use mulch to conserve moisture within field. The key challenges observed and mentioned by farmers include siltation on farms and breaching of bunds during high floods. The participants also visited successful, traditionally managed community ponds in Konso area. On the contrary, the plastic lined ponds introduced by the government in Alaba through a massive up-scaling effort have failed. The RTD activities undertaken by the WHaTeR project will investigate the reasons for the failure and identify possible solutions.

2.2.3 Session on RTD activities and involvement of stakeholders

During this session, Mr. Ermias made a presentation on the extensive availability of WHT technologies in Ethiopia. However, there are several challenges that implementers and farmers/users have faced, and these include lack of training, local management & ownership, limited technology acceptance and lack of adaptation of WHT to local conditions. He briefed participants about the Work Package 10 and thereafter set forth the technologies and the focus of the RTD activities. These included: 1) Household and community managed ponds, 2) Spate irrigation, 3) Integrated watershed management. The two areas selected for

RTD activities are located in the Southern Nations Nationalities and Peoples region. First, the Alaba area earmarked for the assessment of water harvesting ponds and integrated catchment management and second, Konso lowlands for the assessment and improvement of spate irrigation systems.

2.2.4 Stakeholders' discussion and feedback

Mr. Seid Ahmed presented on "Harthas": indigenous knowledge of surface water management in Konso, Ethiopia. He suggested that the indigenous knowledge on surface water management should be studied in collaboration with local institutions in the area. The effectiveness of ponds will be enhanced by integrating indigenous knowledge with modern water management technologies. In order to combat adverse effects of climate mate, the discourse on climate change should also be mainstreamed into these indigenous institutions.

Mr Adane Dinku and Mr Frew Tadesse shared the experiences of the MERET project on integrated watershed management. They argued in their presentation that land degradation is a major cause of low productivity, food insecurity and poverty in the country. They demonstrated this by providing data on the extent, causes and effects of land degradation in parts of the country.

The presenters also talked about the inception and expansion of soil and water conservation (SWC) programmes in the country and how the MERET project has evolved as a leading government agency in addressing land degradation challenges countrywide. World Food Programme (WFP) funds the project. Their core success is on promoting the establishment of 'area enclosures' as a means to reverse land degradation. The project aims to increase the ability of food insecure households to meet necessary food needs and improve livelihoods; through land rehabilitation, proper natural resources management, productivity enhancement, asset creation and diversification of livelihoods. Among others, the strategies promoted include the integrated famous watershed management approach coupled with consistent supervision and technical back up so as to maintain the quality and consistency of technical standards and work norms in the field. MERET emphasizes on diversifying and promoting innovative technologies, building the capacity of implementing partners and empowering the community for decision making. The presenters concluded by detailing the MERET programme and its field activities that include: water harvesting, in-situ moisture conservation, pond construction and success stories on improved livelihoods resulting from tree planting and home gardening.

Mr. Gizachew Toraito made a presentation on community owned and managed ponds and sustainable land management (SLM) practices by the Konso people in Southern Nations, Nationalities and Peoples Region. The Konso people have used traditional soil and water conservation practices for generations, without support from the government or NGOs. This has enabled the community to maintain the productivity of their agricultural systems on a sustainable basis. UNESCO has acknowledged these indigenous practices and given an international award to the Konso people. The age-old community ponds and spate irrigation systems on Yanda and Segen seasonal rivers are among the various SLM practices in the area.

In the case of recently introduced WHT such as household ponds (lined with plastic or cement) and spate irrigation systems, with changing environmental, socio-economic and demographic conditions, there is a growing need to readjust such practices to the changing

conditions to address emergent constraints. The technical problems with household ponds include site selection, construction and management; and danger of flooding due to climatic change. In the case of spate irrigation, the challenges include salinity and siltation; water loss and water logging due to improper water use at Segen irrigation site; lack of recorded meteorological, river discharge, soil type and water quality data for aiding during design of the irrigation systems.

Mr. Mohammed presented the Alaba experience on water harvesting technologies. He stressed that moisture is one of the most limiting factors of agricultural production in the area. Household and community ponds are predominantly used for harvesting and managing rainwater in area. The pond sizes, shapes, lining materials (concrete, clay, plastic or geo-membrane) vary considerably. Uses of water are multiple, i.e., for irrigation of high value vegetables, fruits, and seedlings, watering livestock, and household use. Community ponds are generally well protected and managed, and their performance in the location is good, and the harvested water is used for longer periods of time.

