Knowledge Sharing and Communication Tools for Dialogue Issues on Productivity of Water in Agriculture in Mkoji Sub-catchment, Tanzania

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Abstract

The concept of productivity of water in agriculture is new and is understood differently by different stakeholders. Yet to apply it, all stakeholders require a common understanding. Currently there is limited understanding of how the concept can be communicated to different stakeholders. This limits the potential for dialogue to enable concerns to be resolved. This study investigated knowledge-sharing and communication tools suitable in facilitating dialogue among different stakeholders on the productivity of water in agriculture in Mkoji sub-catchment in the upper part of the Rufiji Basin, Tanzania. The study was based on a survey of multiple stakeholders of water in the study area, including direct water users in agriculture, namely farmers; water resources and agricultural experts; and water managers, especially in irrigated systems. A high proportion (87.5%) of the smallholder farmers indicated low awareness of the concept as universally defined. The experts were aware of the basic definition of productivity of water in agriculture as the ratio of total crop yield to the volume of water used. Given past experience in the study areas, knowledge sharing through farmer training, demonstration plots, field visits, radio and posters will assist in increasing the understanding of different stakeholders and thus improve dialogue.

Key words: Productivity of water in agriculture, Knowledge sharing, Dialogue, Communication tools, Stakeholders, Mkoji sub-catchment, Tanzania

Introduction

Productivity of water (PW) has been defined differently by different authors (Seckler *et al.,* 1998; Bastiaanssen *et al*., 2003), but can simply be described as the ratio of benefits obtained to the amount of water that is quantitatively depleted during a productive process. The benefits may include biomass produced, the economic value of the produce or the value attached to social benefits, e.g. good health resulting from sanitation made possible by the use of water (Dong *et al.,* 2001).

The concept of productivity of water in agriculture is new and understood differently by different stakeholders. Yet to apply it, all stakeholders require a common understanding. Currently, there is limited awareness of how the concept can be communicated to different stakeholders. This limits the potential for dialogue to enable concerns to be resolved (FAO, 2001). Dialogue is the interaction between people with different viewpoints, intent on learning from one another (Phillips, 1984). The purpose of this learning is to lay the foundation for creating new solutions. Dialogue differs from discussion, which focuses on each person presenting, advocating, or selling his or her point of view to others. The intent of discussion appears to be winning, or convincing others of your view. Each side tends to dig in deeper and hold more firmly to their view. Simultaneously, each side becomes more and more convinced that the other's position is untenable. Rigidity creeps in, polarization occurs and the distance between the viewpoints increases. Taken to a logical extreme, discussion can escalate to litigation. Nonetheless, dialogue cannot occur when some people believe they have "the word" and that others do not (Phillips, 1984).

Knowledge sharing is a social activity and so the social implications of knowledge-sharing systems need to be considered and used to help design processes and tools that are actually useful. In a complete knowledge-sharing system, tools to support finding the right person or group of people are required. Once connected, people need to be able to share what they know. The information space in which knowledge is shared needs to be effective in supporting the knowledge-sharing tasks. Relevant information (documents, data, etc) should be readily available and delivered in a form appropriate to the participant. Other tools to support the participant's understanding of the relationships between all participants may help. Understanding the dynamics of those relationships between participants and the knowledge or information they are sharing increases awareness. Communication practices and processes need to be designed to encourage the sharing of knowledge whether through synchronous or asynchronous communication (http://radio.weblogs.com). Synchronous tools enable real-time communication and collaboration in same time-different place mode. These tools allow people to connect at a single point in time, at the same time. Synchronous tools possess the advantage of being able to engage people instantly and at the same point in time (Ashley, 2003), while asynchronous tools enable communication and collaboration over a period of time through a "different time – different place" mode. These tools allow people to connect together at each person's own convenience and own schedule. Asynchronous tools are useful for sustaining dialogue and collaboration over a period of time and providing people with resources and information that are instantly accessible, day or night. Asynchronous tools possess the advantage of being able to involve people from multiple time zones. Evaluations of knowledge-sharing systems in real environments are invaluable in determining what is useful, what works and what does not. Such evaluations help technologists determine what to improve.

Objective of the study

The main objective of this study was to investigate knowledge-sharing and communication tools for facilitating dialogue on issues of productivity of water in agriculture. The specific objectives were as follows: to describe how different stakeholders conceive and understand the concept of productivity of water in agriculture; to identify the type and form of knowledge-sharing tools suitable for each type of stakeholder; to evaluate knowledge-sharing tools necessary for communication and dialogue on issues of productivity of water in agriculture at catchment level.

