ODG - UEA | MAFS SHADRI UYOLE | SUA SWMRG | MAKELE UNIVERSITY | ICRISAT

Productivity of Water in Agriculture and Interacting Systems: Approaches and Options for Eastern Africa

ANNEX 1A

INCEPTION REPORT

Submitted to

COMPREHENSIVE ASSESSMENT Competitive Grant
INTERNATIONAL WATER MANAGEMENT INSTITUTE

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Table of Contents

1 INTRODUCTION

The inception of PWAIS coincided with a 50-year drought in many parts of Tanzania. The situation was so serious that the President of the United Republic of Tanzania gave a speech to the nation on the impending threat of food shortages, in which he declared that:

Furthermore, the Ministry of Agriculture and Food Security is working hard to ensure that all farms with irrigation facilities including all NAFCO (National Agricultural and Food Corporation) farms, are cultivated in full from this season.
(President Benjamin Mkapa, 31 March 2003 – Translated from Kiswahili[1]**)**

This reflects how the fear of food shortages drives the policy on water use for agriculture. The inception period also coincided with the launching of the new National water policy (NWP). The launch was officiated by the President on 16th March 2003, and the policy contains the following policy statement on irrigation:

Irrigated agriculture provides protection against drought and it is also the most important way of ensuring the availability of food reserves. Furthermore, this type of agriculture contributes to the reduction of poverty since it can facilitate many people to cultivate high value crops such as vegetables and fruits.
(National Water Policy, July 2002 - Translated from Kiswahili[2]**)**

During the same period, the National Irrigation Master Plan (NIMP) was launched. This calls for sustainable irrigation development through effective use of natural resources. Increasing the productivity of water in agriculture, offers one option for meeting this objective of NIMP. However, to pursue this objective effectively, there is an urgent need for an increased understanding of the current levels of productivity in both rainfed and irrigated agriculture. This makes this project, Productivity of Water in Agriculture and Interacting Systems (PWAIS) very timely indeed. The tools for assessing productivity of water are not robust enough, and options and benefits of increasing and improving levels of productivity of water have not been well articulated or accepted by stakeholders. More seriously, as yet there is no practice of presenting productivity in terms of water. Yield in terms of land area, for example in tons/hectare, is the only measure of productivity used in agriculture. Building a culture of assessing returns to water used in agriculture is a difficult task that only few have attempted. It requires information, knowledge and tools that do not exist today. Therefore although the purpose of PWAIS project is to identify and verify with stakeholders new knowledge demanded by relevant institutions regarding alternative and best options for improving productivity of water in agriculture and interacting systems, there is a need to put an emphasis on searching for tools for assessing productivity of water.

This report summarizes the progress during the inception period, especially the outputs of an inception workshop that was held in April to finalize implementation plans and launch the project. Section 2 of this report provides a background to the

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[1] Aidha, Wizara ya Kilimo na Chakula inajitahidi kuhakikisha kwamba maeneo yote yaliyokwisha kuandaliwa kwa kilimo cha umwagiliaji maji, yakiwemo mashamba yote ya NAFCO, yanalimwa kwa ukamilifu kuanzia msimu huu.

[2] Kilimo cha umwagiliaji ni kinga dhidi ya ukame, pia ni njia muhimu ya kuhakikisha kuwepo kwa akiba ya kutosha ya chakula. Vilevile, kilimo cha aina hii kinachangia kuondoa umaskini kwa vile watu wengi wanaweza kulima mazao yenye bei kubwa kama vile mbogamboga na matunda.

context under which PWAIS will be conducted. This is based on a literature review in Tanzania on history and plans for irrigation development. The section also provides a summary of the progress to date. Section three gives details of the methodology and work plan that will be followed in implementing the project. Concluding remarks are given in section 4 and the report is supported by several appendices.

2 BACKGROUND

2.1 Irrigation in Tanzania

This section draws materials from the NIMP recently published by the Government of Tanzania in November 2002 (GoT, 2002). The plan defines three types of irrigation schemes in Tanzania. These are:

a) Traditional systems:
   i) Village irrigation based on the diversion of perennial or seasonal flows in hundreds of small schemes in upland areas, used mainly for the production of vegetables and other relatively high value crops.
   ii) Large areas of rainwater harvesting systems, such as those found in the semi-arid areas of much of central Tanzania, and the seasonally flooded *mbuga* found in the central and western parts, all used for rice cultivation.

   The total combined area of these self-sustaining systems is thought to be of the order of 130,000 hectares. They are an important means of livelihood-generation for a large number of rural people. The most important feature of these schemes is that they have been initiated, financed and developed by the farmers themselves, without any external assistance. They are not only farmer-managed, they are farmer-owned. There has been a belief that these traditional systems operate well below potential, due to poor water control, owing to the rudimentary nature of traditional irrigation works. However (SMUWC 2001b) argue that farmers manage water competitively between themselves, far more productively than as found in NAFCO systems. This project seeks to analyze and quantify current productivity levels in the traditional systems and see if there is a scope to increase productivity and incomes from them.

b) Improved traditional systems, which comprises of schemes that have received government or donor assisted interventions to improve the water control structures. The NIMP estimates that there are about 25,500 hectares of land under this kind of schemes. Evidence on productivity in these schemes is mixed, some show that these interventions have not had an impact on productivity, instead enhancing differences between top-enders who have benefited from improvements and tail-enders who have lost a measure of water predictability and supply.

c) Modern schemes that comprises either parastatal estates under NAFCO or private commercial and large-scale farms. It is estimated that a total of 35,900 hectares of cultivated land are irrigated in this form.

Therefore, the total area under irrigation is less than 200,000 hectares out of 10 million hectares estimated to be under cultivation in Tanzania. At the same time more than 80% of irrigation is of supplementary nature operated only during the rainy season. Often supplementary irrigation only compensates for "loss" of the direct rain falling on the crop field Water management improvements in irrigation system should start by increasing productivity of water at farm level, followed by improved water application efficiency and then and only then provision for more water. Unfortunately, little information exists about the productivity of water in both rain fed irrigated and irrigated agriculture. However, it is estimated that yields of the major cereals, maize and paddy are - low at only 1.2 to 3.3 tons/ha as compared to the potential of up to 12 ton/ha (Table 2.1). This indicates that there is a scope for increasing the productivity of water, especially in rainfed agriculture.

Table 2.1: Yields of Maize and Paddy in Tanzania (After GoT, 2002).

Crop	Average Rainfed Yields tons/ha	Average Irrigated Yields tons/ha	*Potential yield (rainfed) tons/ha
Maize	1.4	2.2	12
Paddy	1.2	3.3	10

* Extracted from SHADRI progress reports

2.2 The Rufiji River Basin in Tanzania

The Great Ruaha River Basin (GRB) is an important Sub-Basin within the Rufiji River Basin. This is due to its location; relative to the Rufiji River Basin, geographical coverage, features and socio-economic activities. For better understanding and justification for selecting the Great Ruaha River Sub-Basin as study site the Rufiji River Basin is hereby explored.

2.2.1 Main characteristics

The Rufiji River Basin covers an area of 177,000 km^2 or about a quarter of the total area of Tanzania. The basin is located between latitudes 33º 55´ and 39º 25´ E and longitudes 5º 35´ and 10º 45´ S. The Basin comprises of three distinct major river systems. These are: the Great Ruaha; the Kilombero; and the Luwegu (Figure 2.1). The name Rufiji is assumed after river Kilombero and Luwegu join below Shughuri rapids. Rufiji collects the Great Ruaha and passes through 100 metres deep Stieglers' Gorge on its way to the Indian Ocean. The basin can be divided into five major zones as shown in Figure 2.2, which have the following important characteristics:

Zone A: Poroto and Chunya escarpments

This zone is formed by the Southwest highlands of Poroto and Chunya with towns and urban areas. The Poroto and Chunya escarpment forms sources and tributaries of most of the major rivers in the GRB, thus the source of much of the basin waters. This area is highly populated with high rainfall, deep soils and intensive agricultural production. Some natural and commercial forests, protecting the water sources, cover the zone.

Zone B: Usangu and Pawaga plains

This zone is engaged with intensive rainfed and irrigated agriculture. It is characterized by large-scale irrigation schemes of Kapunga and Mbarali, a high concentration of traditional irrigation schemes and the newly established Usangu Game reserve. The area is basically semi arid with alluvial and *mbuga* soils; and a high concentration of livestock particularly cattle, which had moved to the area from the Sukumaland. Therefore this is also the area of high competitive water demand and persistent water conflicts. The Mtera Reservoir and hydropower station is located at the exit of this zone.

Zone C: Kilombero valley

The humid alluvial and flood plains of the Rufiji River Basin with intensive agriculture and sugar cane plantations. The major characteristic is the Kidatu hydropower generation plant.

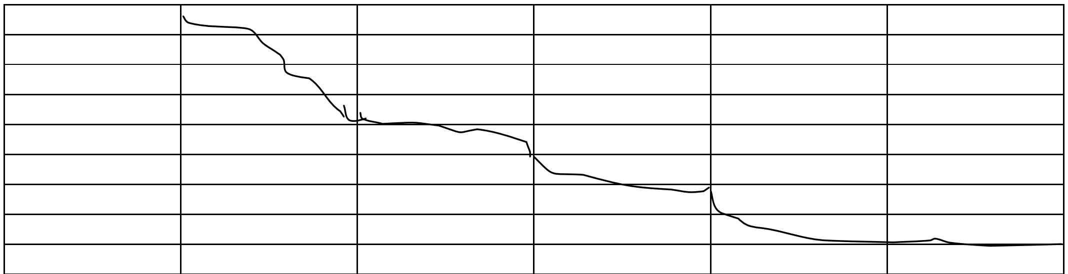
Zone D: Rufiji flood plains

This is the lower Rufiji flood plain extending soon after the Stiglers' Gorge waterfalls. Agriculture and fishing are the major livelihood sources. There is a high potential for hydropower generation and irrigated agriculture in this zone.

Zone E: Rufiji Delta

The Rufiji delta zone is formed by the Rufiji River distributaries and the flood plains extending to the Indian Ocean. Both agriculture and fishing are sources of the urban and rural livelihood. This area is famous for marine fish farming.

Figure 2.1 Rufiji River Basin in Tanzania



Zone	A	B	C	D	E
Features	Poroto Escarpment	Pawaga Plains	Kilombero valley	Rufiji Flood Plains	Rufiji Delta

Figure 2.2: Profile of the Rufiji River showing the different zones

2.2.2 Historical development

The historical development of the Rufiji River Basin may be viewed in terms of physical, institutional and knowledge base. These are elaborated in the following sections:

i) Physical

The physical developments within the basin include a fairly good network of roads and railway. For example, both the Dar es Salaam - Mbeya highway and Tanzania-Zambia railway line (TAZARA) constructed in the mid 1970s, pass through the basin. Therefore, there is a good accessibility to the basin, but within the basin, the road networks are not well developed. The most important hydropower plants in the country (viz. Mtera, Kidatu and Kihansi) are located within the basin. This has facilitated electrification of cities, towns and some rural communities within the basin. Most of the few large irrigation schemes in the country are also found in the basin. These include schemes like Mbarali (3200 ha), Kapunga Rice Farms (3,800 ha), Madibira Smallholders (3,000 ha) and Kimani (1,200 ha). The presence of these infrastructures has contributed towards the opening up of the basin, leading to rapid population expansion, increased agricultural activities and competition for water resources.

ii) Institutional

The Government, with the purpose of developing and managing the Rufiji River Basin natural resources, has instituted various institutions. Among these include:

- Water policy and legislation:

  The current water policy (GoT, 2003) has just been approved and the legislation is in the process of being formulated. The main areas of emphasis in the NWP, with implications for the PWAIS project, include the following:

- ✓ Policy recognizes the diminishing water resources and the need to improve water use efficiency and productivity, which is the main concern of this Project,

- ✓ The policy asserts that efforts should be made to ensure reliable supply of water in all the competing uses important for the national economy, like agriculture, domestic use, hydropower generation, mining and industry. Increasing water productivity will contribute to releasing water to these intersectoral needs, and

- ✓ The policy encourages all efforts to ensure food security for households and the nation through efficient and more productive use of water so as to enable the irrigation sector to release water for other economic sectors.