However, in areas where household ponds (i.e. plastic or cement lined ponds) have recently been introduced by the government, users generally a lack knowledge on the use of the harvested water. During pond implementation, the government's top-down approach placed most emphasis on how to dig the pond rather than on the efficient utilization of the harvested water. Site selection for pond establishment was inadequate, and most of the cemented household ponds were poorly constructed. Promoters focused more on the quantity rather than on the quality of ponds. The absence of fencing has also endangered the lives of children and livestock due to increased drowning risk. Most of the household ponds have no roof cover and thus have large evaporation losses. The cost of maintenance is higher than that of the traditional ponds. Therefore, there is a need to re-assess the impact of the existing rainwater harvesting systems in the area to determine their effectiveness and sustainability.

2.2.5 Conclusions

The participants without a dissenting voice agreed that the immediate priority is to contribute to increasing food security among the people at the study sites. However, in order to achieve this, there are technical and socio-economic challenges to be addressed. As relevant data are not available (i.e. meteorological, hydrological, soil data) for appropriate design of spate irrigation systems, there is a need to provide technical support to gather this data. There is also need to create awareness on effective and efficient use of irrigation water as well as treating and managing soil salinity. It is also necessary to study ways on how to address possible conflicts in equitable distribution of irrigation water.

2.2.6 Way forward

There is a need to assess the impact of the existing rainwater harvesting systems in the RTD areas to determine their effectiveness and sustainability.

Spate Irrigation

1. Provide technical support to improve spate irrigation designs and increase water productivity
2. Provide extension support to address the salinity and siltation challenges
3. Conduct research on the impacts of upstream water harvesting interventions on downstream stakeholders for conflict management

Household and Community ponds

1. Integrate local knowledge on ponds with newer innovative technologies and upgrade the traditional ponds to facilitate rapid uptake rather than introducing a new system
2. Improve the approach in promoting household ponds. The top-down approach has been detrimental to sustainability

Integrated watershed management/scaling up good practices of MERET

1. Map stakeholders and identify clear actors in watershed management and promote strategies for asset generation
2. Strengthen networking by creating alliances amongst governmental, non-governmental organizations and donors
3. Promote research to scale up good initiatives such as watershed management and ground water recharge

2.3 Burkina Faso regional workshops

The Institute for Environmental & Agricultural Research (INERA) conducted two stakeholders' workshops in Burkina Faso. The first workshop was held on the 29th of October 2012 in Bobo-Dioulasso, which is approximately 330km to the South West of Ouagadougou, with the second one being held on the 20th of November 2012 in Koudougou, which is approximately 95 km to the West of Ouagadougou. The workshops were held to publicize the WHaTeR project and determine strategies for reducing land degradation and increasing regeneration of the environment. Dr Korodjouma presented slides on INERA's work on soil and water conservation as a way of explaining what WHT options are available for assessment. Discussions were focused on strategy, outreach and impact of the project and discussed under four basic elements:

- Capacity building,
- Access to equipment and inputs,
- Communication between the players and
- Organizational Responsibility and actors.

2.3.1 The Bobo-Dioulasso workshop

The workshop at Bobo-Dioulasso was held in a meeting room of the Regional Director at the Agriculture and Hydraulics department. This was a meeting with the local actors in the field of agriculture within the WHaTeR RTD activity site. Participants comprised farmers, the Village Development Council, Mayor and the Commissioner of Peni, the office of the Regional Director of Agriculture and Hydraulics, the Regional Director of Environment and Agriculture (FARAKO-Ba), the President of the Regional Chamber of Agriculture West, the media and researchers (Annex 4). WHaTer's project coordinator, Dr. Ouattara Korodjouma, chaired the workshop.

After welcoming the participants, the regional director of FARAKO-Ba give an introduction of the workshop programme, its context and purpose. Thereafter, he highlighted the importance of water for agriculture in the context of climate change. The scientists made presentations on the issues of research. Finally, the floor was given to the representative of GOPAL who also welcomed the participants to the workshop and officially opened the workshop.

The meeting resumed after 10.50 a.m. with a plenary session during which Dr. Ogundipe Korodjouma showed a video on the extent of land degradation and its impact on the environment in the country. He informed participants that the aim of the WHaTeR project is to revisit water-harvesting techniques for rehabilitation or a combination of these techniques to enable wider adoption so as to enhance the living conditions of farmers and rural dwellers at large.

Dr. Ogundipe explained that WHaTeR project activities are taking place at three sites within Burkina Faso. That includes Sheng village, Boulkiemdé province, where farmers are accustomed to the use of stone bunds, in the Peni village, Hawkins province, where farmers do not practice water harvesting techniques, and finally, in the village of Nagrengo in Kadiogo province. In each village, sixteen farmers were selected to conduct tests on plots of 0.25 ha.

