WAHARA - Report Series

Second Workshop Report on Participatory Selection of Water Harvesting Technologies

– Study Site Ethiopia –

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SEVENTH FRAMEWORK PROGRAMME

Water Harvesting for Rainfed Africa: Investing in Dryland Agriculture for Growth and Resilience

Second Workshop Report

On

Participatory Selection of Water Harvesting Technologies

Study Site: Ethiopia

Venue: Saint Josef Hall, Wukro, Tigray, Ethiopia

Date of Workshop: December 14-15, 2012

By

WAHARA Research Team

Mekelle University

February 01, 2013

1. Introduction

The "***Water Harvesting for Rainfed Africa: Investing in Dryland Agriculture for Growth and Resilience" (WAHARA)*** is a European Union funded research project currently underway in four African countries including Ethiopia. WAHARA project follows a transdisciplinary approach to develop innovative and locally adapted water harvesting solutions with wider relevance for rainfed Africa. The ultimate objective of the project is to develop water harvesting technologies suitable to Africa through participatory scientific research and scale them up across the continent.

Stakeholder workshop is one of the activities planned to be carried out for selecting and adapting technologies that have synergies with existing farming systems and that are preferred by local stakeholders. In this line, Water Harvesting Technoogy (WHT) selection stakeholder workshop was - held during December 14-15, 2012. The objectives and methods used and the results of the workshop are presented below.

1.1 Objectives

The objectives of the second stakeholder workshop were:

- To select in a participatory manner 3 to 4 water harvesting technologies which could be researched in the next 2 to 3 years in the study site of Ethiopia.
- To discuss and get feedback from stakeholders on how the research could be undertaken, and who could support what for the successful implementation of the project.
- To strengthen the collaboration among stakeholders, researchers and collaborating organizations.

1.2 Approach Used

a. The approaches followed in the selection of the WHT are given below.Identification of stakeholders from the study area who have participated in the first stakeholder workshop: those individuals and organizations involved in the first stakeholder workshop were the main focus. A total of 63 participants from the four administrative areas that cover the project site were invited: (1) Kilite Awlaelo [(with 17 smallest administrative units called Tabias"], (2) Atsbi [4 Tabias], (3) Hawzien [8 Tabias], (4) Saesi Tsaeda Emba [18 Tabias]. These areas drain to the three watersheds of the study area, namely, Suluh, Genfel and Agule. The 63 participants included one farmer from each Tabia, and District (Woreda) experts of natural resources management, irrigation, water resources, and rural development. From the farmer participants, only two were females and the remaining were males.

b. Identification of organizations (Governmental and NGO) which could have important role in the project: all organizations which could play important role in the selection, implementation or scaling-up of the results of the project were identified and invited to the workshop. These organizations included: Tigray Bureau of Water Resources, Tigray Bureau of Agriculture and Rural Development (Natural Resources Management Core Process, Tigray Sustainable Land Management Project and MERET Project), Relief Society of Tigray (REST; an NGO which is highly involved in development works in Tigray), Biruh Tesfa Irrigation and Water Technology PLC (a private organization involved in the manufacturing and construction of different water harvesting technologies), Wukro Saint Marry Vocational School [Wukro Catholic Church] (involved in development works), and IFAD-Tigray. Out of the invited organizations, Tigray Bureau of Water Resources was not able to join because of urgent matters. The rest have participated in the workshop. With regard to gender issues, one was female and the rest were males.

c. Preparation of facilitation plan and agenda for the stakeholder: at this stage, an agreement was reached to implement the following process in the selection of the WHT: (1) Pre-selection of WHT, (2) Identification and definition of the criteria to make a choice between innovative WHT, and (3) Ranking the WHT by giving them a weight.

d. Presentation of pre-selected water harvesting technologies: the MU WAHARA team has pre-selected 8 water harvesting technologies from a number of sources which include: (1) Previous inventories of WHT carried out by the MU team (2) Existing data bases (e.g WOCAT), (3) Discussions with stakeholders and individuals, (4) Existing literatures on WHT, and (5) Data base compiled by WAHARA project.

e. Presentation of pre-selected WHT and identification of additional technologies forward by stakeholders: after presentations of the pre-selected WHT by the MU team, the stakeholders deliberated and gave important comments on improving some of the technologies. They also added two WHT to be considered in the final selection, increasing the total pre-selected WHT to ten.