- Rufiji River Basin Water Office

  The Rufiji River Basin Water Office (RBWO) was established in 1993 in accordance with the Water Utilization (Control and Regulation) Act of 1974. The Main functions of the RBWO include among others: (i) to establish an inventory of the resources in the basin (ii) water allocation (iii) preparation of water development plans (iv)collection of water fees and (v) assist in resolution of conflicts over water.

- Rufiji River Basin Development Authority (RUBADA)

  RUBADA was established in 1975 to coordinate and regulate the utilization of the natural resources of the basin. Since its establishment, however, RUBADA has concentrated on promoting resource development particularly in the Kilombero and Rufiji valley with little attention to the management of the entire basin.

- Tanzania Electric Supply Company (TANESCO)

  TANESCO is the sole organization in Tanzania responsible for hydro-power development. In 1976, a 200 MW hydroelectric power generating plant was commissioned at Kidatu, a place just before the Great Ruaha River enters the Kilombero valley. In 1982, Mtera dam was constructed at Mtera with a live storage of 3,200 million cubic metres for the purposes of regulation of flows into the Kidatu but later a power plant with a capacity of generating 80 MW of power was installed.

- Gazetting of the Usangu Game Reserve

  One of the most important policy measures instituted in the basin is the Gazetting of the Usangu Game Reserve in the mid 1998. The area used to be an important grazing for livestock and historically large numbers of pastoralists came to the area from as far as the Sukumaland. In addition, fishermen used to get their livelihood through fishing activities in the wetlands. Dry season irrigation of vegetables is another activity, which provided farmers with sources of income. The gazetting of this area as a game reserve, has denied many key stakeholders the use of this natural resource.

iii) Knowledge base

- Water resources studies and master plans

A substantial body of knowledge exists on the Rufiji River Basin and this has been achieved mainly through feasibility studies, projects and research carried out byvarious institutions. Among the early studies on water development in the Rufiji River Basin were carried out by FAO in the 1960's. These studies among other things found that the basin had high agricultural potential and ideal sites for hydroelectric power generation. For example, they recommended that the Stieglers' Gorge be developed for power generation. However to date this has not been implemented. On the other hand large-scale irrigation schemes were recommended and several of these have been constructed in the basin.

The studies commissioned by RUBADA (URT, 1981) focused on irrigated agricultural development in in the Rufiji lower valley. The study found that a total area of 64,900 ha could be irrigable in the flood plain. Both large and small-scale farms with flood protection bunds were recommended.

Studies on Regional Master Plans for Iringa, Ruvuma and Mbeya regions (within the Rufiji River Basin) were carried out in the early 1980s (CCKK, 1982). These Regional Water Master Plans aimed at the provision of the rural population with safe and adequate water. Important information given in these reports includes assessment of ground water and surface water resources potential.

Several other projects have been conducted under River Basin Management and Small Holder Irrigation Improvement Project (RBMSIIP) and have provided information on: Ground water assessment, Catchment degradation and conservation options, Water use and water rights survey, Participatory basin management, and Water quality and environmental pollution monitoring.

- Hydrometric measurements

The Rufiji River Basin is fairly instrumented. In terms of hydrometric measurements, both the Great Ruaha and Kilombero sub-basins are gauged. The Luwegu sub-basin is very sparsely gauged (DANIDA/World Bank, 1995). In the Great Ruaha sub-basin,there are over 35 gauging stations giving a network intensity of 4 stations per 10,000 m^2. In the Kilombero sub-basin, there are 23 gauging stations giving a network density of 3.5 stations per 10,000 km2. It is worth noting that some hydrometric stations are not functional due to a number of reasons among which is poor servicing and vandalism. Almost all hydrometric measurements are carried out by the Ministry of Water and Livestock Development. The data is published in the form of a Hydrology Year – Book (URT, 1976, 1980)

- Research

Various individuals and institutions with different aims and objectives have undertaken research work in the Rufiji River Basin. However, the most consistent piece of research is the one conducted by SMUWC (2001a, 2001b) and then followed by RIPARWIN in the Usangu Plains.

2.2.3 Agriculture

a) Zone A with reference to Poroto highlands

This is an important zone of the Mkoji catchment because all its waters flow from the Poroto escarpment. Despite the practice of indigenous water sources conservation measures through *'Iganjo'* natural forest reserve system, intensive agriculture is also practiced in the zone. In this zone, only rain fed agriculture is practiced. The bimodal rainfall pattern and the type of soils allows for crop cultivation all year around. This is made possible through using residual soil moisture and growing of crops demanding low water input such as round potatoes, green peas and other vegetable crops.

b) Zone B with reference to Usangu and Pawaga plains

Agriculture in this zone is comprised of crop production (mainly maize and paddy) under both rainfed and irrigated agriculture. Small-scale irrigation has been practiced in the Usangu and Pawaga plains since 1910s and there are records of water rights as far back as in the 1920s (WorldBack/DANIDA 1995). The major crop under irrigation is rice (rainy season) and to a lesser extent vegetables in the dry season. With simple structures, farmers abstract water from the perennial small rivers flowing from the Poroto mountains into the Usangu plains. The larger rivers such as the Great Ruaha and Mbarali, require sophisticated and expensive diversion structures. Therefore, only large state farms of Mbarali and Kapunga Rice Farms use water from these rivers. Most of the irrigation in the plains is for paddy production and the areal development of rice cultivation over time is shown in Figure 2.3.

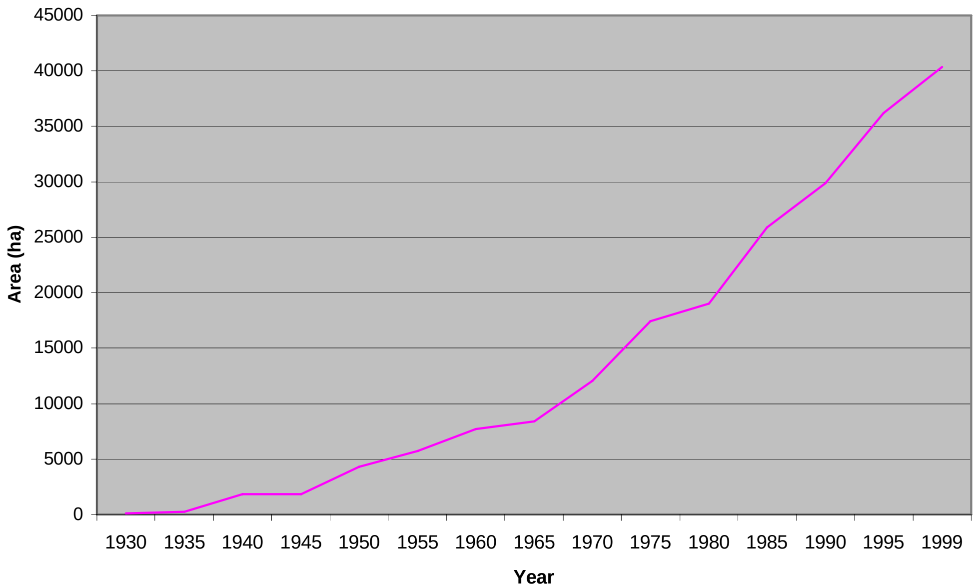
c) Zone C with reference to Kilombero Valley

Agriculture in general is predominantly smallholder production, which is rainfed. Major crops include maize, sugarcane, rice, beans and vegetables. However, the Kilombero Valley has abundant rainfall and water resources and high agricultural potential. Studies by FAO in the early 1960's (FAO 1960a, 1960b)indicated that the irrigation potential stands at 330,000 ha. The most significant development in this valley is the 1,385 ha Kilombero Sugar Estates. Very few farmers practice small-scale irrigation due to the fact that, the Kilombero Valley receives substantial amounts of rainfall and the need for irrigation is not noticed by the people in the area.

d) Zones D & E: Lower Rufiji Valley.

The Lower Rufiji Valley consists of the Rufiji flood plain and delta. Most agricultural activities are carried out on the plain. In the delta, fishing is the predominant occupation. A wide range of crops is grown in the flood plains. These include perennial crops such as mangoes, bananas and papaws. Annual crops include vegetable beans, groundnuts, pineapples, etc. Maize, rice and cotton are grown in the basins found within the flood plain.

Figure 2.3: Historical Record of Irrigated Rice Wet Season Production in the Usangu Plains (ha)(after Lankford, 1999)



The existing agricultural practices in Lower Rufiji Valley depend on the yearly floods of the Rufiji River. Any meaningful development of formal irrigation must be accompanied with flood protection measures and a source of power to pump water from the river and back.

2.3.4 The Great Ruaha River Sub-basin

The Great Ruaha River Basin (GRB) covers an area of 83,970 km^2 or about 47% of the Rufiji River Basin, and cover zones A and B (see section 2.3.1). The GRB can be divided into three distinct river systems: the Great Ruaha, the Little Ruaha and Kisigo (Figure 2.4). From the west, the Kisigo River starts from Manyoni and Rungwi Game Reserve. It drains the dry areas in the Ruaha National Park and joins the Great Ruaha River at Mtera.

The Great Ruaha River originates from the Poroto mountain ranges and in Njombe where numerous rivers flow into the Usangu plains and the vast Utengule swamps. It passes the National Park plains and collects the Little Ruaha River before joining the Kisigo River at Mtera. It then flows westwards through the Ruaha Gorge into Kilombero plains before forming the Rufiji River.

The climatic conditions that exist in the basin vary widely. The area north of the Poroto and Udzungwa mountains is under semi arid conditions. The mean annual rainfall is about 500 mm. Rainfall increases southwards and up to 1,800 mm of rainfall is observed on the slopes at the Udzungwa and Kipengere range. The rainfall pattern is such that there is one rainy season (mid November to May). There is a tendency for the dry season to set earlier in the GRB basin than for example, the Kilombero sub-basin.

Runoff pattern in the basin is closely related to the rainfall pattern. Most rivers start rising in December with a peak in March – April. The mean flow of the Great Ruaha River at Mtera gauging site, IKA5, is about $140m^3/s$. The reservoir at Mtera is capable of holding the mean flow of the river and thus provides complete regulation.

2.2.5 Justification for selecting GRB and Mkoji sub-catchment

The criteria used to choose the GRB for this study are:

- **Information already available in the basin** - a substantial amount of information exists from past and current studies.
- **Basin size** – this basin is of middle size (83,970 km^2) and already exhibits a degree of anthropogenic pressure and inter–sectoral regulation needs.
- **Climate** – the basin consists of diversity of climate situations. Whereas some parts receive very high rainfall, others fall under semi arid conditions. A transition zone exists between these two extremes.

- **Degree of basin development/closure** – the basin is currently experiencing water shortages especially during the dry season. The problem has become acute to the extent that in some months the flow to meet minimum stream and outflow requirements is just not available.

- **Complexity** – the basin supports over 30,000 rice-producing households and it has a high plant and animal biodiversity.

2.3 Productivity of Water

The challenge to grow more food with less water, while improving rural livelihoods and protecting the environment is the common international agenda. With increasing water scarcity productivity of water is becoming a global important concept. This is based on the argument that less water will be available for agriculture due to increasing water demands for domestic, municipal, industrial and environmental purposes in future (Guerra *et al,.* 1998) and potentials or new water development projects and expanding irrigated area are increasingly becoming limited (Guerra *et al.,* 1998, Dong *et al.,* 2001). Thus, strategies for increasing productivity of water such as precision irrigation, supplementary irrigation and rainwater harvesting are being promoted (Oweis *et al*., 1999). This research will examine existing areas of high productivity through choice of crop, access to markets, competition over water, reuse of water, employment of improved deficit irrigation, technical changes to in-field water control, etc.