After the presentation, Dr. Ouattara invited two farmers from Peni village to present field trials practised in their farm plots. The farmer from Peni described the situation on his farm before-and-after the WHaTeR project began. It emerged that there was actually a problem

attributed to lack of stones for construction of the stone bunds. The shortage of these stones is attributed to the competition with builders who use the stones to set up foundations for houses. He raised concerns regarding deforestation by locals who knowingly carried out such practices to the detriment of the environment, and recommended that strategies to raise awareness be developed as done by the representative of SAPA, the President of the Regional Chamber of Agriculture and Mr Traore San, a WHaTeR team member.

2.3.2 The Koudougou workshop

The workshop took place on 20 November 2012 in the boardroom of the Regional Directorate of the Environment and Quality of Life in Koudougou. During the opening ceremony, the Regional Director of the Environmental Research and Agricultural Saria and the representative of the Regional Director of Agriculture and Water each made opening remarks. The first speaker welcomed the participants and stressed the fact that the central region is affected by land degradation and one of the objectives of the WHaTeR project is to identify the right technology to address the problem in this area. This workshop was also held to publicize the project and determine strategies for reducing land degradation and increasing regeneration of the environment. He hoped that the discussions during this workshop would contribute to the achievement of project objectives. The second speaker welcomed participants to the project in the area and encouraged them to share knowledge and experiences in order to find solutions to the environmental stress affecting the area. After this, workshop was officially opened.

Following self-introductions, Dr. Ouattara proceeded with a presentation on the WHaTeR project. Like in Bobo Dioulasso, he presented a video showing the extent of land degradation and its impact on the environment in Burkina Faso. He said, “The ultimate goal is to improve the production conditions in rural areas and thus improve living conditions of the farmers.”

The project works on three sites: In the south, in Bobo-Diallo, grass strips will be introduced to increase the water retention capacity of the land. In the northern region, the project revisited Ziga village where INERA earlier successfully introduced zaï and demi-lunes. In Boukou village, from which stakeholders are today present, the project will make investments in mechanized zaï. The project will also conduct socio-economic research in Nagreongo village to understand the motivations of farmers with relation to their choices regarding water harvesting technology, the reasons for adopting a technology and not another, what technology is adapted to the area and their willingness to take ownership. These types of questions will be asked in Boukou, Bobo-Diallo and Ziga.

In Boukou village, sixteen farmers were selected to receive water-harvesting investments on a plot of 0.25 ha. The investments included: the mechanized Zai associated with stone bunds, soil bunds associated with plowing along the contours and grass strips. As land degradation in this village is very serious, farmers use soil conservation techniques to combat it.

After the presentation by Dr. Ouattara Korodjouma, two farmers stepped in to talk about water harvesting technologies they had received. They explained the advantages and limitations of these technologies. They are generally very happy to have adopted the technology. Participants then responded through clarifying questions and suggestions for

improvement. By listening to the two presentations by farmers, participants were adequately prepared to develop strategies for outreach and impact.

Following these interventions, the discussion turned to the elements of strategy, outreach and impact of the project. Four working sub-groups were created to discuss the following issues:

- Capacity building;
- Access to equipment and inputs;
- Communication between the players;
- Organizational Responsibility and actors.

Results from the group discussions were shared in plenary. In the following, we present the lessons learned from the group.

2.3.2.1 Capacity Building:

Group I reported on interventions to be carried out by WHaTeR, the government and NGOs. The activities proposed include:

- Training on new technologies
- Training of technicians (using mechanized zaï, combination of techniques)
- Training of farmers in the mastery of techniques
- Information/sensitization
- Study tour for the exchange of experiences
- Monitoring and evaluation
- Support and advice
- Training local artisans to manufacture the mechanized tool for constructing Zai
- Visits at the local level.

Note: For training of farmers and other stakeholders, it is recommended to provide this in the national language.

2.3.2.2 Access to equipment and inputs

The second group discussed the main actors and stakeholders that could help facilitate farmer access to equipment and inputs for investments in rainwater harvesting.
These are summarized in Table 3 below:

Table 3: Group II Feedback on access to equipment and inputs

Actors	Means of Dissemination
DRAH; WHaTeR project; Municipal Council	Provision of information / raising awareness among project farmers and provision of techniques for rainwater harvesting
Municipal Council, DRAH, WHaTeR Project, ARC, CVD	Advocacy (to make available) of the production of adaptive equipment, especially mechanized zaï
WHaTeR project	Training for local artisans to manufacture equipment (mechanized zaï)
State	Granting equipment for rainwater harvesting