f. Agreements on criteria for ranking of the ten selected WHT: after a general introductory remark by the MU team on ranking parameters, discussion was carried out on which criteria to use for ranking the pre-selected WHT. After raising and deliberating on several options, the participants have agreed to consider criteria that fall under three major umbrellas of parameters, namely, economic/cost, ecological benefits, and socio-cultural factors. The participants then performed the following three tasks: (1) Various ranking criteria were forwarded by the participants and recorded, (2) The different ranking criteria were categorized into economic, ecological and socio-cultural, and (3) Two most important criteria were selected from each category resulting in a total of six ranking criteria.

g. Ranking of the technologies: since the stakeholders have come from four administrative areas, the participants were grouped based on their respective Woredas. This was done intentionally in order to see the variation in interest among the Woredas. The representatives from the invited organizations were distributed to the different groups to support the process and monitor the participation of each member in the decision making. Finally, each group ranked the WHT from 1 (least preferred) to 10 (highly preferred). This ranking was used by the MU WAHARA team to make the final computation for ranking the WHT using the Analytical Hierarchy Process (AHP) which is discussed in detailed in the following sections of this report.

2. Presentation of Water Harvesting Technologies

The MU WAHARA team has presented 8 pre-selected water harvesting technologies to the stakeholders (Plate 1, 2). The workshop participants have also added two WHT to be included in the final selection.

Plate 1: WAHARA WHT selection workshop, Wukro, Ethiopia (December 14, 2012).

Plate 2: Group discussions: WAHARA WHT selection workshop, Wukro, Ethiopia (December 15, 2012).

2.1 Pre-selected Water Harvesting Technologies presented by MU WAHARA team

Eight potential water harvesting technologies were presented by the MU WAHARA team, discussed by the participants and approved or improved.

Technology 1. Hillside Cisterns with bench terraces

Construction of bench terraces along with series of hillside cisterns (Plate 3) to harvest water for horticultural production using low pressure drip systems.

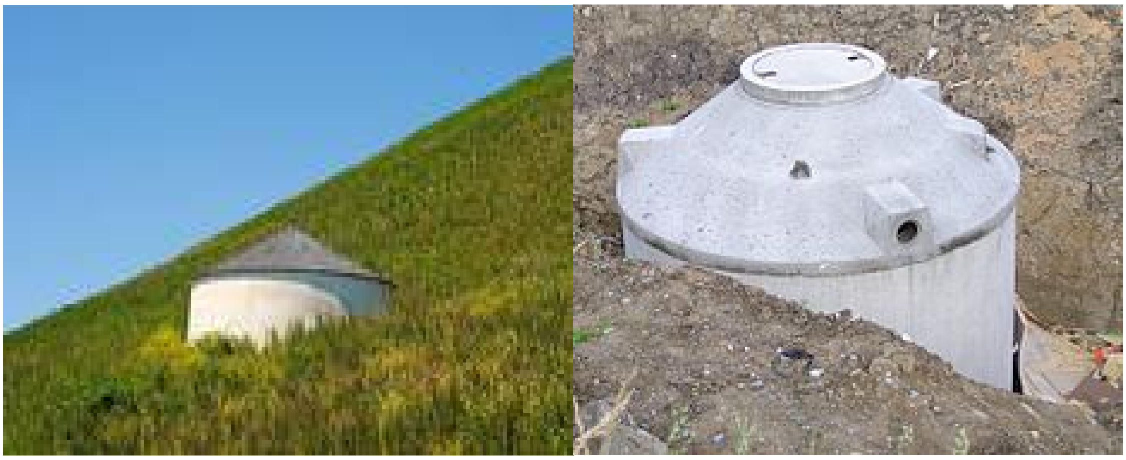

Plate 3. Cisterns.

Technology 2. Stone faced vs. soil faced trench bunds

As can be noted from Plate 4, both soil faced trench bunds (a) and stone faced trench bunds (b) are used in the study areas. The purpose of this study will be to determine in which soil type and landuse each performs best.