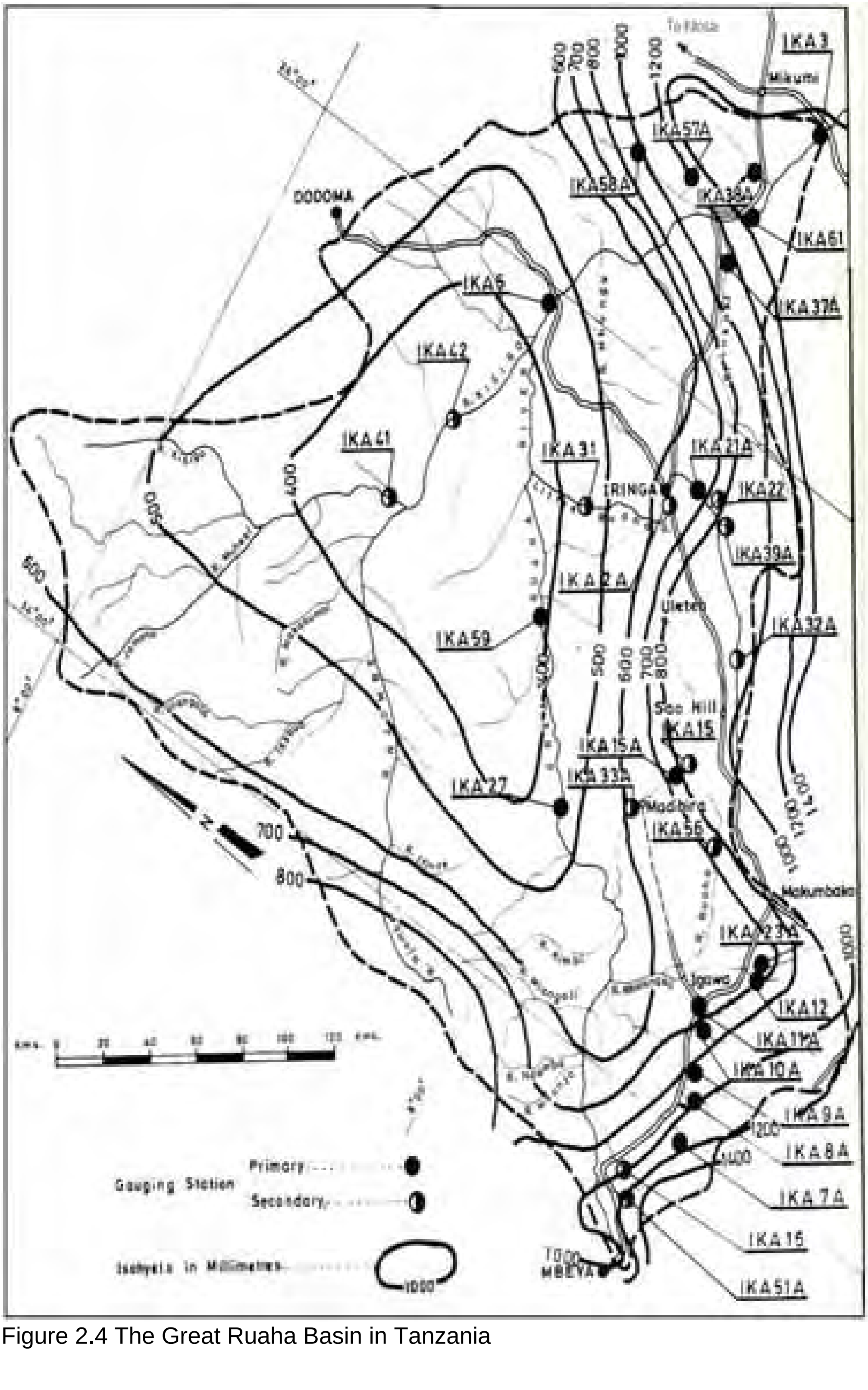


Figure 2.4 The Great Ruaha Basin in Tanzania

2.3.1 Experiences from Tanzania

In Tanzania, there has been efforts to increase efficiency of water use in the traditional irrigation schemes, which is generally presumed to be low. The RBMSIIP (2001) project has been implementing a number of interventions in the GRB aimed at improving the indigenous irrigation schemes through physical works. Specific interventions included:

- Improvement of irrigation water intakes, lining or improvement of the main water conveyance and drainage system;
- Assist farmers to form Water Users Associations (WUA), register the WUA and help them to get statutory water rights;
- Train the Extension Officers and farmers on proper water management and crop husbandry practices;
- Promoting production of high value crops in order to realize high returns to land, labour and water inputs.

Available data show that, before the interventions the traditional schemes had poor water conveyance and management infrastructure whilst farmers were using poor crop husbandry practices; resulting in low irrigation efficiencies and low crop yields. In the recent studies, SMUWC (2001b) noted that past improvement interventions in the GRB may well had negative effects on irrigation management, with less water control, greater competition without contributing to yield increases. It has been difficult though to justify this because there had been no scientifically established figures for water use irrigation efficiency in Tanzania. Many professionals mistakenly quote irrigation efficiencies of 15 – 30% propagated by Hazelwood and Livingstone (1978). Only later, that SMUWC (2001b) established relatively irrigation efficiencies in the range of 45 – 63%. Having no reliable baseline data before RBMSIIP interventions there is insufficient basis to argue for an increase or decrease of water use efficiency.

RIPARWIN findings in GRB have shown that conventional methods for assessing irrigation efficiency and productivity rarely address multiplicity of factors necessary to be involved during irrigation efficiency and productivity analysis. Productivity of water is a ratio of benefits to water depleted in the production of those benefits. However, total amount of benefits and the amount of water depleted are rarely known, monitored or measured.

Often only the amount of the target crop is considered in as the only benefit obtained. Water recycling is always neglected. It is for this reason that productivity figures quoted in Tanzania are so low. For example, in Tanzania, productivity of water of 0.1-0.14 kg/m^3 for rice and 0.22-0.32 kg/m^3 for other cereals have been recorded, which are even much lower when compared to the global water productivity situation. In the Usangu plains, productivity of water to rice is estimated to be in the range of 0.2 to 0.35 kg/m^3 (SMUWC, 2001a) at field scale, which is almost 50% higher to National figures obtained from the literature. Land Management Project (LAMP) in Babati, Tanzania reported rainwater utilization efficiency increase in terms of maize yield, from 0.15 kg/m^3 to 0.41 kg/m^3 due to the implemented land management interventions (RELMA 2000).

These productivity levels are relatively lower than those recorded in other parts of the World. For example, Oweis *et al*. (1999) working in Jordan reported an increase from 0.33 kg/m3 to 3 kg/m3 of wheat in supplementary irrigation of rainfed cropping. Similar, productivity increase from 0.34 kg/m^3 for rainfed and 0.75 kg/m^3 for full irrigation to 2.21 kg/m3 on average under supplementary irrigation was reported in the West Asia and North Africa (WANA) regions (Oweis. 1997 and Oweis *et al.,* 1999).

This data on Productivity of Water in Agriculture (PWA) is underestimated because other interacting uses such as domestic, livestock, fishery, brick making and environmental use are not being included in the analysis. Typically, aggregated levels of water productivity has many omissions in terms of actual amount of water use due to unaccounted for water by different sectors especially from scheme/system and basin levels.

2.4 Why PWAIS

In Tanzania the Rufiji River Basin in general and the GRB portion in particular, is currently the most important basin with respect to water resources development (see section 2.3). The GRB is perhaps approaching hydrological closure from the point of view that the Mtera Dam is filled to capacity only in very few seasons. It is for this reason that considerable development and research efforts are being directed to this basin. Examples include the several sub-projects implemented in the basin under the auspices of the World Bank supported River Basin project. Within the RBM project, DFID supported a three-year project on 'sustainable Management of Usangu Wetlands and its Catchment (SMUWC)'. These projects raised more questions than answers leading to the development of the RIPARWIN research project. The purpose of RIPARWIN is to enhance the availability and application of new knowledge to the enhancement of productivity of irrigation and transference of water to meet other sectoral needs. The project is investigating the hypothesis that increasing the productivity of water in irrigated systems will lead to water being freed to supply other sectors. RIPARWIN is being implemented by eight sub-projects working on about four themes:

a) River and wetland hydrology monitoring and decision aide
b) Livelihood benefits and economic analysis of water uses
c) Efficiency of water use in irrigated rice production
d) Water and irrigation management institutions.

During the implementation of RIPARWIN, it was found that there was a gap in that there was very little knowledge of how productivity of water in especially rainfed agriculture is perceived. Commonly acceptable tools (process and data specification) are not available. The PWAIS project is designed to fill this gap.

2.5 Progress to Date

2.5.1 General progress

The inception period between February and May 2003 was used to consolidate the project team and draft inter-institutional agreements (Appendix 1). Within this period the project recruited one PhD student and two MSc. students in Tanzania. One MSc. student will contribute to the work on the DA for selecting options for improving productivity of water in agriculture. The second student will work on knowledge sharing and dialogue tools. In Ethiopia, it has been difficult to recruit MSc. students as planned since the Makelle University has no in-house postgraduate programme. However, the institution has recruited two junior staff to work on the project. More details about staff are given in section 3.4. The three Tanzanian students participated in a one-week scientific writing workshop organized by SWMRG at SUA Morogoro. This will aid the students to write good reports and deliver project outputs more effectively through knowledge sharing media.

During the inception period a reconnaissance survey of the study sub-basin was conducted between 26th and 29th March 2003 by the team of PWAIS and RIPARWIN Research Associates, for the purpose of selecting project study target areas in Tanzania. This involved a visit to three traditional irrigation schemes; namely Igomelo, Ipatagwa and Motombaya. The Kapunga water system, where productivity studies under RIPARWIN are being conducted, was also visited. The Kapunga system is unique in that it encompasses issues of competing water use, re-used by the smallholder schemes downstream, and the interacting uses such as environment, brick making, livelihood, fishing, and livestock in a single system. A transect through the Mkoji sub-catchment, the selected target area for PWAIS; from the upper, the middle and the lower plains revealed features and issues relevant to the project scope. Examples of these features are mixture of rainfed, supplementary irrigated agriculture and intensive irrigation abstractions.

2.5.2 Inception Workshop

The project-inception workshop was conducted between 7th and 9th April 2003 in Mbeya, Tanzania. This involved partners from IWMI, ICRISAT, SUA, ODG, RIPARWIN and SHARDI. The workshop brought together the researchers and stakeholders who were represented by people from the MAFS, RBWO and DED Mbarali. List of the participants is given in appendix 2. The workshop was used to review the research outputs, activities and methodology and develop implementation plan.

The first day of the workshop was dedicated to presentations by the PWAIS and RIPARWIN researchers and the respective Research Assistants. This was aimed at introducing the project concepts to the workshop participants so as to harness their contributions towards shaping up of the project framework for equitable outputs. The presentations included the PWAIS project overview, PhD and MSc concept notes, RIPARWIN outputs, PWAIS – RIPARWIN linkages and Framework for assessing productivity of water. The presentations are included in Appendix 3.