State DRAH, DRA	Foster / farmers involved in prioritizing WHT techniques, the specific operations in input supply
WHaTeR, DRAH, Municipal Council	farmers Organization and linking with MFIs to access to credit (warranting)

2.3.2.3 Communication among players/actors

The actors and elements of the dissemination strategies and impacts with regards to communication among players/actor are summarized in Table 4 below:

Table 4: Feedback from Group III on communication between players/actors

Actors	Means of Dissemination
Farmers (Farmer organizations)	Meetings (provide information and raise awareness)
Agricultural Research (INERA)	By radio (national and local)
Technical services (Agriculture, Environment, Animal Resources)	Forum Theatre
Projects and programs (PNGT...)	Documentary (disseminate at meetings of actors) television
Administrative authorities (Prefect...)	Prospectus (display and dissemination in the newspapers)
The Chambers of Agriculture	Sheets in the national language
The decentralized communities (Mayor, CVD)	Frameworks for dialogue and exchange between all actors
Media (newspapers, radio and television)	

2.3.2.4 Organizational responsibility

During both workshops, roles were identified for each stakeholder. The WHaTeR project was charged with the responsibility of disseminating technologies. Administrators were to deal with land acquisition and take care of the administrative formalities. Other actors included the Village Development Council (CVD) who would promote the best bet technologies. The municipal, on the other hand, would focus on household activities. Those tasked to create awareness would be remunerated accordingly as long as they sensitize all stakeholders and particularly CVD, and municipal councils to take into account activities related to SWC techniques in their development plans; or organize a farmers' group or association for the application and popularization of SWC techniques. Capacity building teams would carry out training for artisans and farmers on new technologies manufacture of tools, monitoring and evaluation, etc through seminars, workshops, demonstrations and field visits.
The Table 5 below summarizes the actors and their roles with regards to organizational:

Table 5: Feedback from group IV on organizational responsibility

Actors	Roles
1. Administration	Administrative Formalities
2. Project WHaTeR	Dissemination of technologies
3. Chief of the land and traditional leaders	Land Acquisition
4. Technical Service	Support / Council
5. Village Development Council (CVD)	Taking into account the activity of the

	project in their development plans;
6. Municipal council	Adoption and taking into account the development plans of CVD;
7. CRA	Awareness of farmers;
8. Farmers	Application techniques popularized.

2.3.3 Conclusions

The following key points emerged in both workshops.

It is very important to identify the key audience for WHaTeR dissemination activities as different stakeholders and actors will require different means of dissemination (by radio, policy briefs, etc). It is important to pay extra attention to the dissemination of the findings at village level and create awareness of rainwater harvesting techniques. Consider also dissemination and communication channels like markets, mosques, churches, towns to reach farmers and subsistence farmers.

The costs of implementing rainwater-harvesting techniques should be considered, whereas much attention focuses on the benefits of WHTs the costs for implementation need to be properly addressed. In addition, feedback on the level of receptivity of WHTs to farmers should be carried out to assess adoption and upscaling rates;

- Some NGOs and projects should be integrated into the grant process by the state.
- Facilitators should not impose their ideas on communities and should take into account the real concerns of farmers.
- It also emerged that the stakeholders (farmers) are not taken into account in the implementation of activities to be undertaken in the municipalities. It was emphasized that all must start from that basis (CVD, agent coaching) for projects to be successful.
- Dr. Ouatarra promised to produce a comprehensive report as a reference for those who may not have attended the workshops.

2.4 South Africa workshop

As part of its commitments under the Sharm El Sheikh Declaration on Water and Sanitation, the African Union, has committed to promoting Rain Water Harvesting (RWH) and use, with the aim to increase the rainwater harvesting share of total water use to 10% by 2015. South Africa, as a signatory to this commitment, has over the past ten years engaged in supporting and conducting some rainwater harvesting initiatives and research projects in the country, although the majority of these are focused on agricultural, and not domestic water supply.

As part of an ongoing European Union FP7 funded WHaTeR project, the Centre for Water Resources Research at the University of KwaZulu-Natal is leading in an assessment of South Africa's contribution to meeting these targets. Recently UKZN revisited and reported on three water harvesting initiatives located at Thaba Nchu, Potshini and Phutadjithaba. These sites will serve as study areas for the RTD activities of the WHaTeR project. Given that during this assessment, UKZN adequately interacted with local stakeholders, this particular workshop involved key players in the field of rainwater harvesting at national level (see Annex 5).

Following a general introduction to each other and the purpose above, the workshop divided into three discussion groups. The deliberations from each group were then presented in a plenary session for comments and additional input, after which the workshop concluded with a discussion.