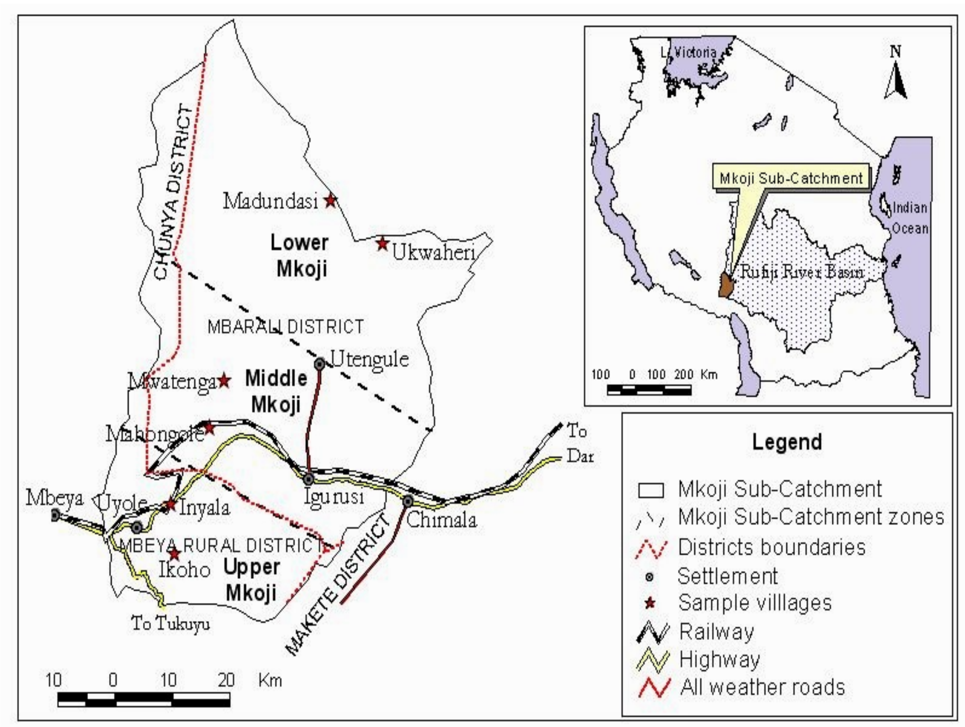
This paper is divided into four major parts. The first part describes the concept of productivity of water in agriculture and explains the importance of dialogue among stakeholders. The second part gives details of the methodologies that were used in data collection and analysis, and the third part presents the results and discussion of the study. The last part presents the conclusions and recommendations of the study.

Research Methodology

Study site

The Mkoji sub-catchment is drained by the Mkoji River and is located in the south-west of Tanzania, between latitudes 7°48' and 9°25' south, and longitudes 33°40' and 34°09' east (Figure 1). It is a sub-catchment of the Rufiji River Basin and covers an area of about 3,400 km². Most of the sub-catchment lies within Mbarali and Mbeya Rural Districts, while smaller portions of the sub-catchment lie within the Makete and Chunya Districts in Iringa and Mbeya regions, respectively. The study area receives a unimodal type of rainfall starting from early November and ending in June. The annual rainfall is about 1,500 mm in the highlands and ranges from 600 - 800 mm in the lowlands (SMUWC, 2001a). There are five major perennial rivers and several seasonal streams, all of which drain into the central plain. Over time, these surface flows have been used for both domestic and agricultural purposes in this area.

Figure 1: Map of the Mkoji sub-catchment and studied villages



Selection of sub-catchments and villages

The Great Ruaha River Basin (GRRB) is made up of eleven sub-catchments. Table 1 summarizes the description of irrigated area and river water use distribution among sub-catchments in the study area. The Mkoji sub-catchment alone has 70 intakes with a capacity of abstracting 12 cubic metres of water per second with 100 percent abstraction efficiency (SMUWC, 2001(b). The Mkoji sub catchment was selected because a considerable area of land (1,388 ha) is under dry season farming; also, there are about 70 intakes in the Mkoji river with a total abstraction of 12 cubic metres per second. Furthermore, the area is densely populated with intensive farming both in wet and dry seasons, thus the knowledge of productivity of water in agriculture (PWA) for water users was thought to be indispensable.

Table 1: Description of surface water flows in the study area

Sub-catchment	Max irrigable (ha)	Wet year (ha)	Dry Year (ha)	Dry season (ha)	Number of intakes in rivers	Total abstraction (cumecs)	Abstraction efficiency (%)
Ndembera	7,623	4,502	3,165	449	6	4.30	65
Kyoga	14,646	5,461	3,075	164	11	7.00	100
Mbarali	8,403	9,367	3,634	240	3	8.50	100
Mlomboji	0	20	0	0	1	0.10	50
Kimani	3,666	2,269	849	46	5	4.00	95
Ruaha	5,432	4,525	1,964	28	1	5.00	85
Chimala	2,115	2,769	566	202	7	2.75	100
Mkoji	12,600	12,675	3,316	1,388	70	12.00	100
Mjenje	657	270	92	0	12	0.60	70
Kimbi	60	28	11	0	3	0.20	70
Total	55,202	41,883	16,670	2,517	119	44.5	835

Source: SMUWC, 2001a

Selection of villages

The Mkoji sub-catchment is large (about 3,400 km^2) and was studied through random sampling of the villages and then the households within the villages (Tables 1 and 2). The sub-catchment was therefore purposefully divided into three zones – upper (27 villages), middle (19 villages), and lower (7 villages). Two villages were purposively selected from each zone, to capture the variability in livelihood and production systems among water users in the catchment (Table 2). The most important criteria used for selecting the villages were (i) sub-zonal representation within the major zone; (ii) inclusion of a wide range of production systems (including irrigated and rain-fed crop production); and (iii) availability of secondary data (Tables 1 and 2).