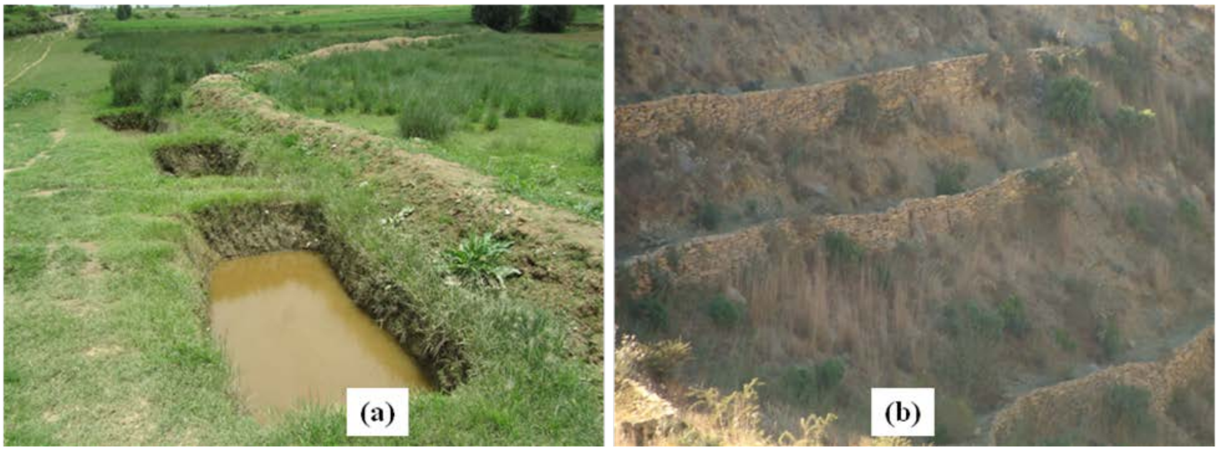

Plate 4: (a) Soil faced trench bunds, and (b) Stone faced trench bunds.

Technology 3: Hillside Conduits with series of ponds

With these hillside conduits (Plate 5), man-made small conveyance channels are used to direct water to fields at the foot of a hill. These systems could be used along with community ponds.

Plate 5: (a) Catchment area of hillside conduits, and (b) Conveyance Channel.

Technology 4: Percolation/sediment storage ponds with hand-dug wells

These technologies (Plate 6; a, b) can be applicable at hill bottom if the farmland is characterized by high infiltration as good results were observed in many areas of Tigray (e.g Abreha Weatsbeha). They can encourage infiltration and subsequent recharge of the groundwater and enable the construction of hand dug wells.

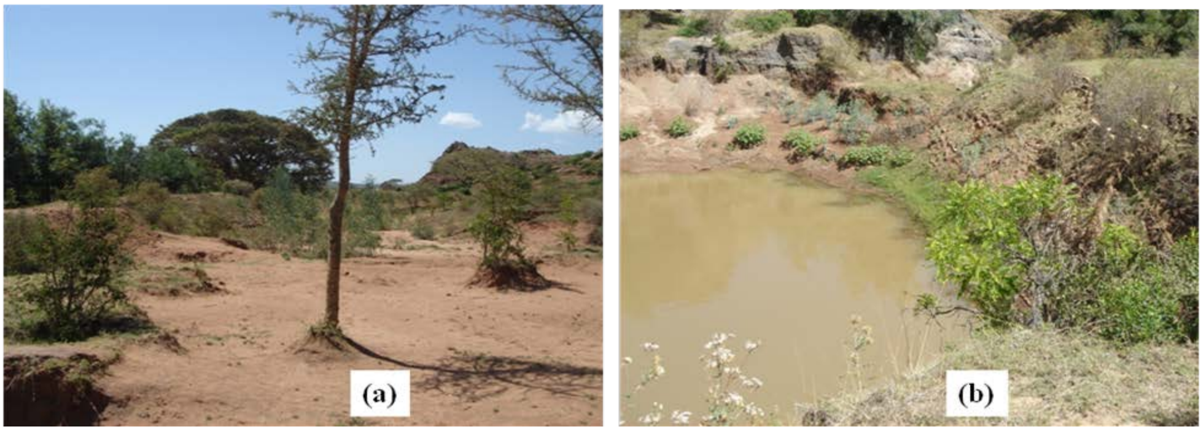

Plate 6. Percolation/sediment storage ponds.

Technology 5: Check-Dams

Construction of series of check-dams reinforced with biological measures (Plate 7; a, b) along a gully can ensure multiple benefits such as gully rehabilitation, water harvesting, improved availability of feed and fruit production.