2.4.1 Extent of rainwater harvesting and monitoring

The fundamental approach was to accept the classification of water harvesting methods as suggested by Denison and Wotshela (2009). This is based on the FAO classification and is illustrated in Figure 1 below.

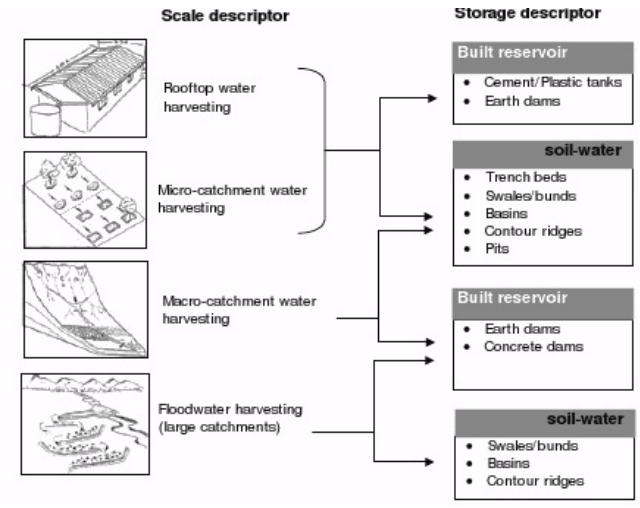

Figure 1: Proposed categorization of water harvesting methods

Source: Denison and Wotshela 2009. Indigenous water harvesting and conservation practices: historical context, cases and implications. Water Research Commission Report No. TT 392/09.

Based on this, a table was constructed (Table 6) which illustrates the rainwater harvesting system, the indicator of its use and the method of measurement.

During discussions in Group 1, participants came up with a summary of existing rainwater harvesting systems in South Africa, suggested indicators and methods for monitoring. The first category is the roof water system, which is widely used for domestic water supply in South Africa. The roof water system could be effectively monitored through surveys conducted during national census. The participants proposed that Department of Water Affairs (DWA) should capture this data during upcoming data collection events/census

Table 6: Rainwater harvesting system, indicator of use and method of measurement

System	Descriptors *	Method	Comment
Roof Water	Storage tank	Survey – preferably national census, project, municipal level survey	Status of DWA water supply database
Micro catchment	Storage Run on area	Survey, aerial photo and orthophotos, high resolution satellites	System versus uptake, How often?
Macro catchment	Non drainage system, run on area	Survey, aerial photo and orthophotos, high to medium resolution satellites	No defined drainage area for RWH systems. Primary use = supplemental not full irrigation
Floodwater	Ephemeral stream adjacent or internal cultivated area	Survey Aerial photo High resolution satellite	

Source: Denison and Wotshela 2009. Indigenous water harvesting and conservation practices: historical context, cases and implications. Water Research Commission Report No. TT 392/09.

2.4.2 Constraints and Opportunities to uptake of rainwater harvesting

Participants in Group 2 categorized the constraints and recommendations as socio-economic (institutional, social, cultural or financial), biophysical – (soils, topography, rainfall, temperature, evaporation etc.) and knowledge (knowledge management – does it exist, who has it and who has access to it?).

Socio-economic

- There is a perception that small-scale agriculture is 'backward' and indicative of poverty. This tends to foster a survivalist rather than an innovative approach to adopting various agricultural systems.
- There are social and cultural dynamics within groups, and traditional beliefs and practices that act as a 'drag' on the uptake of innovative systems. This includes gender dynamics and a general lack of involvement and urbanization of the youth.

- There are constraints to the amount of time that can be spent in the field. This limits what can be practically achieved.
- It is thought that the rollout of social grants in South Africa is causing a decline in small-scale agricultural production. Simply put, people are receiving income from an alternative source so they don't have to farm.
- There is uncertainty about what motivates farmers to adopt or not to adopt new practices.
- There appears to be a high level of social equity in rural traditional settings – is this an opportunity or a constraint?
- Donor dependence and, with this, a lack of initiative slows the uptake of new ideas
- Financial – lack of tenure/security significantly limits investment and borrowing options

Biophysical

- Enhancement of water harvesting needs identification of requirements for each type of rainwater harvesting - tin roofs for roof water harvesting, suitable soils for infield rainwater harvesting, etc.
- In this context, a land suitability evaluation framework, which can be matched to the environmental conditions where it is applied, seems to be within reach of this project.
- There is a need for better models that can be applied in specific circumstances, as examples, runoff vs storage ratio; plant density; improvements to SAPWAT3 - RWH/crop water/irrigation model.

Knowledge management and dissemination (or lack thereof)

- There is need to differentiate between RWH technology and the role of agronomic practices.
- There is need to understand better the possible cumulative effects of RWH on catchments
- There is a general lack of knowledge amongst communities and target groups.