Table 2: Selected study villages

Name of village	Zones	Farming systems	Availability of data
Ikhoho	Upper	Rain-fed (maize, potatoes and wheat)	RIPARWIN database and SHARDI reports
Inyala	Upper	Dry-season irrigation (maize, beans, potatoes, vegetables)	RIPARWIN database and SHARDI reports
Mahongole	Middle	Dry season irrigation (maize, beans, vegetables) and wet season irrigation (paddy)	SMUWC and RIPARWIN databases
Mwatenga	Middle	Wet season irrigation (paddy)	RIPARWIN database
Ukwaheri	Lower	Rainfed (maize, sorghum/millet) and livestock	SMUWC and RIPARWIN databases
Madundasi	Lower	Rainfed (maize, sorghum/millet) and livestock	SMUWC and RIPARWIN databases

Source: SWMRG, 2001.

Vulnerable group assessment and gender analysis

Vulnerability relates to the presence of factors that place people's livelihoods at risk of becoming food-insecure or malnourished, including those factors that affect their ability to cope. Vulnerable groups living in the agro-ecological zones within the targeted agricultural production systems were identified and their conditions assessed. The key aspects addressed included, among others, the questions of i) who are the insecure and the vulnerable? ii) where are they located within the agricultural production system? iii) why and how are they vulnerable to food insecurity? iv) what strategies do they adopt to cope with their vulnerability? and v) how effective are these strategies?

There is a wide range of both internal and external factors that contribute to the vulnerability of households to food insecurity. The internal factors are numerous, and relate to the socio-economic position of an individual or a group, physical constraints, culture or geo-political situation. External factors may include changes in the social, physical, economic and/or natural environment. The study analysed a multiplicity of these factors in as much as they interact with the productivity of water within agricultural parameters. An integral component of this methodological approach consists of the inclusion of gender relationships, with special attention to disadvantaged groups (including women and children). Selection was random within each category. Table 3 shows characteristics of the wealth categories that emerged from focus group discussions with villagers.

Table 3: Characteristics of wealth groups in the study area

Variables	Poor	Middle	Well-off
Total land irrigable (ha)	<0.4	0.3 –1.2	>1.2
Livestock owned	Cattle: 0 Chickens: 1-5	Cattle: 1-5 Goats & Sheep's: Variable Chickens: 8-24	Cattle: >8
Farm tools used	Hand hoe	Hand hoe	Hand hoe and ox-plough
Type of labour used	Family labour	Family and casual Labour	Family labour, casual labor

Selection of sample households in the sampled villages

In order to map up water linkages with poverty among households, a participatory wealth ranking technique was used. The wealth ranking criteria included such variables like livestock holding, area under cultivation, access to irrigable land and access to water. The exercise allowed the researcher to stratify households and classify them as poor, middle and well-off. The stratification was based on the villagers' own criteria for wealth ranking obtained during the survey. A sample of 248 households was randomly drawn from the list of stratified households in each village included in the study. The total sample contained 108 households from the poor wealth group, 124 households from the middle group and 16 households from the well-off group. The distribution of households by wealth rank in the catchment is shown in Table 4.

Table 4: Distribution of households by wealth rank

Location	Poor	Middle	Well-off	Total
Upper zone villages	38	42	6	86
Mid-zone villages	32	36	4	72
Lower zone villages	38	46	6	90
Total	108	124	16	248

Source: Survey data, 2003.

Respondent characteristics
The study was based on a survey of multiple-stakeholders in water in the study area, including direct water users in agriculture, namely farmers, water resources and agricultural experts and water managers, especially in irrigated systems. The survey of smallholder farmers covered 6 villages and 248 households selected randomly from each wealth strata (Table 4).

Other stakeholders included village agricultural extension officers, Ministry of Agriculture Training Institute (MATI) Igurusi tutors, Southern Highland Agricultural Research Development Institute (SHARDI) Uyole researchers, Rufiji basin water officers and local government leaders, who were considered indirect water users. Table 5 shows indirect water user distribution (stakeholders) most of whom were extension officers, trainers of extension officers, irrigation technicians, researchers and water managers.

Table 5: Distribution of other stakeholders and their institutions (N = 95)

Institution	Number	Percent
MATI Igurusi tutors	16	16.8
MATI Igurusi students	20	21.1
SHARDI Uyole researchers	20	21.1
Zonal irrigation officers	15	15.7
Water managers	10	10.6
Total	95	100

Source: Survey data, 2003.

Data collection
For the three specific objectives, Participatory Rural Appraisal (PRA), focus group discussions (FGD) and household surveys were employed in data collection for each objective. The study employed a qualitative approach through focus group discussions. The purpose of the visits was to explain to the villagers and their leaders the purpose of the study, and to ask them to join the focus group discussions. Representatives, who were also key informants, were selected based on the fact that they were knowledgeable on issues of water management. Different focus group discussions were held for MATI Igurusi tutors, SHARDI Uyole, water managers, River Basin Water Office (RBWO) officers and irrigation managers.

Focus group discussions of twelve participants were held for villagers and other stakeholders. All discussions were led by a researcher as facilitator. Discussants were allowed to talk freely about the topic. The participants were chosen from a target group whose opinions, attitudes and ideas were relevant to the investigation. The sessions were conducted with various sub-groups, for example young males and females, old women and men. Participants were chosen at random and briefly interviewed to determine whether they qualified for the group discussions.

Bearing in mind the advantages and disadvantages of different methods of data collection, this study employed both qualitative and quantitative approaches. A combination of different methods usually maximises the quality of data collected. It also reduces the chance of bias. Qualitative studies have the merit of exposing attitudes and opinions underlying various norms, traits and characteristics rather than seeking to quantify the phenomena statistically. Furthermore, they reduce exaggeration, since some discussants may feel shy to tell lies before the group. They greatly promote bottom-up planning and social cohesion.