A field visit to the Mkoji sub-catchment was made on the second day of the workshop. The tour began at the upper Mkoji along the Mporoto escarpment, which forms the southwest border of the sub-catchment. It was fascinating to see sources of the Mkoji tributaries and the intensive rain fed agricultural production activities. The field tour proceeded to the middle section of the sub-catchment where participants could see some mixed rainfed and irrigated agriculture. The marked feature was intensive irrigation development and irrigation water use quite close to the water sources. From the bird's eye view the participants were shown the background of the lower Mkoji sub-catchment. Right in the field the participants got first hand explanations from representatives from the zonal irrigation office and RBWO on the intensity of irrigation development in the sub-catchment and some local institutional arrangements on irrigation schemes management and conflict resolution. Participants could also see and get some explanations on some RIPARWIN activities particularly hydrology and institutional studies.

This field visit helped to familiarize the participants with the research area and the inherent basin issues. The visit put clear the justification to select Mkoji sub-catchment as the PWAIS study area in which the rainfed and irrigated agriculture, upper and lower catchments, intensive RIPARWIN activities, and a variety of scenarios can be captured. It was generally agreed that the Mkoji sub-catchment has sufficient features, pertinent issues and comparative scenarios enough to feed into PWAIS agenda and operations.

The third day way dedicated to brainstorming on the project outputs, activities and methodologies. Outcomes from the third day of the workshop are the basis of the next section of this report.

3 REVISED PROJECT PLAN

There are basically no changes to the main outputs. However the activities have been expanded in order to accommodate the project outputs more comprehensively. There has been a need to study the indigenous information and methodological tools for PWA (Activity 1.2), so as to capture traditional concepts of water valuing and water productivity. The project had also to improvise means to establish consultation dialogue (Activity 1.3) as a media for stakeholders to participate in reaching consensus on methodological tools for PWA. The dialogue will also be used to disseminate project outputs. Besides conducting historical analysis of productivity of water (Activity 2.3) a comparative analysis of PWA in rainfed and irrigated agriculture (Activity 2.2) will be done. It is hypothesized that increasing PWA in rainfed agriculture may have a bigger impetus to improving food security and poverty alleviation, because over 90% of agriculture in Tanzania in rainfed.

3.1 Revised Logframe

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal: Strategies for improving the productivity of water in both rainfed and irrigated agriculture so as to ensure social, economic and environmental sustainability in river basins, ADOPTED			
Purpose New knowledge demanded by relevant institutions regarding alternative and best options for improving Productivity of Water in Agriculture and Interacting Systems in Eastern Africa, Identified and Verified with stakeholders	By June 2005, National regulations and strategies developed in Tanzania and Ethiopia to implement relevant policies (e.g. WP, PRSP and ASDS) contain comprehensive components regarding increasing productivity of water in agriculture	Records of Policy instruments (e.g. legislations & regulations) approved and published by relevant organs	Improving the productivity of water is given high priority by those investing in agriculture.
Outputs 1) Methodological tools for assessing PWA Collated, Evaluated and Disseminated to stakeholders in the case study basins (CSB) 2) Benefits and consequences of options for improving PWA under different scenarios in CSB, Evaluated 3) River Basin Management Decision Aide (RBMDA) with robust modules dealing with selection of options for increasing productivity of water in agricultural as well as interacting systems, Produced. 4) Knowledge sharing tools that link stakeholders from the community to basin to national level, Adapted and Used to disseminate the developed knowledge on PWA	By 2004: two MSc. Dissertations produced At least 4 papers and poster presented at International fora There is evidence that the RBMDA is accepted by a wide cross-section of the stakeholders. At least one report on cross-sectoral dialogue on productivity of water in both Tanzania and Ethiopia, Produced	Reports of Relevant University Departments Proceedings of relevant fora Project records Reports of the Dialogue programme	Different stakeholders and institutions will reach consensus on appropriate options

Activities	Milestones	Assumptions
1.1 Undertake a comprehensive international literature survey to identify methodological tools used to assess PWA 1.2 Undertake a participatory survey of indigenous Information and methodological Tools on PWA 1.3 Establish a stakeholders consultation dialogue to identify promising methodologies and tools for measuring PWA 1.4 Assess suitability of the most promising tools under different production, institutional and social situations 1.5 Promote (through training, study tours, workshops, etc.) dialogue and consensus on methodological tools for assessing PWA. 2.1 Assess the current levels of PWA in the Ruaha River Basin in Tanzania. 2.2 Compare and contrast PWA in rain fed and irrigated agriculture 2.3 Conduct historical analysis of productivity of water to determine trends and causes of changes in levels of productivity of water 2.4 Identify promising options for improving PWA in relation to types of enterprises, crop varieties, husbandry practices, institutions and policy instruments 3.1 Integrate into the RIPARWIN Decision Aide, aspects for decision making on action to improving PWA 3.2 Pilot test the best options in Ethiopia 4.1 Assess current impediments to ideas and knowledge flow and sharing especially in relation to PWA 4.2 Identify promising approaches to overcoming the existing impediments 4.3 Evaluate the approaches/tools while using them to disseminate PWA ideas/knowledge in both Tanzania and Ethiopia.	• 2003 April, Planning workshop involving collaborators and key stakeholders held to launch the project. • 2003 June, Inception Report produced and students in place. • 2003 August, Expanded Literature survey completed and report produced. • 2003 October, Survey of Indigenous knowledge, and methodological tools and information for assessing PWA completed • 2003 December, Stakeholders dialogue on methodological tools for assessing PWA established • 2003 December, Dialogue Workshop for consensus on Tools for assessing PWA and PhD thesis on efficiency of water in irrigated systems produced • 2004 March, Synthesis report of existing methodological tools for assessing PWA produced • 2004 June Synthesis report on current levels of PWA completed • 2004 September, River Basin Management Conference shared with RIPARWIN • 2004 September, Preliminary report at the African Symposium on Water Reforms. • 2004 December, RUBDA available for testing, two MSc dissertations completed, • 2004 December CA reports contribution to the Dialogue Programme delivered. • 2005 March Final Technical Report produced.	Target stakeholders will continue to view assessment of PWA as an important issue The RIPARWIN project continues smoothly and produce the necessary complementary results Extension service and other change agents (e.g. NGOs) continue to promote water management issues and approaches

3.2 Activities and Methodologies

3.2.1 Activities for output 1

The aim of activities 1.1 to 1.3 is to produce information that can help a stakeholders' dialogue leading to identification of acceptable and implementable tools for assessing productivity of water in agriculture, especially rainfed, and interacting systems. We start with the hypothesis that there is very little awareness and understanding on productivity of water, because the amount of water used in agricultural systems is seldom monitored or measured. It is expected that the global and local literature review will give some more light on this. Efforts will be made to access results from sister CA projects in other parts of the world.

For activities 1.2 and 1.3, Focus Group Discussions (FGD) supplemented by limited questionnaire surveys will be implemented to explore the following questions:

i) What is the general understanding, by different stakeholders, on productivity of water? More specifically, how are the benefits and the amount of water used to produce them assessed?
ii) What are the differences and similarities regarding the way different categories of stakeholders assess benefits and amount of water used? Three main categories of stakeholders will be studied; water users, extension and advocacy workers, and regulators and planners.
iii) In the absence of direct measurements for calculation of productivity, what proxies are available? For example, do farmers allocate water from one use to another? If they do, what criteria do they use?

Results from these surveys will be used on dialogue meetings and workshops to select alternative but most user-friendly tools (process and information). To implement activity 1.4, at least 3 tools will be used by different stakeholders to undertake:

(i) a historical assessment of productivity of water, and
(ii) an assessment of productivity of water, both during the rain and dry seasons

Activity 1.5 will be implemented as part of the dialogue on water, food and environment being organized by SWMRG.

The sampling frame for this exercise will be as follows:

a) Category of stakeholders
    i) Crop and livestock producers
    ii) Users of water for other smallholder economic enterprises
    iii) Extension and advocacy groups
        - Extension (crop and livestock husbandry)
        - Extension irrigation

- Environmental lobby

iv) Water resource regulators and planners
- River basin/catchment water officers
- District water engineers/ planners

b) Type of water use system
   i) Rainfed only
   ii) With assess and possibility for run-of the river supplementary irrigation
   iii) With access and possibility of dry season irrigation
   iv) Other water uses

c) Relative location in the catchment
   i) Up-stream
   ii) Mid-stream
   iii) Down-stream

d) Category of farmers and other water users
   i) Poverty level
   ii) Gender

These activities will be implemented in both sub-basins that are in Tanzania and Ethiopia.

3.2.2 Activities for output 2

The aim is to produce information that can help stakeholders to conduct dialogue on available and possible options for increasing benefits from use of water. The hypothesis is that even where water used (especially in irrigated systems) is measured, the overall productivity of water is highly underestimated, because of a partial valuation of benefits. Therefore, key informants from the different categories of stakeholders will be used to identify and put value on different benefits obtained from use of water in agriculture and related systems in the study area. These benefits will include:

- Agriculture produce/products in terms of yield and economic benefits
- Employment – direct and indirect
- Other NRM produce/products – e.g. fish, timber and firewood
- Other economic activities, e.g. brick making
- Ecological services

Following an improved understanding of various benefits, measurements will be undertaken to evaluate current productivity of rainfed and run-of the river supplementary irrigation, under different management scenarios. This will produce data to deliver activities 2.1 and 2.2 through the following sampling frame:

i) Type of water use systems
ii) Location (up-, mid- and down-stream)
iii) Type of crop enterprise
iv) Different management and husbandry practices

- Water
- Agronomic

Apart from monitoring farmers' fields, detailed controlled experiments will be implemented in Tanzania to produce bench-mark data, which will assist in the comparison of productivity under:

- Rainfed only
- Run-of the river supplementary irrigation
- Strategic supplementary irrigation, i.e., where storage of water is introduced and irrigation supplied strategically to overcome drought spells.

A questionnaire survey will be used to collect retrospective data and information from farmers on the historical trends of water productivity. This will be done after the definition and tools for assessing the productivity of water have been agreed upon. This survey will be supplemented by secondary data, especially from appraisal and evaluation reports of various past agriculture development projects in the study area.

Activity 2.4 will involve the initiation of an in-depth PhD study on theoretical approaches to productivity of water in rainfed agriculture. Benefits to cost ratio of different options (water and agronomic) for increasing productivity of water will be studied through controlled trials, scenario analysis and modeling.

3.2.3 Activities for output 3

Work for activity 2.4 as described above will contribute a theoretical framework of productivity under rainfed systems for inclusion in the Rufiji River Basin Decision Aide (RUBDA). The RUBDA will then be used to assess hydrological, economic, and social performance at sub-basin level of different options for up-grading the productivity of water in rainfed agriculture. This will be conducted in both Tanzania and Ethiopia leading to synthesis of policy on productivity of water.

3.2.4 Activities for output 4

The aim is to ensure that there is an adequate understanding of how information and knowledge necessary for the dialogue on productivity of water can be shared among the different stakeholders. The hypothesis is that different stakeholders require different forms of presenting the same information in order to appreciate it. For example, while researchers and agro-meteorologists will understand productivity presented as kg/mm of water, a farmer may not understand this. Therefore, a form that farmers can understand must be found, otherwise there will be a communication breakdown. Hence, surveys will be conducted together with those for output 1 using the same methodological approach to determine forms and terminologies for presenting the different aspects of productivity of water, such as amount of water used or quantification of social and ecosystem benefits.

Impediments to information and knowledge flow will be determined through Focus Group Discussions (FGD) supplemented by limited questionnaire surveys together with activities 1.2 and 1.3. Evaluation of knowledge sharing products and tools will be conducted through testing with key informants from different categories of stakeholders.

3.3 Communication strategy

PWAIS has an in-built dissemination strategy since disseminating developed knowledge is one of the log frame outputs. PWAIS seek to clear knowledge flow impediments, adapt/develop and use effective knowledge sharing tools to propagate PWA ideas. From the very outset, PWAIS was set up to target and effect knowledge dissemination to all stakeholders. Key to this is to involve stakeholder in development of knowledge and assessment of knowledge sharing tools through:

Dialogue proposal

A Dialogue proposal by SWMRG has been submitted to the Secretariat – Dialogue on Water, Food and Environment. It has been accepted and provide some funds to it will help the project to establish and operate dialogue in the basin through which the project outputs will be communicated.