Opportunities

- Once people see and experience the benefits of RWH, this will enhance uptake, upscaling and outscaling.
- Project design needs to ensure sustainability and value adding beyond the project lifespan.
- There are opportunities to develop new models for and systems of extension - "barefoot" extension – involving local champions.
- Start with local people that have an interest and a passion for agriculture and RWH.
- Promote institutional and organizational change at a scale that ensures long-term support for adoption, upscaling and outscaling. In this context develop rewards and local incentive systems. This would include farmers' days, prizes and infrastructure supply (limit handouts).
- Strengthen property rights and security of tenure to promote investment in systems.
- Strengthen national policy in support of RWH.
- Establish models to demonstrate benefits and costs (economic/social/environmental).

- Consider the entire value chain, particularly markets, when analyzing factors that affect adoption.
- Consider investing in other infrastructure such as fencing which will act in support of RWH systems.
- Promote RWH in areas where the return is more visible or significant – focus on drier areas where improvement will be more obvious.
- Bring in young farmers and establish systems through which the experienced farmers can mentor less experienced farmers.
- Identify approaches, models and examples that illustrate success and that make RWH systems attractive.
- Focus on individuals rather than groups, voluntary uptake – leads to ownership and success.
- Use successful individuals as leaders, innovators and "shepherds".

2.4.3 Overview of rainwater harvesting systems in South Africa

In this context we are dealing primarily with small-scale farmers and landholders. Their primary needs are health security (water for drinking, cleaning, bathing and washing) and food security (water for small-scale agriculture).

The Denison et al (2009) classification is useful in determining which system is suitable for which primary need (Figure 2**Error! Reference source not found.**). Simply, one requires smaller volumes of higher quality water to satisfy health security. In this instance rooftop harvesting is appropriate. For food security micro-catchment harvesting which delivers more water at a lower quality is appropriate. Macro-catchment harvesting is inappropriate for both as the scale and associated costs are usually too high. In considering an appropriate system or systems one also needs to consider which one can serve multiple purposes and which work effectively in combination with each other.

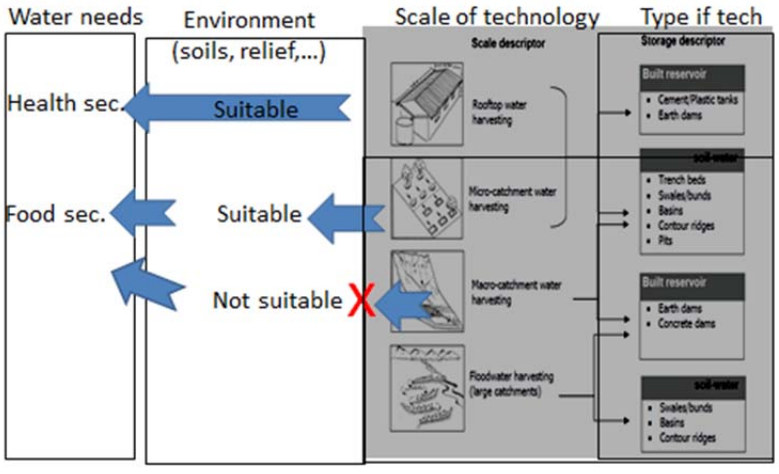

Figure 2: Using the Denison and Wotshela (2009) classification to establish appropriate uses of various RWH systems

Rooftop water harvesting

- **Roof lining** – experiences from Ecolink in the field indicate that, while rooftop collection is being used for irrigation, most people are also drinking this water. This has implications for the type of roofing used as some contain heavy metals and other toxic materials. Roof lining might be required.
- **Gutter systems** – in order to take advantage of rooftop collection gutter systems are required. These are perceived as expensive but it is possible to split conventional piping and place it along the roof edge leading to the water tank. In very dry areas, most roofs should be used for domestic needs and yards used for agricultural purposes (because of poor quality).
- **Design and set-up of storage tanks** – currently not being optimised to take rainfall patterns/events into account. Programmes do exist but the information is not broadly accessible. Also, it appears that these programmes have not been validated.