However, there is often more focus on techniques than on enhancing the central role of the community in the development process, resulting in the community having high expectations of outside assistance. In many developing countries there is no mechanism for the sharing of information. This often results in the duplication of research activities. As a consequence, the reaction of communities may become negative and hostile, since they become exhausted with repeated exercises.

Data Analysis

Data collected using questionnaires were reduced, summarized, coded and entered into the Statistical Package for Social Science (SPSS) computer software and later analyzed. Descriptive statistics such as frequencies, means and cross-tabulations were used to display data, and later in writing the study results. Structural analysis was employed in the analysis of documented information and qualitative data collected during the PRA session.

Figure 2: Conceptual framework of the dialogue in the productivity of water in agriculture.

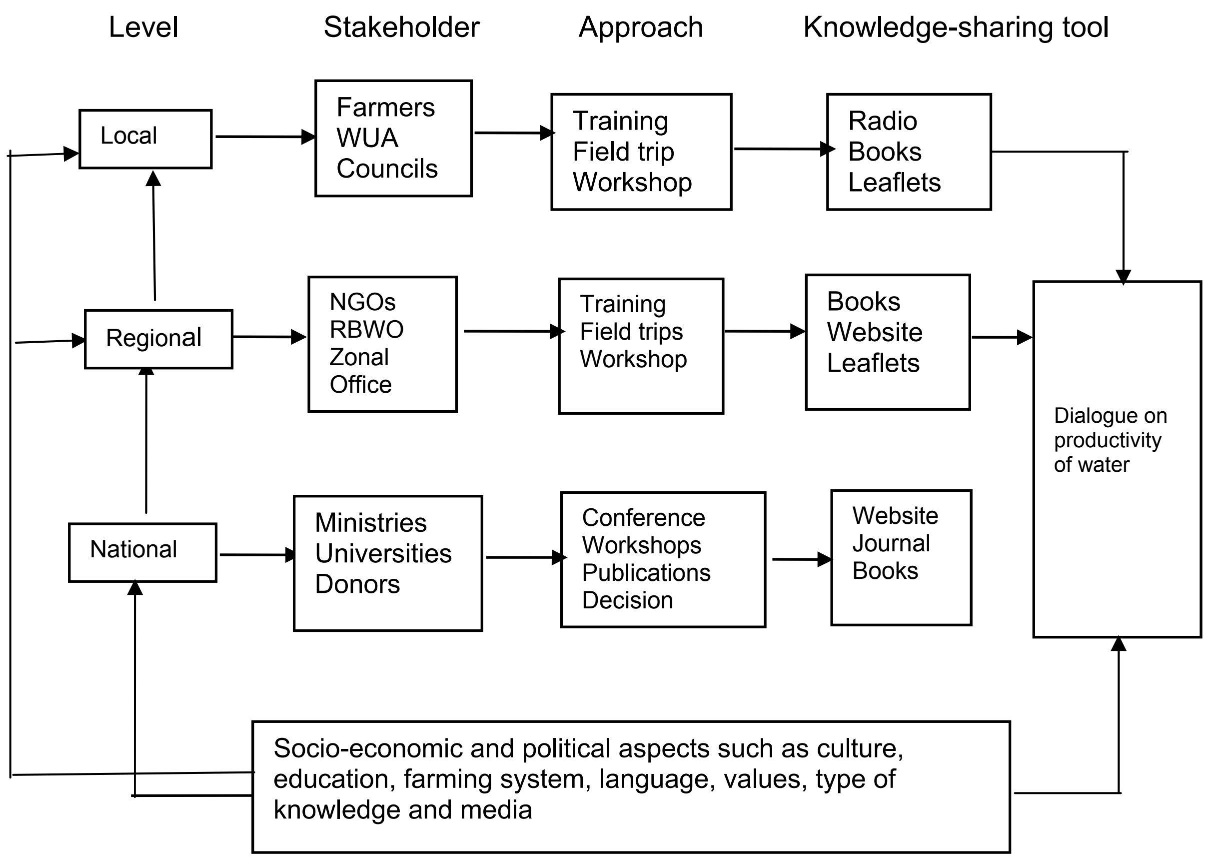


Figure 2 shows a conceptual framework of this study. According to the conceptual frameworks there are three levels on which dialogue on the productivity of water can be undertaken. First is the local, then the regional and finally the national level. At the local level, dialogue was with farmers within the Water Users Association (WUA), while at the regional level were the different NGOs and RBWOs. At the national level, the dialogue was undertaken with ministers, universities and donors.

Fig.2 shows the three hypothesized approaches used in enhancing dialogue at the three levels, which include training, field trips, workshops and sometimes publications. The common sharing tools at the three levels include radio, books, websites and journals. The framework considers the importance of knowledge sharing and communication among stakeholders. It shows the process of sharing or conveying information and knowledge from the local level to national level. Further, it shows the best knowledge-sharing and communication tools for different stakeholders for facilitating dialogue on issues of productivity of water in agriculture.

Results and discussions

Respondents' Understanding of PWA

In the focus group discussions held for the selected villages, participants described the concept of PWA as new for them, and asserted not measuring the volume of water used to produce crops. However, it was revealed that farmers had their own way of describing PWA, by referring to good or bad rainfall years. Box 1 presents an abstract of the views of water users in Mwatenga village (mid-zone of Mkoji sub-catchment) during the FGD session on how they understood the productivity of water in agriculture.