African symposium

The African Symposium, which is being organized to take place in Tanzania, will be an opportunity to present the project findings through presentation of papers and posters.

Collaboration with FAO

SWMRG will implement an FAO funded project under the FNPP on Water and Food Security: Water Resources Management Policies for the Poor in Tanzania. A comprehensive study will be carried out into the opportunities to enhance crop water productivity so as to achieve food security through integrated and sustainable water resource management in the Mkoji sub-catchment. The results from this study will be widely communicated to various stakeholders.

Publications

Formal reports will be produced and circulated through the SWMRG website. Papers will be published in various journals and the project will contribute to the CA dialogue publications.

Thesis

It is planned that the project will produce at least two PhD and two MSc theses.

3.4 Involved Staff

There are no changes as to the main researchers for the project, who we listed in the proposal. There will be one PhD student, Mr. Zakaria Mkoga who will be the Research Associate and field supervisor of the day-to-day field activities in the project location in Tanzania. There will be two MSc. Students on the Tanzania part. These three Research Associates/Assistants will be based in the RIPARWIN field office in Usangu. Another PhD student who is registered at SUA with funds from DAAD, Mr. Henry, will also work on PWAIS.

3.5 Work plan

The start date for the project is proposed to be April 1st, 2003. On the basis of this, a work plan summary in form of activity bar chart is presented in Appendix 4.

4 CONCLUDING REMARKS

It is unfortunate that due to delays in identifying staff, Makelle University has not initiated work, and did not participate in the Inception Workshop. It is planned to organize a mini-workshop in Ethiopia by end of July to design that component of work. There are no consequences on progress, as the Ethiopian component is designed to undertake testing of findings from Tanzania.

The work has started and is very well integrated with other on-going activities, in the study area. There is, therefore, a good potential for a successful project.

4.1 Monitoring and Evaluation

4.1.1 Output indicators

There are no changes as to the output indicators presented in the submitted proposal and contract. However it is proposed to change the completion date from December 2004 to 1st April 2005 due to shift of project start date.

4.1.2 Activity indicators

Table 4.1 reflects changes made in the project activity indicators as a result of the suggestions made during the Inception Workshop. As already mentioned, there are changes to the activity timing due to shift in start date.

Table 4.1: The Revised Activity Indicators and Milestones

No.	Activity/Milestones	Original date	New date being proposed
1	Planning workshop involving collaborators and key stakeholders held to launch the project.	January 2003	2003 April,
2	Inception Report produced and students in place.	March 2003	2003 June,
3	Expanded literature survey completed and report produced.	June 2003	2003 August
4	Survey of Indigenous knowledge, and methodological tools and information for assessing PWA completed	New mile stone	2003October
5	Stakeholders dialogue on methodological tools for assessing PWA established	New milestone	2003 December
6	Dialogue Workshop held on Tools for assessing PWA and PhD thesis on efficiency of water in irrigated systems produced.	2003 December	2003 December
7	Synthesis report of existing methodological tools for assessing PWA produced	New milestone	2004 March,
	Synthesis report on historical and current levels of PWA completed	New milestone	2004 June
	River Basin Management Conference, shared with RIPARWIN.	2004 June	2004 September
	Preliminary report at the African Symposium on Water Reforms.	New milestone	2004 September,
12	RBMDA available for testing, four MSc dissertations completed	2004 September	2004 December
	CA reports contribution to the Dialogue Programme delivered	New milestone	2004 December
13	Final Technical Report produced	2004 December	March 2005

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APPENDIX 1: SAMPLE OF AGREEMENT BETWEEN PARTNERS LETTER OF AGREEMENT FOR RESEARCH SERVICES

This AGREEMENT dated ???? 2003, is made BETWEEN the Sokoine University of Agriculture, whose offices are situate at the Administration Building, Main Campus, P. O. Box 3000, Morogoro, Tanzania (hereinafter referred to as “SUA”)

AND

The????????? whose registered offices are situated at??????????? (“Hereinafter referred to as “??????”)

WHEREAS

SUA has signed a contract with the International Water Management Institute, dated ?? February 2003 (“the Head Contract”), shown in Annex 1, under the terms of which SUA has agreed to provide research services and to deliver defined outputs in relation to the research project on ***Productivity of Water in Agriculture and Interacting systems: Approaches and Options for Eastern Africa*** - under the Comprehensive Assessment of Water Management in Agriculture.

SUA wishes to engage ??? to act as a sub-contractor to SUA to provide certain Services and Outputs as described in Annex 2 (“the Project Proposal”) on the terms of this Agreement.

???, having represented to SUA that they have the professional skills, personnel and technical resources, and has agreed to provide the Services and to deliver the Outputs on the terms and conditions of this Agreement.

IT IS HEREBY AGREED as follows:-

A. Documents

The contract shall comprise the following documents:

i)	Letter of Agreement (this document)	
ii)	Annex 1	Head Contract
iii)	Annex 2	Project Proposal and Budget
iv)	Annex 3	General Administration

B. Entire Agreement

The Agreement formed by the four documents stated in ‘A’ above, constitutes the entire contract and supersedes all previous communications between the parties whether oral or written, in relation to the Services.

C. Payments

i) The portion of the Project Budget allocated to ??? is a maximum total of US$??? (see Annex 2, Appendix 2). This shall be paid against invoices as follows:

a) The first installment of US$??? will be paid after the acceptance by the Comprehensive Assessment Director of the inception report, as specified in the Head Contract.
b) The second installment of US$??? to be paid at the end of the first year based on satisfactory progress and submission of report on project progress, to the satisfaction of the Comprehensive Assessment Director, as specified in the Head Contract.
c) The final installment of US$??? will be paid on approval of all deliverables including an overall project appraisal report, by the Comprehensive Assessment Director, as specified in the Head Contract.

ii) The sum stipulated represents the maximum amount to be paid by SUA for all services to be provided by ???. At each stage payments will be made once SUA has received transfer of funds from the International Water Management Institute.

D. Commencement of the Services

The services to be performed under the terms of the Agreement will commence on 1 April 2003 and continue for a period of 2 years expiring on 31 March 2005, unless terminated earlier in accordance with the provisions of this Agreement.

E. Publications

The results of the research project will be publishable in accordance with normal academic practices and authorships will be through written agreement of the parties.

F. Acknowledgement

???? shall confirm acceptance of the terms of this Agreement by signing and returning to SUA the duplicate copy enclosed herewith.

For and on behalf of Sokoine University of Agriculture:	Name: Position: Signature: Date:
For and on behalf of The ??????	Name: Position: Signature: Date:

APPENDIX 2: LIST OF PARTICIPANTS

No	Name	Address	Telephone	Fax:	EMAIL	Position	Institution
A: Stakeholders							
1	Rodgers K. Masha	Box 237, Rujewa	025-2590148, 0744/8-477479	025-2590108	masharo2002@lycos.com	SMS- Irrigation	DED- Mbarali
2	Marianus G. Mwangamila	Box 237, Rujewa	2590160			District Water Engineer.	Mbarali District Council
3	Alex J.S. Nalitolela	Box 2066, Dar es salaam	022-2865323, 0741-465373	022-2865312	dortafrica@hotmail.com, drd@ud.org.tz	Agr. Researcher	Directorate of Research and Development (MAF)
4	Zakaria J.U. Malley	Box 400 Mbeya	2552510062	2552510062	Uyole@ud.co.tz	Researcher	Agriculture Research Institute - Uyole.
5	Rumishaeli J. Masuki	Box 3575, Mbeya	025-2503485	025-2502242		Irrigation Engineer	Ministry of Agriculture and Food Security – Zonal Irrigation Mbeya
6	Idris Abdallah Msuya	Box 134, Rujewa , 1798, Iringa	025-2590246, 0744-028930	026-2702434		Water Officer	Rufiji Basin Water Office
B: Other Researchers							
7	Prof. Malongo R.S. Mlozi	Box 3002, Morogoro	0255-023260-4795	0255-023 260 3718/4649	malom2003@yahoo.co.uk	Professor + Researcher + Extensionist	SUA
8	Dr. Sylevester Mpanduji	Box 3003, Morogoro	0744-852224		Smmpanduji@yahoo.com	Senior Lecture	Agriculture Engineering SUA
C: SWMRG - Researchers							
9	Jeremias G. Mowo	Box 22, Lushoto	027-2640214 or 0748-754463 or 0744-754463		jgmowo@yahoo.com	Researcher	Directorete of Research and Development, Mligano, Tanga
10	Prof. Henry Mahoo	Box 3003, Morogoro	0232601206	0232604649	hmahoo10@yahoo.co.uk	Associate Professor	SUA
D: ODG, IWMI & ICRISAT							
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No	Name	Address	Telephone	Fax:	EMAIL	Position	Institution
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12	Dr. Daniel Kwesi Yawson	IWMI Private bag x813 silverton 0127, Pretoria, S/Africa	+27-12-8459100	+27-12-8459110	d.yawson@cgiar.org	Researcher	International Water Management Institute – Africa Regional Office, Pretoria
13	Dr. Bruce Lankford	NR4 7TJ Norwich, UK	+44 1603 593378		B.lankford@uea.ac.uk	Lecturer	UEA, UK
E: Research Associates – PhD.							
14	Julien G. Cour	Box 336, Igurusi	0744-637826		j.cour@uea.ac.uk	Research Associates	RIPARWIN - UEA
15	Zakaria J. Mkoga	Box 400, Uyole Mbeya	0744-824881	025-2510065	mkogazj@yahoo.co.uk	Agr. Researcher	Shardi Uyole Mbeya
16	Charles S. Sokile	74, Igurusi	0744-645142		sokile@email.com	Research Associate	SUA (SWMRG)
17	Kossa R.M. Rajabu	Box 74, Igurusi	0744-642967		krajabu@yahoo.com	Research Associate	SWMRG, SUA
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19	Makarius Mdemu	Box 74, Igurusi	0744-886964	023-2604649	mak_mdemu@yahoo.co.uk	Research Associate and PhD students	SUA (SWMRG)
20	Japhet J. Kashaigili	Box 74, Igurusi	0744-645144	0232604649	jkashaigili@yahoo.co.uk	Research Associate and PhD Student	SUA
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22	Machibya Magayane	Box 3003 Morogoro	0744-884579		mmagayane@hotmail.com, m.machibya@uea.ac.uk	Research Associate and PhD student	SUA
F: Research Assistants – MSc.							
23	Seith Siwale	3003, Morogoro			seithsiwale@Endoramail.com	Msc. Student	SUA
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APPENDIX 3: PRESENTATIONS MADE AT THE INCEPTION WORKSHOP IN MBEYA

Appendix 3.1 Ruaha Basin Decision – Aide (RUBDA) by Julien G. COUR Research
Associate RIPARWIN PhD student, University of East Anglia, U.K

Contents

What is a DA? For whom? Why a DA in Great Ruaha? What is RUBDA? Conclusion

What is a DA?

An interactive system consisting of « any and all data, information, expertise or activities that aid or contribute in option selection ».

For whom?

All stakeholders of the basin, especially decision makers, water professionals and researchers

Why a DA in Great Ruaha?

In order to go beyond the hydrological model to involve economic, environmental and social implications in the various scenarios created.

What is RUBDA?