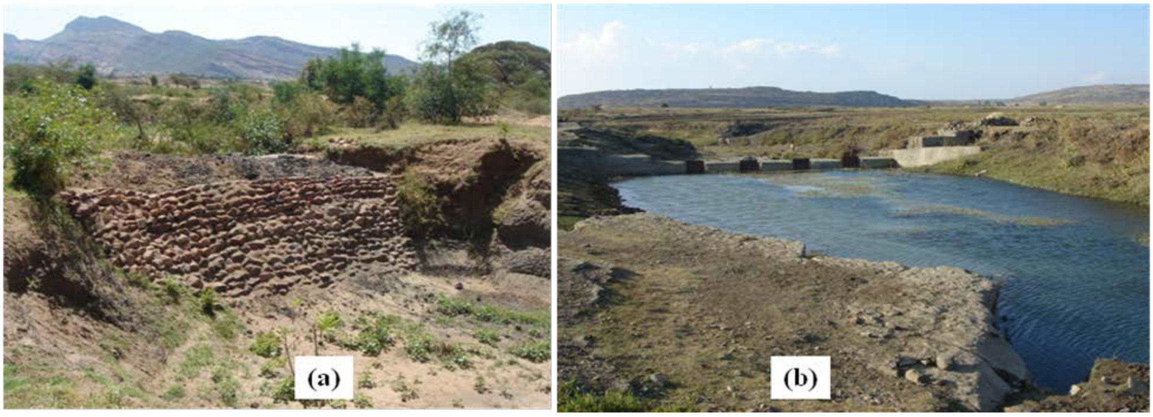

Plate 7. Check-dams: (a) Earthen Check-dam, (b) Concrete/Masonry Check-dams.

Technology 6: Infiltration trenches coupled with biological measures

Construction of infiltration trenches following the root system of nitrogen fixing trees such as "Momona" and cutting/notching the root can ensure multiple benefits (reduced evaporation; increased feed, fuel wood and farm implement availability; and increased fertility).

Technology 7: Soil Improvement Methods

Implementation of different soil management techniques such as mulching, compost and effective micro-organisms can improve the fertility and productivity of the land.

Plate 8. Mulch (biological).

Technology 8: Sub-surface Dams

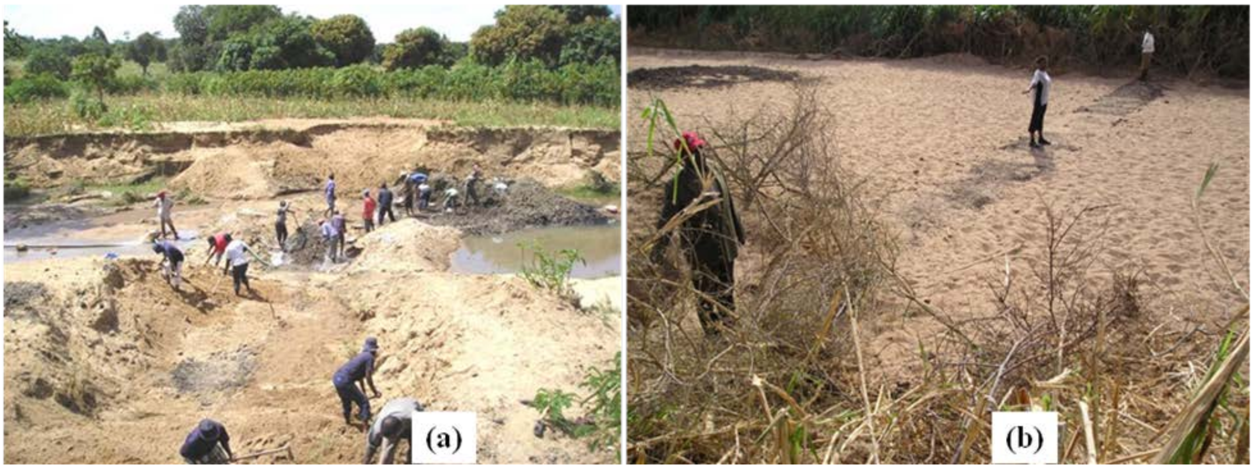

Plate 9. Subsurface dams: (a) under construction, (b) after the construction.

2.2 Water harvesting Technologies suggested by participants

A discussion was made on the presented WHT pre-selected by MU WAHARA team and the participants have fully accepted the proposed technologies. They have also added the following two technologies to be included in the pool of technologies to be ranked by the participants.

Technology 9: Large Semi-Circular Bunds

The participants have suggested that these technologies are among the introduced technologies in Tigray and they have recommended further research to be carried out on the design and performance of such technologies.

Plate 10. Large semi-circular bunds.

Technology 10: Deep tillage and other on farm moisture conservation techniques

The participants (especially the farmers) have stressed that one of the problem with moisture stress is the fact that only the top 15 cm of the soil mass is ploughed by the traditional “maresha”. With deep tillage, the soil can store more moisture and there is a strong need by the farmers for the introduction of technologies which can plough deeper than the traditional ploughing depth.

3. Identification and definition of the criteria

The MU WAHARA team has presented to the participants that it is better to select technologies that would enhance the following benefits:

a. Economic benefits
b. Ecological benefits
c. Socio-cultural benefits

The MU WAHARA team has presented some criteria that have been used in **Burkina Faso** and some research finding in Ethiopia. The participants agreed on the three broad categories and proceeded with setting representative criteria as follows.