Box 1: Mwatenga village focus group discussion views on perception of PWA

*The concept of PWA is new in the village. Normally, farmers ask themselves whether there is progress forward or backward. Productivity of water is explained by referring to good rainfall years. The Sangu ethnic group describe PWA as '*Mwagka ughu matile deni' *or* 'ikienye ikhi ngavile fijo' *('there were few harvests this season') while description by the Sangu ethnic participants, '*mwaka gwanu mwaka mnofu a malenga enonya ninji'*, means 'this year there was good rainfall and plenty of water'.*

Box 2 presents an abstract of the views of water users in Mahongole village (mid-zone of Mkoji sub-catchment) during the FGD session on the meaning of PWA. FGD participants said that in the past there was no need to consider the productivity of water because there was sufficient rainfall and soils were fertile. They said that water use for agriculture differed in spatial and temporal terms. Furthermore, water use differences were due to crop stages, and some villagers could harvest more and others had smaller crop yields because of wet and dry years. Participants also said that because there was enough water, some farmers allowed water to flow to their neighbors' crop fields, which lowered field temperatures and paddy yields.

Box 2: Mahongole villagers' views on the perception of knowledge of PWA

The concept of PWA is new and we hear it from you for the first time. It might be related to application of less water for more paddy yield. But, soils have been depleted of fertility and one needs to put more water to suppress weeds. Because of weeds, we are compelled to allow water for some days in the paddy bunds. This increases the amounts of water used in paddy production and hence reduces productivity of water in agriculture.

Most farmers' fields in the village are not well leveled and are not square like those of Kapunga state rice farm. It was difficult to measure the volume of water used in this cascading pattern of fields whereby the paddy fields of individual smallholder farmers are linked by small water canals. "The PWA concept is good, but the government should construct a water reservoir and have agricultural extension officers in the village to advise smallholder farmers", Mr Juma Mwakanyamale, the chairman of Mahongole village, commented.

Regarding the perception of PWA, some members had an idea following a farmer training course conducted by the MAFS in 2003. In the dry season, members of this association practiced bottom valley farming in which they grew maize during the dry season. Maize plants from the plot were irrigated using a twenty litre bucket of water, applying 30 buckets of water per day for 30 days. The maize harvest is usually one 100 kg bag per plot. Participants in the FGD described PWA as the crop yield obtained after proper use of water. However, farmers were not measuring PWA, due to lack of skill.

Effects of level of education of respondent on their understanding of PWA

The results in Table 6 show the responses by education level of smallholder farmers' understanding of productivity of water in agriculture. There were no significant differences between group means of education levels and the perception of PWA at $p<0.05$. Since the p value (0.367) was greater than 0.05, it implied that the mean had no significance difference, hence educational level had no influence in understanding PWA.

Table 6: Education level of smallholder farmers in relation to their understanding of PWA by percentage (N = 242)

	Knowledge on productivity of water in agriculture				
Education of respondents	Yes	No	Total	χ^2	p value
No formal education	6(2.5)	66(27.3)	72(29.8)	5.422	0.367
Standard four	4(1.7)	28(11.6)	32(13.2)		
Standard seven	17(7.0)	111(45.9)	128(52.9)		
Standard eight	2(0.8)	3(1.2)	5(2.1)		
Form four	1(0.4)	3(1.2)	4(1.7)		
Higher education	0(0.0)	1(0.4)	1(0.4)		
Total	30(12.4)	212(87.6)	242(100.0)		

Source: Survey data, 2003; Figures in parentheses are percentages and those out of parentheses are responses; not significant at $p< 0.05$.

The reason for poor knowledge of PWA might be twofold. First, those few respondents who were aware of PWA might have attended farmers' training courses conducted by the Ministry of Agriculture and Food Security (MAFS). Second, the inadequacy of agricultural extension officers in the study areas also probably contributed to the low level of PWA knowledge among smallholder farmers.

Gender of respondents by their understanding of PWA

Cross-tabulation was done between gender and respondents' understanding of PWA. There was no significant difference between means of the groups at $p<0.05$, while the statistical value was very low (0.587), implying that no relationship existed between gender and understanding of PWA (Table 7).

Table 7: Gender aspects in relation to understanding of PWA by percentage (N = 248)

Gender	Knowledge on Water productivity in agriculture				
	Yes	No	Total	χ^2	p value
Male	28(11.3)	184(74.2)	212(85.5)	0.587	0.306
Female	3(1.2)	33(13.3)	36(14.5)		
Total	31(12.5)	217(87.5))	248(100.0)(		

Source: Survey data, 2003; Figures in parentheses are percentages and those out of parentheses are responses; not significant at $p< 0.05$.

Furthermore, the study found that few females (3, or 1.2%) of the total respondents sampled understood the concept of PWA compared to males (28, or 11.3%). This implied that most females were not aware of the concept of PWA, which might have been due to lack of agricultural extension officers to teach them. It was, however, possible that most females measured the crop harvested but not the volume of water used to produce it. It also implied that female respondents probably did not have access to some of the technology sent to the villages. However, respondents and other informants agreed that they had indigenous knowledge related to PWA. Box 4 shows the abstract of key informants' views in Ukwaheri village in the lower Mkoji sub-catchment, which shows that they used indigenous knowledge to improve the productivity of water during water scarcity periods. For example, adoption of minimum tillage, early planting, mixed cropping and planting drought resistant crops indicated that they were aware of PWA.