Micro-catchment water harvesting

- **Digital soil mapping** – this can act as a precursor to other technologies as it establishes fundamental feasibility. As an example, most urban food gardens in the Johannesburg area are on soil that is unsuitable. So, failure rates are high and this affects an individual's confidence.
- **Infield rainwater harvesting systems** – these have been demonstrated at Thaba Nchu in the Free State and in the Eastern Cape.
- **Plastic sheeting** – demonstrated at Richmond where sheeting is placed above the crop and directs water to the crop (however, this reduces cropping area).
- **Basins and trenches** – Ecolink and four villages in the Ehlanzeni area have demonstrated these.
- **In-soil water conservation** – demonstrated at Richmond and Thaba Nchu an including various mulching technologies. Source material can be scarce so one might consider growing vetiver or napier fodder.
- **Conservation agriculture** – this is a fundamental water harvesting technology (but this project will not consider it in detail).
- **Drought resistant technologies** – a need to consider what cultivars are available.
- **Alternative practices e.g. crop establishment processes** – might need to change people's social behaviour though (e.g. starting seedlings in trays).
- **Road runoff channelled** – demonstrated in Mpumalanga Township where water from a road system is channelled into a dam, which is now used to irrigate community.
- **Impermeable surfaces** – demonstrated in Mpumalanga (province) where a large granite rock is used to collect water, which is now being stored in a reservoir.
- **Yard harvesting** – demonstrated at Potshini where channels capture water in yards and which is then fed into underground tanks or directly to crops.
- **Interflow water harvesting** – demonstrated at Potshini where trenches in the footslope are used to capture water flowing within the soil profile.

Macro-catchment

- **Pedo-hydrological mapping** – to ensure that certain practices such as contouring are suitable
- **IFRW harvesting plough** – that creates ridges and furrows in large-scale cropping areas
- **Channels and contours** – there is a need to be very careful about where these technologies are applied as they can concentrate water flow and cause erosion.
- **Subsurface irrigation furrows** – to move water to other parts of the slope (using interflow) – need to be very careful since we have very disbursive soil this is perhaps redistribution rather than water harvesting.
- **Grazing and water harvesting** – can it be done? Can grazing management practices contribute to improving grass cover, concentrating water flow and capturing run-off?

Floodwater harvesting (catchment harvesting)

- **Dams** - The use of dams and other catchment harvesting practices requires stronger institutional intervention to ensure that communities have common goals and support collective action. This also has an impact on on where dams are sited. It also requires understanding of stream flow to know how best to use these resources. Below 2000m^3, no water use license is required.
- **Recharging aquifers** – in e.g. Israel floodwater is captured and fed back into aquifers to recharge them and distribute the water onward to other areas.

Technologies to filter water and improve quality

- **Ceramic filters** – The University of Zululand has rolled out filtration systems using ceramic filters for providing potable water
- **Small water treatment plants** – for village scale water treatment.

2.4.4 Networking and information exchange

- This workshop is the starting point in the establishment of a community of practice and a network focused on rainwater harvesting in South Africa.
- There should be a programmatic response that draws research questions from this workshop.
- Funding might be sought from, amongst others, GWP, African Water Facility, SIDA, Development Bank of SA, DGIS, IFAD, Bill and Melinda Gates Foundation (through the WRC call).
- Network has a better opportunity to attract funding than individual organizations.
- Green Village initiative of the WRC – link this work to this initiative.

2.4.5 Conclusions

As with most other systems and technologies RWH is not a panacea but, in many instances, it can make a significant and positive difference to both agricultural production and

domestic water supply (health. With this comes improved well-being. However, any system can only be as good as the larger system in which it is located. The uptake of RWH in a small-scale agricultural context is low. What exists is driven largely by research and NGO funding and support. Agricultural extension to small-scale farmers is poor so support for the systems included in this is also poor.

If public sector extension support is a poor place to start where might we find better leverage points? These are probably located in the markets of which there are two. The first is the market for produce. With improved access to these markets small-scale farmers are likely to adopt innovative systems such as RWH in order to better service the markets. This requires that, from a research perspective, we analyze more closely the entire supply/value chain. The second market is the market for physical systems – Jojo tanks and the like. Suppliers need to actively engage in marketing RWH as a mechanism for marketing their products. If these are useful leverage points researchers and NGOs need to start interacting more closely with the private sector.