3.1 Identification and categorization of ranking criteria

Various ranking criteria were first forwarded by the participants and listed. Afterwards, the criteria were categorized into economic, ecological and socio-cultural as given undearneath.

a. Economic benefits

- Production improvement
- Profitable

b. Ecological benefits

- Big role in erosion protection
- Suitable on different landscape, soil types and climatic conditions
- Improve availability additional arable land
- Adapt to climate change
- Improve water availability
- Allow diversified cropping system
- Improve land reclamation

- Not conflicting with existing ecological conditions

c. Socio-cultural benefits

- Adaptable technology
- Socially acceptable
- Create employment opportunities
- Improve water fetching distance
- Improve workload
- Not conflicting with health and sanitation of the community
- Improve gender participation
- Acceptable by all parties

3.2 Selection of most relevant ranking criteria

As indicated above, many ranking criteria were identified by the participants. However, ranking based on all the criteria would be complicated and tedious. In addition, selection of the most relevant ones is more beneficial since all criteria do not have equal importance. As a result and after a heated discussion, the participants agreed to select 2 most important criteria from each category and came up with the decision given in Table 1.

Table 1. Criteria used for ranking the water harvesting technologies.

Factors	**Abbreviation**	**Explanation**
Economic	C1	Production improvement
	C2	Profitable
Ecological	C3	Technology that protect erosion, increase arable land and reclaim plantation
	C4	Adaptable to different ecological conditions
Socio-cultural	C5	Adaptable and socially acceptable
	C6	Beneficial to females and the youth

For ranking the technologies, the above six criteria (C1-C6) were used.

4. Identification and definition of the criteria analysis tool

After the criteria for selecting the technologies were set and agreed by the workshop participants, the MU WAHARA team has decided to use the Analytical Hierarchy Process (AHP) to be the tool for unbiased ranking of the technologies. Some theoretical background on the AHP method is given below.

The Analytic Hierarchy Process (AHP), a theory of measurements developed by Saaty (1980), is a multi-objective, multi-criteria decision-making approach that employs a pair-wise comparison procedure to arrive at a scale of preferences among a set of alternatives. AHP provides a means of making decisions or choices among alternatives, particularly where a number of objectives have to be satisfied which involve multiple criteria or multi-attribute evaluation in multilevel hierarchic structures. According to Saaty (1980, 2004a, 2004b), AHP is about breaking a problem down and then aggregating the solutions of all the sub-problems into a conclusion. It facilitates decision-making by organizing perceptions, feelings, judgments, and memories into a framework that exhibits the forces that influence a decision (Saaty, 1980).

4.1 Steps in AHP based decision-making

The application of AHP to a decision involves the following steps (Saaty, 1980, 2004a, 2004b): (1) Structuring the decision problem into a hierarchical model, and (2) Making pair-wise comparisons and obtaining the judgmental matrix, (3) Making local priorities and consistency comparisons, and (4) Aggregation of priorities.

Step 1: Structuring the decision problem into a hierarchical model

The most creative part of decision-making using AHP that has a significant effect on the outcome is modeling the problem (Saaty, 1980, 2004a). It involves decomposition of the decision problem into elements according to their common characteristics and the formation of a hierarchical model having different levels. Saaty (1980) indicated that the topmost level is the “focus” or “objective” of the problem; the intermediate levels correspond to criteria, while the lowest levels contain sub-criteria.

Step 2: Pair-wise comparisons and obtaining the judgmental matrix

In this step, the elements of a particular level are compared pair-wise, with respect to a specific element in the immediate upper level. A judgmental matrix is formed and used for comparing the priorities of the corresponding elements with respect to their influence on the elements in the immediate upper level. The judgment or comparison is the numerical representation of a relationship between two elements that share a common parent (Saaty, 1980, 2004a). According to Saaty (1980, 2004a), the set of all such judgments can be represented in a square matrix (e.g. matrix A indicated in Table 2) in which the set of elements is compared with itself. The matrix is reciprocally symmetric, i.e. $A_{ij} = 1/A_{ji}$. Each entry A_{ij} of the judgmental matrix is formed comparing the row elements, A_i, with the column elements, A_j.

$A = (A_{ij})$ (i, j=1, 2, ……… n), where n is the number of criteria.