Box 4 Ukwaheri villagers' views on their perception of PWA

The concept of PWA is new in the village, but the soils in the lower zone are fertile because we have been harvesting 10 to 15 bags of maize per acre without use of fertilizers. Due to unreliable rainfall, we have some coping strategies like planting mixed crops (sorghum, groundnuts and green grams). We plant drought resistant crops like sorghum and cassava, and practice flat cultivation in order to increase crop yields. We are still growing local crop varieties because they are high yielding, early maturing and are drought resistant. Recently, the Sukuma ethnic group has introduced a new technology of planting a leguminous plant known as chickpeas (Cicer arietinum) or 'dengu' immediately after paddy harvest to exploit the available moisture residue. Apart from food, the crop produce is sold at a high price (Tshs 13, 000/= per 20 kg) during the dry season. Other ethnic groups have started adopting it.

Understanding of PWA by other stakeholders

Sixteen agricultural tutors from MATI Igurusi were involved in the FGD sessions. The institute trained irrigation technicians and smallholder farmers on aspects of water management. Of the 16 tutors, 4 (25%) indicated that they understood PWA and 12 (75%) said that it was a concept to them. MATI tutors described PWA as the amount of crop harvest per volume of water used, but indicated that it was difficult to quantify the volume of water used in crop production, especially in rain-fed agriculture. Furthermore, there was lack of technical know-how and equipment for measuring the volume of water used for crop production. For those who said that the concept of productivity of water in agriculture was new to them, they had reasons that it was not included in the syllabus for both irrigation and land use planning diploma courses at the Institute.

Furthermore, some tutors from MATI Igurusi related the concept of PWA to irrigation efficiency, which was described as the ratio of the amount of water required for an intended purpose, divided by the total amount of water diverted. Such a description is similar to that given by Wolters and Bos (1989) and Jensen (1980). Others defined PWA as the amount of crop harvested per unit volume of water used. A similar description was given by Viets (1962), Tabbal *et al.* (1992), and Molden (1997), that productivity of water in agriculture is the amount of food produced per unit volume of water. The volume of water used implies that water used in crop production has various components (evaporation, transpiration, gross inflow and net inflow) hence it is important to specify which component is included when calculating the productivity of water (Tuong and Bhiyan, 1997, Molden, 1997). Hence water efficiency and productivity concepts should be used in conjunction to assess water management strategies and practices to produce more food with less water.

The Mkoji sub-catchment had few village agricultural extension officers (VEOs). Of the six sampled villages, only two village's extension officers, which included Inyala and Mahongole of the upper and middle zones, respectively. Of the two VEOs neither had knowledge of PWA. This idea was considered new for them. Box 5 shows the abstracts of the VEOs' views describing their understanding of PWA.

Box 5: Inyala village extension officers' views on perception of PWA

We do not measure the volume of water used in crop production, but traditionally the cultivated area is measured and everyone can tell how much is harvested per acre. Crop harvests per unit of land have improved because new agronomic practices have been adopted by farmers; these include early planting, use of improved seeds, application of fertilizers, timely weeding, proper spacing, use of insecticide and fungicide and adoption of dry season farming. The agricultural extension officers have taught these practices.

Participants from the Southern Highland Agriculture Research Development Institute (SHARDI) at Uyole described PWA as the ratio of total crop harvested to the volume of water used. Other SHARDI Uyole participants in the FGD said that productivity of water in agriculture could be increased by using better varieties or agronomic practices, or by growing crops during the most suitable periods. The implications of such explanations were that productivity of water could be determined by parameters other than water management. This implied that productivity of water alone would not be particularly useful in identifying saving opportunities of the system under consideration. Basically, researchers conceptualized the knowledge of PWA as all benefits of using water. The benefits include biomass and are classified as food grain, fodder and crop residues. The purpose is to meet household food security and the sustainable maintenance of soil fertility.

Further, participants said that researchers assessed PWA using two main components of productivity of water: the physical mass of production or the economic value of produce and the unit volume of water used. Researchers acknowledged the multiple use of water in an irrigated system, but most of these uses are not accounted for in many irrigated systems, even though the users claim a large amount of water. The simple reason is that some of these water uses are not easy to quantify. Box 6 shows an abstract of researchers' views on their understanding of PWA.

Box 6: Researchers' views on their perception of PWA

Productivity of water in agriculture is the ratio of crop benefit to the volume of water used, one participant explained. Researchers record irrigation flow diverted for crop production, weather data, evaporation pan data, soil hydrologic properties and crop water requirement to determine the denominator of productivity of water. Direct measurement of water used/depletion from irrigated field and productivity of water can be done on the field by quantifying water accounting components such as transpiration or evapotranspiration, runoff and drainage from the crop field.