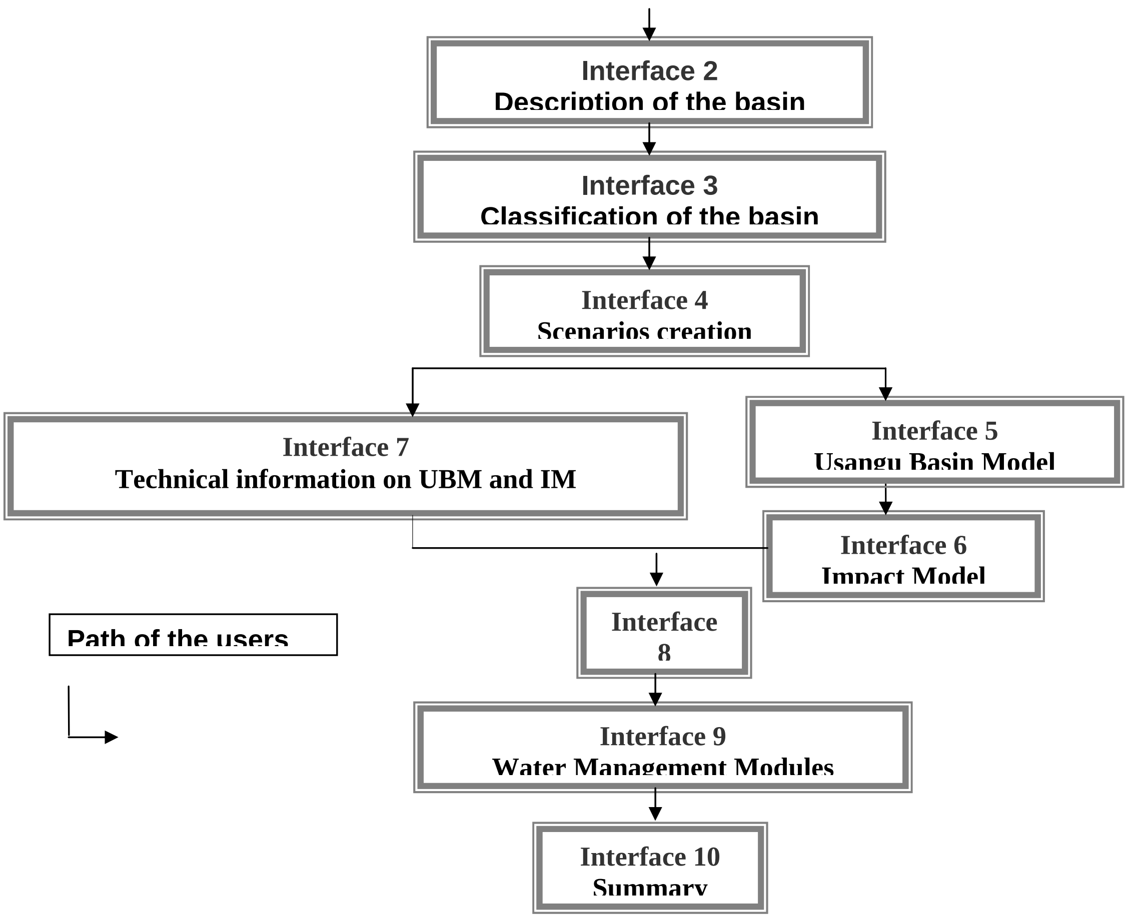
The RUBDA:
- A source of data and information on the physical characteristics, the institutional framework, the water uses etc
- Provides means of running both policy driven scenarios, physical changes scenarios and water demand scenarios

A multi-model tool:
- Based on a Hydrological model: the Usangu Basin Model upgraded
- Sustained by an Impact Model and Water Management Modules

Conclusion

- Develop a conceptual framework to link the hydrological, economic, environmental, and social sets of indicators and their use in the model.
- RUBDA must be a sustainable tool developed and owned by the users
- Flexible enough to meet the different users expectation
- The consultation process must be of iterative nature in the sense that DA development efforts will build up on intermittent feedback in the DA as the work proceeds
- RUBDA requires the involvement of stakeholders

RUBDA' S FRAMEWORK



Appendix 3.2 MSc. Presentation Knowledge sharing tools

RESEARCH TITLE:
Assessment of the Knowledge Sharing Tools for Improving Productivity of Water in Irrigated Agriculture in the Great Ruaha catchments.

SOKOINE UNIVERSITY OF AGRICULTURE
DEPARTMENT OF AGRICULTURAL EDUCATION
AND EXTENSION

NAME : KASELE SYDNEY STEVEN

JUSTIFICATION

Existing knowledge in productivity of water in agriculture.

- indigenous knowledge(IK) e.g, growing crops during most suitable period,early
- maturing varieties,intercropping,etc. It is neglected and disregarded.
- Scientific knowledge(SK) e.g,use of high yielding varieties,agronomic practices,etc. Most of the developed knowledge are shelved,not shared by stakeholders.
- No interlinking between the two type of knowledge

How is the knowledge shared.

- TK-Social gathering,oral traditional,peer group discussion,
- traditional dancing,etc.Not much shared.
- SK-training, Meeting, etc.Very few training.

Tools for sharing

- SK- Video,Pamphlets,Radio,Leaflets,Newspapers,etc
- Not available to stakeholders at all levels.
- TK-Village meeting,Farmer to farmer,local beer shops.
- cultural events,etc.Disregarded.

Objectives of the study

General objective
To assess knowledge sharing tools which link stakeholders at all levels in the process of improving productivity of water in the Great Ruaha catchments.

Specific objectives
1.To identify the exiting knowledge sharing tools for improving productivity of water in Agriculture.
2. To evaluate the approaches/tools which will bring about productivity of water for irrigated agriculture.
3. To identify approaches for knowledge sharing for increasing productivity of water in the Great Ruaha catchments. 4. To assess current impediments hindering the idea and knowledge flow in productivity of water.

5. To conduct literature survey relevant to the knowledge sharing tools for improving productivity of water
6. To recommend to relevant authorities the appropriate knowledge sharing tools for improving productivity of water.

METHODOLOGY

Data collection:-

Activity 1.Questionnaires,open ended questions and FGD
Activity 2.Focus group discussion (FGD)
Activity 3.Questionnaire,open ended questions and FGD
Activity 4.Questionnaire and FGD
Activity 5.Document analysis.

Primary data:

- Case study will be used as a Research design.
- For qualitative data, PRA tools e.g, wealth ranking, problem ranking,seasonal calendar,etc will be adopted.
- Where as with quantitative data questionnaires will be adopted.Sampling frame and sample size will be determined ready for data collection.

Secondary data

Will be collected from irrigation schemes,farm estate, MATI'S, Uyole research centre,Zonal irrigation office ,Local government offices.

Data processing and analysis

Data processing

The collected data will be coded in Statistical Package for Social Science (SPSS) program.

Data analysis

SPSS programme will be used to determine descriptive statistics such as frequencies, percentages and cross tabulation for determining showing the relationship between variables.

Appendix 3.3 MSc. Presentation Decision Aide

TITLE: DECISION AIDE FOR IMPROVING PRODUCTIVITY OF WATER IN AGRICULTURE A CASE STUDY OF GREAT RUAHA RIVER BASIN

Name: Alphonce CB Mganga, MSc. Student.
Sokoine University of Agriculture.
Department of Agricultural Engineering and Land planning.

Introduction
Proposed research is the component of PWAIS-project.

Presentation outline
-Justification
-Objective of the research,
-Methodology to meet the goals,
-Data processing & analysis, and
-Conclusions of the research proposal.

Justification
Great Ruaha River Basin and its Function.
-Agricultural activities
-Rangelands
-Support Plant and animal biodiversity (RNP,Usangu game reserve & wetland) & others d/s
-Its water contribute power generation 40-80% National grid.
-For Domestic water supply.

Why DA in Usangu basin for improving PWA

- Water scarcity in the basin.

Reduction in river flow, this is due to:
-Increase water demand in the basin,
-Change into hydrological regime.

- Rise of conflicts in sectoral water allocations & equity distribution.

Therefore which option to follow to give high yield per drop.

What has been done in Usangu Basin

Usangu agricultural models :
-Explains Agriculture scenarios.

Usangu hydrological models:
-Current river flow situations,
-Change of hydrological regime.

Ruaha RBMDA:
-RBM in general,
-Secterial water demand & allocation

What a DA in improving PWA can do

Identify options for improving PWA in one of catchment within Ruaha basin.
Evaluate and cost the best option and assist decision makers and/or stakeholders to indicate the best options for implementation.

Objectives

1. General Objective
To develop a decision aide that will assist in *selecting best options* for improving productivity of water in agriculture.

2. Specific objectives
- To identify options for improving productivity of water in agriculture.
- To evaluate benefits and cost of the promising options for improving PWA.
- Pilot test the best option in other river basins.

Methodology

Comprehensive literature survey to identify the options:
-From RIPARWIN project,
-From SMUWC project, and
-Other relevant literatures.

Specific objective 1

Identifying options:
-Secondary data for various options will be collected through RIPARWIN projects & other relevant projects conducted in Usangu.
-Primary data for various options will be collected through questionnaires.

Specific objective 2

Evaluation of benefits and cost of options:

- Through collecting yield data and evaluating time series production data.
- Review and select appropriate agricultural economical models for best use.
- Gross margin analysis.

Specific objective 3

Pilot test the best option to other river basins:
-By using secondary data from other sub-catchments to test the best option.

Summary of methodology

- Data processing and analysis
- Same data (like gross profit analysis, production time series data) will be processed & analyzed using appropriate computer programs, like SPSS .
- Obtained results/data will be presented into tabular form and graphs/charts (using Excel program).

Conclusion

This are primary ideas for this research proposal. So comments & criticism from the audiences are welcome to reshape the these concepts.

Appendix 3.4 PhD. Study Concept By Zakaria J. Mkoga

Options for Increasing Productivity of Water in Agriculture in the Farmer Managed Irrigation Systems: Case of Usangu in the Great Ruaha Basin

General Objective

To develop and Assess Options for increasing productivity of water for Farmer managed Irrigation Systems

Specific Objectives

- To identify options for increasing PWA
- To identify and evaluate the benefits and consequences of options for improving PWA
- To contribute to development of **appropriate modules for selecting options** for increasing PWA

Justification

- Declining fresh water reserves
- Increasing water demand (industry, agriculture, domestic and other uses)
- Negative consequences on agriculture and environment (livelihood)
- Increasing PWA is important in addressing water scarcity

Research questions

- What are the water management options needed for increasing PWA?
- What are the effects and consequences of the management options?
- What are the appropriate husbandry practices for increasing PWA
- Which are the appropriate crops and variety combinations?
- What is the competitive advantage of the different irrigation methods, irrigation structures and level of irrigation technology?
- What are the external factors (e.g. Policy) affecting PWA.