Each judgment represents the dominance of an element in the column on the left over an element in the row on top. This requires n(n-1)/2 comparisons, where n is the number of elements or criteria. Saaty (1980, 2004a) suggests the use of the fundamental scale of absolute numbers (Table 3) from 1 to 9 to transform the verbal judgments into numerical quantities representing the values of A_{ij}. These numbers indicate the relative dominance with respect to a given criterion of one alternative over another. A preference of 1 indicates equality between the two items while a preference of 9 (extreme importance) indicates that one item is 9 times larger or more important than the one to which is being compared. The entries A_{ij} are governed by the following rules:

$A_{ij} > 0$; $A_{ij} = 1/A_{ji}$; $A_{ii} = 1$ for all i.

Because of the above rules, the judgmental matrix A (Table 2) is a positive reciprocal pair-wise comparison.

Table 2. Pair-wise comparison of elements in the AHP.

Criteria	A_1	A_2	.	.	.	A_j	.	.	.	A_n
A_1	1	.	.	.	.	.	.	.	.	.
A_2	.	1	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
A_i	.	.	.	.	.	A_{ij}	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
A_n	.	.	.	.	.	.	.	.	.	A_{nn}

(Matrix represented by letter A).

Table 3. The fundamental scale of absolute numbers (Saaty, 1980, 2004a, 2004b).

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgement slightly favour one activity over the other
5	Strong importance	Experience and judgement strongly favour one activity over another
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	For compromise between the above values	A reasonable assumption; sometimes one needs to interpolate a compromise judgement numerically because there is no good word to describe it
Reciprocals of the above judgements	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	A comparison mandated by choosing the smaller element as the unit to estimate the larger one as a multiple of that unit.

Step 3: Local priorities (weights) and consistency comparisons

Once the judgmental matrix of comparisons of criteria with respect to the goal is available, the local priorities of criteria are obtained and the consistency of the judgments is determined. It has been demonstrated (Saaty, 1980; Saaty and Vargas, 1991) that the eigenvector corresponding to the largest eigenvalue of the matrix provides the relative priorities of the factors, i.e. if a factor is preferred to another, its eigenvector component is larger than that of the other. The components of the eigenvector sum equals unity. Thus we obtain vector weights, which reflect the relative importance of the various factors from the matrix of paired comparisons. As has been outlined by Saaty (1980, 2004a), the relative priorities (or "weight") of a criterion can be estimated by finding the principal eigenvector (W) corresponding to the highest eigenvalue (λ_{max}) of the matrix A. That is:

$A.W = \lambda_{max}.W$

When the vector W is normalized, it becomes the vector of priorities of the criteria with respect to the goal (Saaty, 1980). λ_{max} is the largest eigenvalue of the matrix A and the corresponding eigenvector W contains only positive entries.

The procedure described above is repeated for all criteria and sub-criteria in the hierarchy. When the pair-wise comparison matrices are completely consistent, the highest eigenvalue (λ_{max}) is equal to the number of elements compared (n) (Saaty, 1980, 2004a, 2004b). In case the inconsistency of the pair-wise matrices is limited, λ_{max} could slightly deviate from n. This deviation (λ_{max}-n), according to Saaty (1980), is used as a measure for inconsistency. When this measure is divided by n-1, it yields the average of the other eigenvectors (Forman, 1998). The consistency of the judgmental matrix can be determined by a measure called the consistency ratio (CR), defined as (Saaty, 1980):

$$\text{CR} = \frac{CI}{RI}$$

Where CI is called the consistency index, which is given by:

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

, and RI is the Random consistency index (Table 4).

Saaty (1980) suggested that the consistency ratio should not be higher than 10% (CR $\leq$ 0.1). A consistency ratio higher than 10% means that the consistency of the pair-wise comparisons is insufficient and requires revisions of the judgement matrix because of an inconsistent treatment of particular factor ratings (Saaty, 1980).

Table 4: Random consistency indices (RI) of random reciprocal matrices of order n (Saaty, 1980, 2004a, 2004b).

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.0	0.0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Step 4: Aggregation of priorities (weights)

The AHP method can be considered as a complete aggregation method of the additive type (Saaty, 1980, 2004a, 2004b; Kamenetzky, 1982). Once the local priorities of elements of different levels are available, as outlined in the previous steps (step 1-3), they are aggregated to obtain final priorities of the alternatives.

5. Ranking of the pre-selected WHT

5.1 Rating of the WHT ranking criteria

The selected six WHT ranking criteria (C1-C6) are equally important, some are more important than others. As a result, the participants were assigned into four groups according to their Woreda administration and asked to weigh each criteria from 1 to 10 based on their importance. The representatives of the various organizations were also distributed to each group to support and monitor the decision process. The MU WAHARA team also followed whether the discussions in each group were proceeding properly. The score given to each criteria by individual Woreda was then compiled and the weighted rating across the entire study area and the corresponding rank determined by AHP (Table 5).