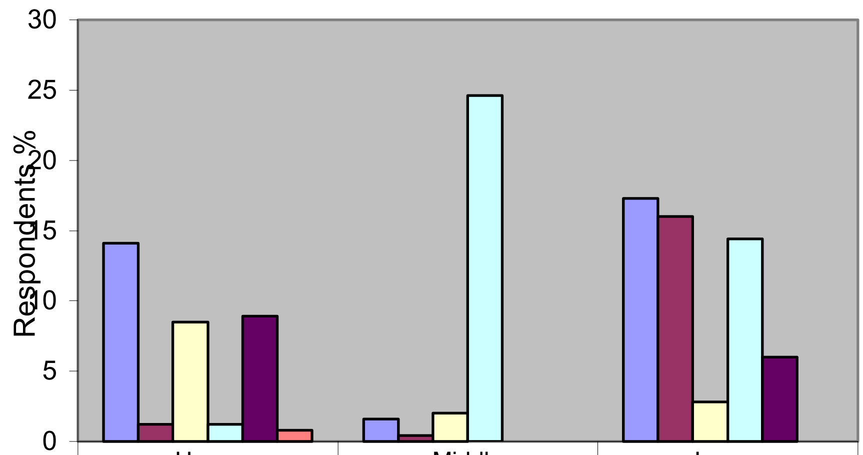
The River Basin Water Office (RBWO) was responsible for water management, granting water rights and allocation, collection of water user fees and co-ordination of stakeholders towards better water management. The RBWO has established a sub-office in Mbarali district, which among other things, monitors river water levels, collects water use fees and arbitrates conflicts that arise from water use. Few of the RBWO officers understood productivity of water in agriculture. The areas and amounts of water under different agricultural domains in Mkoji sub-catchment were provided.

Knowledge-sharing Tools Suitable for Each Type of Stakeholder

Knowledge-sharing tools for smallholder farmers

'Figure 3, below, shows the knowledge-sharing tools used in Mkoji sub-catchment communities to explain PWA. Results show that flip charts were used for 14.1 and 17.3% of respondents for upper and lower Mkoji sub-catchment respectively. Furthermore, pamphlets were used with 24.6 and 14.4% of respondents for middle and lower Mkoji sub-catchment respectively. The implication of the findings is that facilitators used theory methods rather than practical methods, which means that participants might not have understood the intended intervention. Furthermore, there were probably inadequate' (do you mean 'too few' or 'inadequately informed'?) 'village agricultural extension officers. Farmers need appropriate knowledge-sharing tools that provide both theory and practical skills regarding productivity of water in agriculture.'

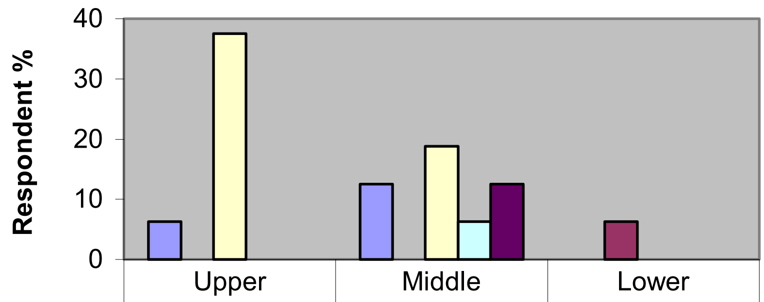
Figure 3: The most used knowledge-sharing tool in Mkoji sub catchment



	Upper	Middle	Lower
Flip chart	14.1	1.6	17.3
Blackboard	1.2	0.4	16
Demonstration plot	8.5	2	2.8
Pamphlets	1.2	24.6	14.4
Flip charts/demo plots	8.9	0	6
Posters	0.8	0	0

Figure 3 shows the best-bet knowledge-sharing tool for farmers training in Mkoji sub-catchment. The study found that demonstration plots scored 37.5 and 18.8% for the upper and middle locations respectively. However, respondents from the lower Mkoji sub-catchment showed a poor response, probably because of lack of awareness of these tools. The results probably imply that there was a relationship between location of the village of respondents and the best-bet knowledge-sharing tools for training farmers about the productivity of water. Farmers from the upper and middle Mkoji sub-catchments wanted interaction through demonstration plots by village agricultural extension officers. Furthermore, lack of village agricultural extension officers and the location of these villages might be reasons that deny farmers access to agricultural extension services.

Figure 4: Best-bet knowledge sharing tool in Mkoji sub-catchment



	Upper	Middle	Lower
Farm visits	6.3	12.5	0
Booklets	0	0	6.3
Demonstration	37.5	18.8	0
Pamphlets	0	6.3	0
Radio	0	12.5	0

Similar results were obtained from focus group discussion sessions. Pair-wise ranking of the knowledge-sharing tools was conducted during focus group discussion sessions. The results in Table 8 show the best knowledge-sharing tool for farmers training in Mahongole village sub-catchment. Mahongole village had a village agricultural extension officer and was most visited by experts. A high score (53.4%) was recorded for demonstration methods, meaning that smallholder farmers possibly wanted to learn by doing rather than by hearing and observation. Other village results for pair-wise ranking were similar. However, other participants requested books for further reference in the absence of the facilitator.

Table 8: Pair-wise ranking scores for best knowledge-sharing tool by FGD participants at Mahongole village (N=15)

Method	Vote	Percentage	Remarks
Demonstration	8	53.4	Best bet method
Field visit	3	20.0	
Booklets	2	13.3	
Posters	0	0.0	
Pamphlets	2	13.3	
Total	15	100.0	

Source: Field survey, 2003.