Methodology

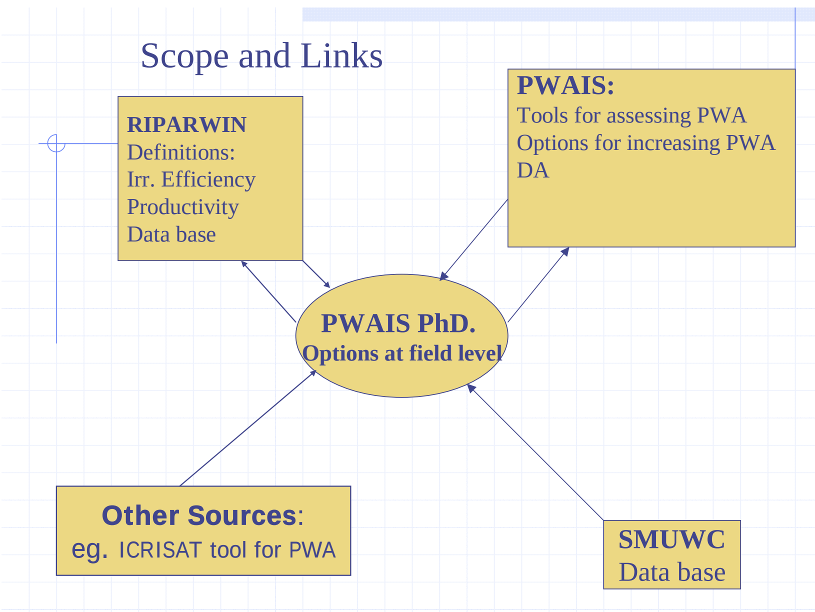
Objective 1: Identify options
- Comprehensive literature survey to explore the options
- Review RIPARWIN findings for current productivity and options
- Participatory exploration of options with stakeholders

Objective 2: Evaluate options
- Collect time series data (yield, flows etc.) from appropriate data bases
- Carry out experiments for generating data necessary for evaluation of options for increasing PWA
- Develop or adapt appropriate tools for assessing PWA

- Develop or adapt (RIPARWIN) water accounting frame work for assessing different components of water use' thus productivity
- Different scenarios will be formulated for evaluating costs and benefits of options for using the different options

Objective 3: Contribution to DA

- Develop excel based modules able to describe, quantify PWA and aid in selecting appropriate management options



Conceptual framework:

Appendix 3.5 Links between PWAIS and RIPARWIN B. A. Lankford

RIPARWIN objective

Research of re-allocation of water on the basis of two key decisions
Greater benefit exists with new allocation pattern (higher 'productivity')
Inefficiencies exist so that allocation is made on basis of savings rather than subtracting from net use of water in the donating sector

RIPARWIN productivity studies

- Japhet – values associated with wetlands
- Rueben – livelihoods and economics of different water uses
- Makarius/Machibya – water accounting within the Kapunga Water System
- Julien – decision-aide
- Kossa – modelling/monitoring water system
- Charles/Omare – mgt of RBM to raise productivity

PWAIS introduction

- Knowledge regarding water productivity and values
- Supports decision-making regarding water re-allocation and tools to effect RBM
- Opportunity to enrich work of RIPARWIN, and mutually support each project

Options for PWAIS

- Explore new theoretical approaches & methods not covered under RIPARWIN
- Add sectors not adequately covered e.g. rainfed agriculture
- Explore case material not covered under RIPARWIN (e.g. Igomelo)
- Utilise RIPARWIN methods and findings, but strengthen comparative studies and fill gaps (e.g. Kapunga – see below)
- With RIPARWIN, add to synthesis and policy work on productivity
- PWAIS – 5 levels of objectives?
- Sector- and zone-based comparative study of water productivity (various options) to derive agreed tools and measures of productivity
- Analysis of constraints on and incentives for raising productivity
- Analysis of productivity of interacting systems and trade-offs
- Productivity theory, interpretation and synthesis
- Policy analysis and commentary
- Comparative productivity study e.g. Kapunga rice vs wetland

1st level: Indicators for Kapunga Water Productivity Study

OUTPUT (production) variables

- No. of individuals & households supported
- Agricultural produce
- Fish, duck, other yield
- Brick-making
- Jobs, paid activities
- Ecological productivity
- Re-expressed as $ production
- Primary and secondary (knock-on) benefits

INPUT variables

- Time
- Area and area dynamics
- Volumetric water use and depletive consumption
- Capital/recurrent $
- Staff, people, labour-days

RESULTS (as ratios to re-base)

- Per cubic-metre water
- Per year and season
- Per m^3/year/ha
- Per $, per m^3/$
- Per livelihood effort

2nd level: Analysis of Kapunga water productivity (and other case studies)

- Assessment of other complementary inputs to generate higher productivity (e.g. labour, fertilisers, skills, O&M, timing)
- Establishing realistic levels of potential production
- Constraints analysis (what limits productivity?)
- Incentive system – political economy of productivity (markets, taxes, prices)

3rd level: Analysis of interacting systems

- Identifying and characterising matrix of interactions
- Sectors of water use (irrigation, domestic, environment)
- Zones of water use (irrigation & brickmaking in one area)
- Distinguishing water from water-based livelihood systems
- Water moves within and between zones/sectors
- People move within and between zones/sectors

Interacting….

- Physical sequence (upstream, downstream)
- Seasonally-located and dependent
- Timing, duration, scheduling
- Mutually exclusive
- Mutually dependent
- Positive, neutral/blind, negative
- Major, minor and niche
- Diversified livelihood 'shopping'
- Nature of accumulation of productivity
- Physical vs policy sequences and priorities

4th level: Productivity theory, interpretation and synthesis

- Interpretation of comparative results – what is actual vs potential = what is high production vs what is waste?
- Boundaries of productivity studies
- Physical, economic, livelihood based?
- Primary vs secondary benefits
- Poverty & Governance-based? (value of water in creating stable viable rural economies)
- Thus, question of scale…..and interactions
- Applicability of study to other locations?

5th level: Analysis of productivity policy

In association with RIPARWIN findings:

- Total production benefits gained/lost

- Costs and benefits of effecting or maintaining water allocation pattern and change, incl. opportunity

- Distinguishing between values and productivity "is 'productivity' enough?"

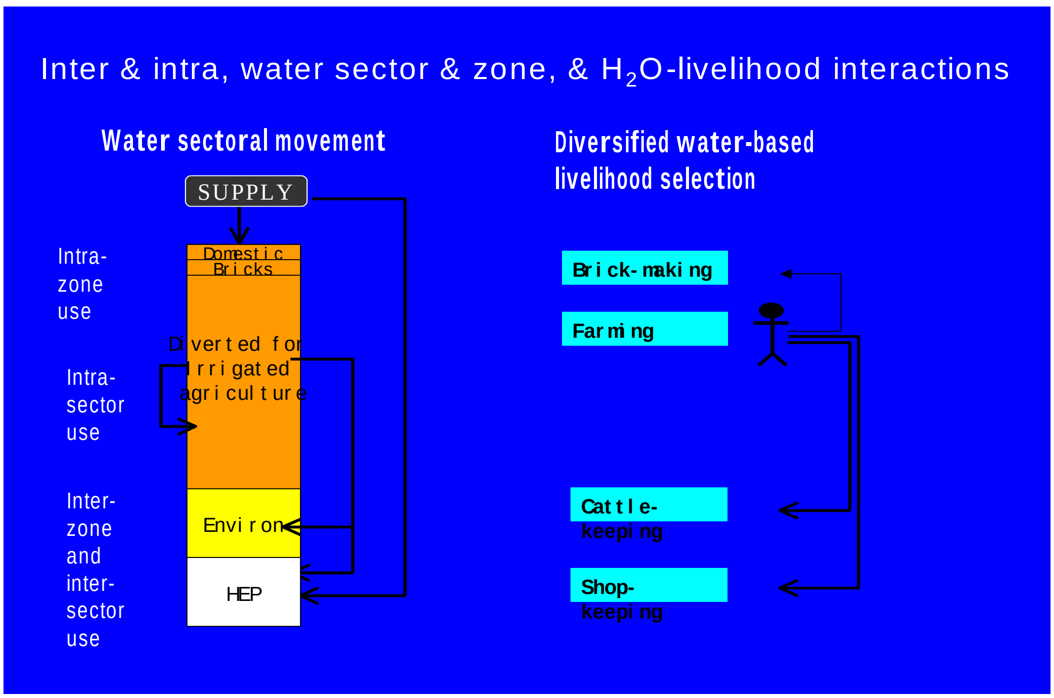
- Suggest alternative visions of water allocation

- Strategies and policies to raise productivity

Conclusions – PWAIS

- Firstly, emphasis on knowledge and tools for evaluating sector productivity measures
- Then synthesis/analysis of PWAIS and RIPARWIN work towards more complex understanding of
- Limits and incentives regarding productivity
- Interacting systems productivity
- Productivity interpretation and theory

- Policy analysis
- Clarification
- RIPARWIN is conducting work on a river-basin decision-aide to allocate water on various criteria
- PWAIS has suggested a decision-aide to tackle water productivity
- This possible overlap needs discussion – do we need a new DA?
- Working modalities - questions
- Comparative work and gap filling?
- Responsible for decision-aide module?
- Lines of responsibility
- Terms of reference for new researchers
- Balance of product vs process?
- Who will do the synthesis work?



<u>Appendixc 3..6 </u>Framework for Assessing Productivity of Water in Agriculture Presented by K.P.C. Rao and Nuhu Hatibu

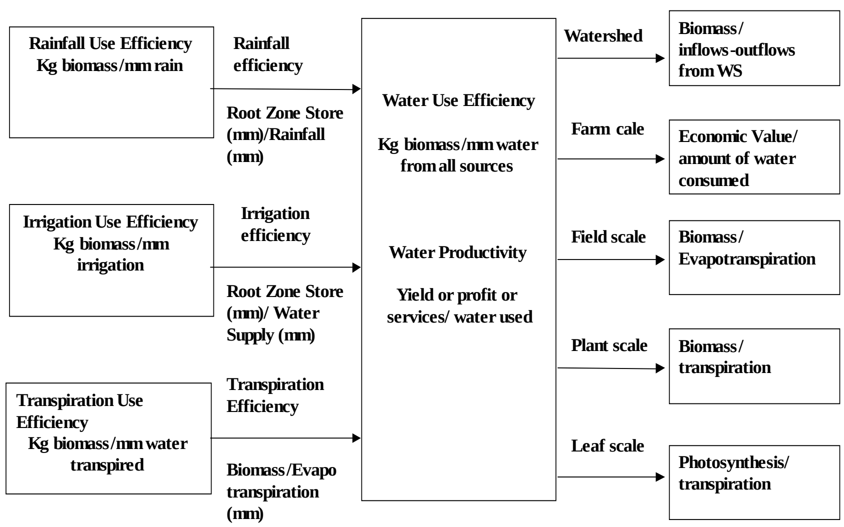
Project outputs

Tools for assessing productivity of water in agriculture
Assessment of benefits and consequences of available options on productivity of water

Assessing Productivity of Water

- What systems?
- What management and policy options?
- What benefits: products and services?
- What Scales?

Water Productivity in Agriculture



Rainfall Use Efficiency (Kg biomass/mm rain)

•Effective Rainfall Use Efficiency
•Total Rainfall Use Efficiency
•Annual, seasonal, crop period
•Total RF-(Runoff + Deep percolation)

Rainfall efficiency:
Root Zone Store (mm)/Rainfall (mm)

Irrigation Use Efficiency (Kg biomass/mm irrigation)

- *Conveyance efficiency:* Ratio of amount of water received at farm gate to amount of water supplied from the reservoir
- *Farm Efficiency:* Ratio of water delivered to the field to water received at the farm gate
- *Field Efficiency:*Ratio of amount of water contributed to the profile water storage to the water received at the farm and is also referred as application efficiency.

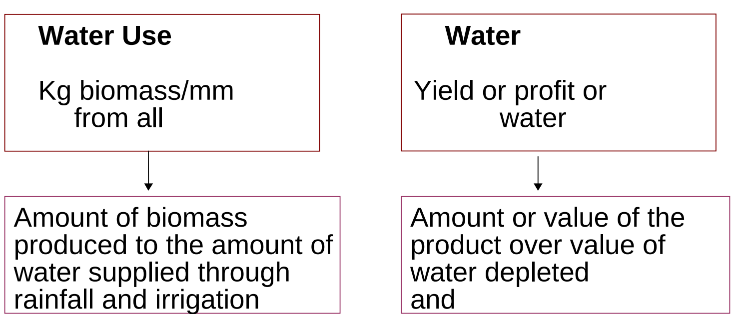
Irrigation efficiency:
Root Zone Store (mm)/ Water Supply (mm**)**

Transpiration Use Efficiency (Kg biomass/mm water transpired)

Influenced by:
•Crop type or variety
•Management

Transpiration Efficiency: ratio of the amount of biomass produced to the amount of water used for evapotranspiration**.**

WUE Vs WP



Scales:

- *Watershed scale:* Biomass to the amount of water flowing in and out of watersheds.
- *Farm Scale:* Economic value of produce to the amount of water consumed by the crop
- *Field Scale:* Biomass produced to amount of water evapotranspired
- *Plant Scale:* Biomass produced to amount of water transpired by the plant
- *Leaf Scale:* Photosynthesis per unit leaf area to transpiration per unit leaf area

Simulation models

- PARCHED-THIRST
- DSSAT
- APSIM
- WEPP

Way forward?