Annexes

Annex 1: Multi-stakeholders at local workshop in Tanzania

SN.	Name	Occupation	Work station
1	Prof. Henry Mahoo	Senior Lecturer, Sokoine University of Agriculture	Morogoro
2	Dr. Fredrick Kahimba	Senior Lecturer, Sokoine University of Agriculture	Morogoro
3	Dr. Zacharia Katambara	(MIST)	Mbeya
4	Eng. Alex Oduor	Programme Officer - ICRAF/SearNet	Nairobi, Kenya
5	DALDO Same	DALDO	Same
6	Heriel Mjema	Agric. Engineer	Same
7	Omari Mhina	District Agric. Extension Officer	Same
8	Dr. Emmanuel Mpeta	TMA	Dar-es-Salaam
9	Eng. Omari Mzee	ZIO	Dar-es-Salaam
10	Eng. Kalinga, G.	MAFSC	Dar-es-Salaam
11	Eng. Daruti, R.L.	MAFSC	Dar-es-Salaam
12	Eng. Lwena, A.D.	MAFSC	Dar-es-Salaam
13	Eng. Lait Simukanga	MAFSC	Same
14	John Muze	SAIPRO	Dar-es-Salaam
15	Shija Masikula	Officer, OXFAM	Bangalala
16	Ms. Aisha	VEO	Bangalala
17	Crisant S. Mghamba	WEO	Mwembe
18	Dennis Mjewa	Mayor	Bangalala
19	Aggrey Mbaga	VAEO	Mwembe
20	Kapombe Mshana	WAEO	Bangalala
21	Dinda Juma	Farmer	Bangalala
22	Saumu Bakari	Farmer	Bangalala
23	Elifuraha Mtaita	Farmer	Makanya
24	Ramadhan B. Ramadhani	VEO	Makanya
25	Emmanuel Kitato	WEO	Makanya
26	Verani Mtenga	VAEO	Makanya
27	Abdalah S. Kitanda	Mayor	Makanya
28	Fletcher Kamba	WAEO	Makanya
29	Grace Edward	Farmer	Makanya
30	Asha Said	Farmer	Makanya
31	Miraji Mgonja	Farmer	Bangalala
32	Rabson Marira	Artisan	Bangalala
33	Langeni Simon	Artisan	Makanya

	34	Zuberi Vuzo	Spate expert	Makanya
	35	WalterFahamuel	Spate expert	Makanya
	36	Vedasto Msungu	Journalist	ITV-Iringa
	37	Issa Faraji Tembo	TRL	Makanya stat

Annex 2: Multi-stakeholders at national and local workshop in Ethiopia

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Annex 3 Multi-stakeholders at the regional workshop at Koudougou in Burkina Faso

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10	ZOMA Joseph	ZAT/Sabou		71257363
11	NADIE Ali	DPAH/Bouliemdé		78191446
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13	KABORE Joachim	CVD/Boukou		71594099
14	KABORE Mathieu	Producteur/Boukou		71935125
15	SINARE T. Augustin	Maire de Siglé		70261578
16	OUEDRAOGO Loukoumane	Chef du service (SDEDD/Siglé)		72861451
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18	OUEDRAOGO Adama	INERA		
19	KABORE Issa	ZAT/ Siglé	Issakabore21@yahoo.fr	070707594
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21	KABORE Jacques	Producteur/Boukou		73549768
22	IDO Mamadou	Préfet de Siglé		70703030

Annex 4: Multi-stakeholders at the regional workshop at Bobo-Dioulasso in Burkina Faso

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3	OUATTARA Sékou	Mayor / Péni	76 61 85 94
4	KABORE Célestin Pascal	DRAH/ Hauts Bassins	70 24 46 96
5	TRAORE Drissa	DRAH/ Hauts Bassins / SAPA	70 15 74 26
6	OUEDRAOGO/TRAORE Justine	DRAH/ Hauts Bassins / SAPA	70 27 00 20
7	OTOIDOBIGA/SAWADOGO Sophie	DRAH/ Hauts Bassins / SAPA	76 55 32 06
8	OUATTARA Kassoum	Producer / Péni	76 53 97 79
9	BICABA François	DPRA / Houet	70 12 51 28
10	OUATTARA Lassina	CVD / Péni	76 56 50 31
11	OUATTARA Bassourkou	Monitoring officer / Péni	76 09 89 71
12	BARRO Kassoum	Producer / Péni	76 02 70 78
13	COULIBALY N. Faustin	CRA / Hauts Bassins	70 67 63 42
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19	TAMBOURA Issa	Agricultural economist	75 47 00 31
20	SANOGO Abdoulaye	Agricultural economist	78 15 12 84
21	SANOU Jacob	Director of DRREA de Farakôba	
22	OUATTARA Korodjouma	DRREA Director/Project coordinator Saria and WHaTe	70 51 99 97
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Annex 5 Multi-stakeholders at national workshop in South Africa

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Annex 6: Projects in Progress and Publications – South Africa

Projects in progress

- Institute of Natural Resources on behalf of the Water Research Commission – Constraints for upscaling and outscaling of Rainwater Harvesting Technology
- University of Pretoria on behalf of Water Research Commission – Water Quality and Rainwater Harvesting Systems
- University of Free State – improved productivity from rainwater harvesting systems and institutional arrangements – Eastern Cape, Limpopo and Free State
- Challenge Programme - Water for Food in Limpopo - some aspects of rainwater harvesting

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