Participants in the focus group discussions described the exchange of ideas between individual farmers and scientists as the best knowledge-sharing tool. Traditionally, farmers have their own ways of exchanging information, as explained by the Sangu ethnic phrase '*mawazo uluhala numiayangu'*, meaning 'we exchange ideas with a friend'. For example, smallholders exchanged ideas about changing from cultivating one crop to another for improving crop yields, which was believed to preserve soil fertility and water. These findings implied that smallholder farmers probably had a wealth of knowledge that needed to be integrated by the scientific knowledge paradigm to improve the productivity of water in agriculture. However, suitable knowledge-sharing tools were needed to communicate this knowledge. Participants at Mwatenga FGD described knowledge sharing as the exchange of ideas, common among farmers. Box 7 shows abstracts from the Mahongole village views on knowledge-sharing tools.

Box 7: Mahongole villagers' views on perception of knowledge sharing

Knowledge sharing means telling a farmer friend about a profitable operation in crop production or farmer to farmer extension or advice to another farmer. The Kyusa ethnic group describes it as kupelania unogono *('give another person a farming technique'), while the Sangu ethnic group describes it as* tipelanila luhala *('give a fellow farmer a farming technique'), and the Safwa ethnic group,* tipelana injele *('give another a technique to solve a problem'). What is important is to educate each other, improve production and share ideas. For example, a friend was advised to plant TMV 1 maize variety in the dry season because of its resistance to maize streak.*

Knowledge-sharing tools for communication and dialogue used by other stakeholders

The in-depth interviews with trainers, researchers, agricultural extension workers and water managers from Mbarali and Mbeya rural districts indicated that agricultural shows, campaigns, study tours, video cassettes and method and results demonstrations were useful when imparting knowledge to farmers. These group methods motivated agricultural village extension officers to increase the awareness of the productivity of water in agriculture. Stakeholders further insisted that experts should use combinations of methods, and most agreed that demonstration plots were the suitable knowledge-sharing tools.

Furthermore, since productivity of water in agriculture was a new idea, stakeholders said that reference books, leaflets, newsletters, scientific journals and web-based knowledge-sharing tools should be available. However, it was difficult to secure reference books, and in most cases, their prices were not affordable. The cost and availability of the knowledge-sharing tools was another limiting factor. Most stakeholders showed an interest in web-based knowledge-sharing tools, as they were was accessible to most of them and cheaper, with current information, and the language was well understood.

MATI Igurusi tutors expressed their concern about the lack of knowledge-sharing tools among stakeholders. The Institute has obsolete books, teaching aids and equipment that are necessary for knowledge sharing, and lacks knowledge on how to use knowledge-sharing tools like web-sites. In the Institute, only two tutors were able to access Internet services. In the past, knowledge was mostly acquired through formal training and lasted a lifetime, but now this is not the case. Box 8 shows an abstract of MATI Igurusi participants' views on knowledge-sharing tools.

Box 8: MATI Igurusi participants' views on perception to knowledge sharing

Knowledge sharing means reading books, attending workshops or any training and visiting the World Wide Web for information. Further, storytelling or advice by a friend implies sharing knowledge. However, the Institute has obsolete books and lacks Internet facilities. Most of the tutors are computer illiterate. This is a bottleneck to knowledge sharing.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the findings from this study the following conclusions are drawn:

1. There was little understanding of PWA by stakeholders. Most smallholder farmers related PWA to scarcity of water, but showed lack of awareness regarding this new science. Furthermore, water users described this knowledge by relating it to practices of planting fast-maturing varieties, high value crops, early planting, application of farmyard manure and use of industrial fertilizers for the purpose of increasing crop yield both in rainfed and irrigated agriculture.
2. Farmers had a positive attitude towards knowledge of PWA, and indicated that it had added value to government initiatives for agricultural training programmes, emphasizing good methodologies of quantifying crop harvests and the volume of water used. The findings showed inadequate extension services and sometimes complete lack of them, as was the case in the lower zone of Mkoji sub-catchment, where farmers were ready to learn new ideas from agricultural experts, but were denied the service.
3. Farmer training, demonstration plots, radio and field visits received a high score as suitable forms of knowledge-sharing tools. This implied that there was stakeholder willingness to learn scientific methods through practical rather than classroom sessions. The integration of indigenous and scientific knowledge needed to be underscored to be underscored to promote common understanding and description of the productivity of water in agriculture in Mkoji sub-catchment and elsewhere.

Recommendations

Based on the conclusions drawn from the findings, the following recommendations are made.

1. Farmer training, demonstration plots, radio and field visits should be employed as knowledge-sharing tools for creating awareness of PWA.
2. Communication and dialogue should be held among organizations that are operational in the Mkoji sub-catchment to influence productivity of water and water management.
3. Dialogue on issues concerning productivity of water in agriculture should be held between stakeholders from village to national level to reach a common understanding of the description of PWA.
4. Formal and informal knowledge-sharing tools for ways of improving productivity of water should be integrated to raise the level of PWA in Mkoji sub-catchment.
5. The majority of smallholder farmers showed that radio was the best knowledge-sharing tool because farmers can afford it and agricultural extension officers were too few to reach most of the farmers. Hence, radio programmes should be used to create awareness of the productivity of water. However, caution should be taken against inappropriate broadcasting times.
6. Professional help in assessing and articulating farmers' technology needs, technology development and transfer, and technology evaluation is vital. Therefore, capacity building of trainers and village agricultural extension workers is the fundamental prerequisite for achieving the widespread adoption of PWA.

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