- Identify and agree on the systems and issues to focus (What is meant and what has to be measured)
- Identify the tools required to make WP assessments on the systems
- Identify the data requirements and assess their availability and accessibility
- Define and agree on sharing of responsibilities by the participating institutions

Appendix 3.7 RIPARWIN findings on Irrigation Efficiency and Productivity of Water in rice production presented by Machibya Magayane and Makarius Mdemu.

Introduction

- RIPARWIN is a follow up project to the SMUWC project.
- SMUWC studied many aspects of natural resource use in Usangu
- RIPARWIN is looking very closely the aspect of water management in Usangu
- PWAIS is sister project of the RIPARWIN project and aims to develop tools for assessing productivity of water in agriculture and interacting systems.
- This paper outline one of the components of water management in the RIPARWIN project i.e. Efficiency and productivity determination.
- The efficiency and productivity information available with the RIPARWIN project are, therefore, platform materials for the PWAIS.

RIPARWIN arguments on Efficiency and Productivity of irrigated savannah plains

- **There are many factors that need to be considered during IE and productivity analysis in savannah plains e.g. in Usangu.**
- **SMUWC/RIPARWIN experience in Usangu informs that conventional methods for assessing IE and productivity rarely address these factors.**
- **Based on these facts, the RIPARWIN project is promoting an alternative approach of assessing IE and productivity that tackle a range of diverse irrigation conditions in irrigated savannah plains in developing countries.**
- RIPARWIN strategies to develop a methodology for efficiency and productivity determination in river basin

RIPARWIN is promoting a meso-scale concept of irrigation situational efficiency (ISE), a method inspired by conditions found in Usangu irrigated savannah plains.

The nature of efficiency and productivity of irrigation systems in Usangu was found to be dynamic depending on :

1: Water availability

2: Location of field relative to water source

3: Swings of market for irrigated products and

4: Irrigation types, technologies of irrigation methods, and infrastructures.

Necessary factors considered in the ISE:

- Based on the four factors available in Usangu, IE and productivity analysed in the area should recognise the following:
- Existence of water reuse process,
- Limitations and importance of drain water for the downstream users,
- Changes in water availability for different years,
- Lack of ground water recovery,
- Changes in irrigated areas,
- Products price fluctuations and wealth status of the drain water users, and

The significance of Efficiency changes between seasons/years:
The ISE Approach to IE and Productivity Determination
The following irrigation types which reused water between each other, in Usangu, were assessed for IE and productivity:

- ISE Sub Methods
- Measurement of the amount of water use for each irrigation types.
- Measurement of the delay of drain water to the downstream users
- Determination of change in irrigated area using GIS between wet/dry years
- Measurement of system hydromodule (l/sec/ha)
- Measurement of rice productivity resulted from water reuse
- Measurement of mean annual water depths for different irrigation types
- Monitoring the change in water supply as reflected by irrigated areas
- Monitoring monthly and seasonal rice price fluctuation

Some Results From the ISE Method

The nested sub-method of ISE indicate that water use efficiencies in rice fields for the types of irrigation were:

- Large farms uses about 2300 mm of water at net rice requirement of 1100 mm this is 45% efficiency,

- Improved smallholders uses about 1900 mm of water. At net rice requirement of 1100 mm this is about 55% efficiency,

- Traditional smallholders uses about 1700 mm of water which gives about 68% efficiency at 1100 mm net rice requirement

- Some Results From the ISE Method

- Irrigated area changed by about 35% between dry and wet year,

- Water delayed to reach downstream users for about 1-2 months,

- Price of rice fluctuated in a range of 200% between up/downstream farmers,

- Rice water productivity was in the range of 0.17 – 0.31 kg/m^3 between irrigation types and seasons,

- As a result of drain water reuse across irrigation types, rice water productivity ranged between 0.55 – 0.66 kg/m^3 for the dry and wet years respectively

- Mean annual depth of standing water in fields were 2200 mm and 1600 mm in large and smallholder irrigation systems.

- System irrigation hydromodule was about 0.91l/sec/ha.

Conclusion

RIPARWIN concludes that IE and productivity in savannah plains are complex subjects as they vary with location and time. RIPARWIN has, therefore, differentiated four terms regarding Efficiency and productivity as follow:

- **THE PRODUCTIVITY OF WATER: is a measure of the economic, livelihood or biophysical outputs derived from the use of a unit of water. Such outputs are brickmaking, crop production, fishing, livestock watering etc.**

- **THE PRODUCTIVITY OF IRRIGATION WATER: is a measure of the economic or biophysical gain from the use of a unit of irrigation water in crop production and is expressed in productive crop units of kg/ha, or kg/m^3.**
- THE WATER USE EFFICIENCY: is a measure of efficiency of water use for a defiined user type with specified boundaries, and is expressed without units (ie as a percentage) requiring the formulation of the net and gross amount of water utilised for the activity under study.
- IRRIGATION EFFICIENCY: is a special case of the water use efficiency (above) as it is the measure of efficiency for irrigation given specified boundaries

Appendix 3.8 Description Of The Pwais Project And Proposed Sites For The Study By Prof. H.F. Mahoo

Productivity of Water in Agriculture and Interacting Systems (PWAIS): Approaches and Options for Eastern Africa

FUNDED BY: CA/IWMI

Principal Investigators

1. Dr. Nuhu Hatibu/Henry Mahoo
   Associate Professors – Sokoine University of Agriculture

2. Dr. Bruce Lankford
   Lecturer – University of East Anglia - UK
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3. Dr. Mintesinot Behalu
   Vice President – Makelle University

4. Dr. K.P.C. Rao
   Special Project Scientist – East Africa Region, ICRISAT

5. Mr. Zakaria Mkoga
   Research Officer – Southern Highlands Research and Development Institute, Ministry of Agriculture and Food Security, Mbeya, Tanzania

GOAL AND PURPOSE

GOAL

The adoption of strategies for improving the productivity of water in both rainfed and irrigated agriculture and interacting systems in Eastern Africa.

PURPOSE

To identify and verify with stakeholders, new knowledge demanded by relevant institutions regarding alternative and best options for improving productivity of water in agriculture and interacting systems.

PLANNED OUTPUTS

The project purpose will be achieved through four major outputs as described below.

1. Information and methodological tools for assessing the productivity of water in agriculture (PWA) will be collated, evaluated and disseminated to stakeholders.

2. Benefits and consequences of options for improving productivity of water in agriculture under different scenarios, identified and evaluated in the case study basins.

3. River Basin Management Decision Aide (RBMDA) with robust modules dealing with selection of options for increasing productivity of water in agricultural as well as interacting systems, produced.

4. Knowledge sharing tools that are participatory and able to link stakeholders at all levels will be developed, adopted and used to disseminate project results.

ACTIVITIES

1.1 Undertake a comprehensive international literature survey to identify tools used to assess PWA

1.2 Assess suitability of different tools under varying conditions and identify and adapt promising tools for the situation found in Tanzania and Ethiopia

1.3 Promote (through training, study tours, workshops etc.) dialogue and consensus on methodological tools for assessing PWA.

2.1 Assess the current levels of PWA in the Ruaha sub-Basin in Tanzania and Tekeze/Atbara sub-Basin in Ethiopia.

2.2 Conduct historical analysis of PWA to gain insights on trends and causes of increasing productivity.

2.3 Review work conducted by RIPARWIN on benefits gained from water in Gt Ruaha.

2.1 Determine and quantify factors from the farm to policy levels, which are important drivers of PWA

2.2 Identify promising options for improving PWA in relation to types of enterprises, crop varieties, husbandry practices, institutions and policy instruments

3.1 Evaluate benefits and costs of the promising options through scenario analysis using appropriate models and participatory tools in Ruaha Basin, Tanzania

3.2 Integrate into the RIPARWIN Decision Aide, aspects for decision making on action to improving PWA

3.3 Pilot test the best options in Ethiopia

4.1 Assess current impediments to ideas and knowledge flow and sharing especially in relation to PWA

4.2 Identify promising approaches to overcoming the existing impediments

4.4 Evaluate the approaches /tools while using them to disseminate PWA ideas/knowledge in both Tanzania and Ethiopia.

METHODOLOGY

The PWAIS project is designed to consolidate and build on the findings from RIPARWIN project (Figure 1). PWAIS will facilitate the principal investigators and students to implement global, regional, national and local reviews to establish inventory of tools for assessing PWA, as well as options for improving it. These will be undertaken through:

- An international review of literature and of RIPARWIN work.
- Participatory surveys with stakeholders in Tanzania and Ethiopia
- Study tours to other regions in Africa and Asia to gather experience.

IMPLEMENTATION AND MANAGEMENT

The roles and responsibilities of collaborators for implementing the project are as follows:

SW**MRG-SUA** – Research management, rainwater harvesting, hydrology, participatory approaches and capacity building.

ODG-UEA – In-depth knowledge of SMUWC and RIPARWIN studies of water dynamics and utilisation in the Ruaha area.

ICRISAT - Management of water in semi-arid tropics, genetic and agronomic options for optimising productivity of water, international and CG linkages to mobilize international experience.

Makelle University – In-depth knowledge of water dynamics and utilisation in the Tekeze/Atbara sub-catchment, capacity building and supervision of students, knowledge in rainwater harvesting and small scale storage options.

SHARDI-Uyole – Outreach linkages in the Gt. Ruaha being the responsible Agricultural Research Institute for the area.

APPENDIX 4: PWAIS WORK PLAN

Activity	2003							2004												2005		
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Output 1																						
1.1 Undertake a comprehensive literature survey	xxx	xx	xx	xx	xxx	xxx																
1.2 Undertake a participatory survey of indigenous methodological tools					xxx	xxx	xxx	xxx														
1.3 Establish stakeholders consultation dialogue on PWA	xxx	xxx	xxx	xxx	xxx	xxx	xxx															
1.4 Asses suitability of different tools under varying conditions						x	xx	xxx	xxx	xxx												
1.3 Promote dialogue and consensus on methodological tools for assessing PWAIU								xx	xx	xx	xx	xx	xx									
Output 2																						
2.1 Asse the current levels of PWA in the Ruaha Sub-Basin in Tanzania and Atbara Sub-Basin in Ethiopia					x	x	x	x	xx	xx	xxx	xxx	xxx	xxx								
2.2 Compare and contrast PWA in rainfed and irrigated agriculture					xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx									
2.3 Conduct historical analysis of PWA					x	xx	xx	xxx	xx	xx												
2.4 Identify promising option for improving PWA									x	xx	xx	xxx	xx	xx								
Output 3																						
3.1 Integrate into the RIPARWIN Decision Aide, aspects for decision making			x	x	x	x	x	x	x	x	xxx	xxx	xxx	xxx	xxx	xxx						
3.2 Pilot test the best options in a sub basin in Tanzania											xxx	xxx	xxx	xxx								
Output 4																						
4.1 Assess current impediments to ideas and knowledge flow in relation to PWA	xxx	xxx	xxx	xxx																		
4.2 Identify promising approaches to overcoming the existing impediments		xxx	xxx	xxx	xxx	xxx	xxx															
4.3 Evaluate the approaches/tools					xx	xx	xx	xx	xx	xx	xx	xx	x	x	x	xx	xx	xx	xx			