Table 5. The weighted score of the WHT ranking criteria based on the score given by the participants

Criterion (C)	**Score out of 10**				**Weight (AHP)**	**Rank**
	Woreda Atsibi Womberta	**Woreda Hawzien**	**Woreda Saesie TsaedaAmba**	**Woreda Kilite Awlaelo**		
C1:Improve productivity	10	10	10	10	0.191	1
C2: Profitable	9	9	8	8	0.162	4
C3: Technology that protect erosion, increase arable land and reclaim plantation	10	8	10	9	0.177	2
C4: Adaptable to different ecological conditions	8	8	7	8	0.148	6
C5: Adaptable and socially acceptable	9	9	8	10	0.171	3
C6: Beneficial to females and the	10	7	5	10	0.150	5

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Note: rating was from 1-10, 1=least important and 10=most important.

5.2 Prioritization of pre-selected Water Harvesting Technologies

The next step in the process is to prioritize the 10 pre-selected WHT based on the six ranking criteria. As a result, each Woreda rated each WHT from 1 to 10 for each WHT ranking criteria. The scores given by each Woreda is presented in Table 6.

Technology Choices	***Score (1-10) of each technology as evaluated by each criteria***																							
	Woreda Atsibi Womberta						***Woreda Hawzien***						***Woreda Saesie TsaedaAmba***						***Woreda Kilite Awlaelo***					
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
T1: Series of Hillside Cistern with bench terraces	10	10	10	6	8	10	8	8	9	8	9	10	7	8	9	7	7	9	10	8	10	8	8	10
T2: Stone faced Vs soil faced trench bunds	9	9	10	9	9	8	5	5	10	9	8	6	8	9	10	9	8	7	6	6	8	8	8	7
T3: Hillside conduits with series of community ponds	9	8	5	4	7	8	9	9	8	8	8	9	7	7	9	7	7	9	8	9	6	9	6	8
T4: Percolation/sediment storage ponds with hand dug wells	9	10	9	8	9	9	10	10	8	8	9	9	9	10	8	9	7	8	10	8	8	8	9	8
T5: Check dams	8	8	8	7	9	9	7	7	9	9	8	8	9	9	9	7	8	8	10	10	10	10	10	10
T6: Infiltration trenches with biological measures	8	9	9	8	9	8	8	8	8	7	7	6	7	8	8	8	8	7	6	6	6	6	6	7
T7: Soil improvement methods (Mulching, Compost, EM)	10	10	5	10	10	7	9	9	8	8	8	8	10	10	7	9	8	8	8	8	6	7	8	8
T8: Sub-surface dams	5	5	6	4	2	6	7	7	6	7	8	9	6	4	5	5	5	7	4	5	4	6	5	5
T9: Large semi-circular bunds	9	9	8	8	8	8	5	5	7	6	7	8	5	7	6	8	8	8	6	6	5	8	6	6
T10: On farm conservation measures (deep tillage,..)	6	8	7	6	8	5	6	6	5	5	6	6	7	9	6	6	7	5	10	10	8	7	8	10

Table 6. Weight given by the participants to each of the technology choices.

After the scores of the technologies as indicated above was collected, the ranking of the technologies was performed by MU WAHARA team as per the scores of each technology and taking into account the weight of the criteria using the AHP method. The summarized result of the process for the entire study area is given in Table 7.

Table 7. Weighted score and corresponding rank of each WHT determined by AHP

Technology	**Weight (AHP)**	**Ranking**	**Remark**
T1: Series of Hillside Cistern with bench terraces	0.112	3	To be tested
T2: Stone faced Vs soil faced trench bunds	0.104	5	
T3: Hillside conduits with series of community ponds	0.100	6	
T4: Percolation/sediment storage ponds with hand dug wells	0.114	1	To be tested
T5: Check dams	0.113	2	To be tested
T6: Infiltration trenches with biological measures	0.097	7	
T7: Soil improvement methods (Mulching, Compost, EM)	0.108	4	To be tested
T8: Sub-surface dams	0.072	10	
T9: Large semi-circular bunds	0.089	9	
T10: On farm conservation measures (deep tillage,..)	0.091	8	

6. Reflection of participants on the outcomes

After the WHT selection process was completed, the room was open for discussion regarding the selection process and any valuable remarks.

Most of the participants agreed that the result reflected what has been discussed and evaluated by the workshop participants mainly the farmers. It was also indicated that the selected WHTs could have a significant impact on the endeavour to change the livelihood of the farmers. Others also gave their comments regarding the selection processes and final results.

- The participants stated that many technologies have been experienced in Tigray but they have to be supported with research outputs so as to deliver a better change in the livelihood of the society. The good thing is that those selected technologies have also good acceptance by other stakeholders and NGOs.

- The participants (especially the experts) first appreciated that it was an excellent selection process; those selected technologies will have a wider impact on the society and the regional government has a strategy tailored to implement such technologies.

The research should focus on the evaluation of the performance of different percolation ponds so as to prioritize those technologies with better impact.

- Members of the MU WAHARA team appreciated the process and the outcome of the workshop.

7. Evaluation of the workshop

The workshop was so successful for a number of reasons:

- The participants have a lot of experience and the issues raised in the workshop (especially the first workshop) were so helpful to identify technologies of high acceptance by the farmers.
- Most of the participants who attended the first stakeholder workshop were present in the final selection workshop. This has helped a lot in better understanding of the objectives of the workshop and for the WHT selection process.
- The guidelines developed by the WAHARA project was fully implemented; with no major deviations from the initially planned activities.
- The MU WAHARA team was highly impressed by the active participation and the huge knowledge of the participants in general and the farmers in particular. This practical knowledge and experience has helped to select WHT that have critical relevance to the study area and the community.
- The MU WAHARA team has read the material on choice experiment. Some of the concepts in this material were used in the process of technology selection but not the whole approach.
- The Quick scan tool was only used in the pre-selection process in order to identify which technologies could be applied where.

The program and the Minutes of the workshop are presented in Annex I and II of this report respectively.

Annex I : Program of the Workshop

Water Harvesting for Rainfed Africa: ***Investing in Dryland Agriculture for Growth and Resilience***
(WAHARA Project)
Water Harvesting Technology Selection Stakeholder Workshop Program
14 – 15 December 2012
Wukro, Tigray, Ethiopia

No.	**Event**	**Speaker**	**Time**	**Chairman/Facilitator**	**Rapportuer**
14 December 2012					
1	Registration	-	8:30 – 9:00	Wt. Berhan Halefom	-
2	Welcome address	Dr. Dereje A.	9:00 – 9:10	Dr. Fredu N.	Berhane G.
3	Opening remark	Ato Getachew W.	9:10 – 9:20	Dr. Fredu N.	Berhane G.
4	Objectives of the workshop	Dr. Eyasu Y.	9:20 – 9:40	Dr. Fredu N.	
5	Presentation by MU of potential WHT to be tested in Tigray	Dr. Kifle W.	9:40 – 10:30	Dr. Fredu N.	Berhane G.
6	*Health Break*	-	*10:30 – 11:00*	*Wt. Berhan Halefom*	-
7	Feedback on the WHT proposed by MU and presentation of additional technologies by participants	Participants	11:00 – 12:30	Dr. Kifle W., Dr. Eyasu	Berhane G.
8	*Lunch Break*	-	*12:30 – 14:00*	*Wt. Berhan Halefom*	-
9	Presentation of potential WHT selection criteria	Dr. Fredu, Dr. Dereje	14:00 – 14:30	Dr. Eyasu Y.	Berhane G.
10	Identification and definition of selection criteria	Participants	14:30 – 15:30	Dr. Fredu, Dr. Dereje	Berhane G.
11	*Health Break*	-	*15:30 – 16:00*	*Wt. Berhan Halefom*	-
12	Analysis/ranking of pre-selected WHT	Participants	16:00 – 18:00	Dr. Fredu, Dr. Dereje	Berhane G.
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13	Prioritization of the WHT to be tested and Discussion	Dr. Dereje, Dr. Fredu	8:30 – 9:30	Ato Getachew W.	Berhane G.
14	Presentation of forthcoming activities and responsibilities of partners	Dr. Kifle, Dr. Eyasu	9:30 – 9:45	Ato Getachew W.	Berhane G.
15	*Health Break*	-	*9:45 – 10:00*	*Wt. Berhan Halefom*	-
16	General discussion on the way forward and possible contributions by the stakeholders	Participants	10:00 – 10:30	Ato Mulugeta G.	Berhane G.
17	Presentation of workshop evaluation and summarized outputs	Dr. Eyasu Y.	10:30 – 11:00	Ato Mulugeta G.	Berhane G.
18	Closing remark	Dr. Abdelkadir K.	11:00 – 11:10	Dr. Kifle W.	Berhane G.