Feasibility Study for Finfish Project in Mtwara District

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Guarding the Fish at Elimu Kichwa, Mngoji

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1.0 Background

Experimental pond finfish mariculture was started in Makoba Bay in 1995-1996 by the Institute of Marine Sciences working with partners from National Center for Mariculture (NCM) in Eilat, Israel and Woodshole Oceanographic Institute, USA (Mmochi et al., 1996). In 2001, Institute of Marine Sciences (IMS) won a grant from the Western Indian Ocean Marine Sciences Association (WIOMSA) and conducted an Integrated Mariculture Pond System experimenting with milkfish (*Chanos chanos*), mullet (*Mugil cephalus*), rabbit fish (*Siganus canaliculatus*) and marine acclimatized Zanzibar Tilapia (*Oreochromis urolepis urolepis*). During the closure of this project IMS conducted a national stake holders workshop disseminating the information to partners in the coastal areas (Mmochi et al, 2004).

Milkfish farming in Mtwara started in 2004 with pond farming in Mbuo following the training in Zanzibar which was attended by the Mtwara District Fisheries Officer. The efforts were also taken over by Mnazi Bay and Ruvuma Estuary Marine Park (MBREMP) who supported development of a demonstration pond in an effort to develop alternative livelihoods to the traditional harvesting of the marine resources. The endeavours were not successful (Msuya and Mmochi, 2007). In 2008, WIOMSA won a project from Regional Programme for the Sustainable Management of the Coastal Zones of the Countries of the Indian Ocean Countries (ReCoMaP) projects funded by EU. The implementation of the project was preceded by survey of the ongoing milkfish farming in Tanzania including Mtwara that was found to be scanty (Msuya and Mmochi, 2007). The main objective of the WIOMSA project was to develop one demonstration pond in Mtwara and support two others (By building the main gates) and training farmers the principles and practices of fish farming.

At the end of the two years there were some tangible achievements. The two years project managed to develop a 1 ha milkfish demonstration pond and train 22 trainees on all aspects of milkfish farming including site selection, pond construction, pond preparation, fingerling collection, pond management, harvesting and marketing. The project further facilitated 3 othe groups by providing them with gates as a reward for good pond design and construction. At the end a total of 24 ha were developed in Mtwara District alone. The per ha annual production improved from the maximum of 1 ton per ha (Requintina et al., 2008) to a new record of 7.5 tons/ha equivalent to 10000 USD/year (Mmochi, 2010). There are therefore very clear indications that milkfish aquaculture is feasible. However, two years were too short to accomplish everything. Most of the ponds were not dug and farmers were satisfied in building the dikes. Accordingly, half of the pond areas are completely dry most of the time. Only 3 farms are producing more than 1 ton/ha/year which is thought to be economically reasonable but the remaining 12 farms are producing an average of 263 kg/ha/year. Interestingly the low production farms are also the most poorly constructed at a lower average cost of 840 USD compared to 2151 for the 3. A common problem facing all the farmers is availability of fingerlings. The farmers collect fingerlings from the wild with consequences to biodiversity. In some years, especially with shortage of rainfalls, there is are reported serious shortages of fingerlings and most of the ponds are under-stocked

From the beginning of the ReCoMaP project to date the number of farmers and ponds have continued to grow. Because of the trends and following advice from ReCoMaP project, Mtwara fish farmers established a fish farmers union named “Umoja wa Wafugaji Samaki Mtwara” translating to union of Mtwara fish farmers. The newly established union has 404 members 152 of whom are women from 30 fish farming groups. The members are mainly from Mbuo, Ndumbwe, Kisiwa and Namgogori Villages out of the MBREMP conservation

area. Already six groups from the MBREMP conservation area have applied to join UWASA and it is hoped that all the groups from Mtwara will join.

It is against this background that SWISSAID developed interest to try and help in the development of the project.

2.0 Introduction

Aquaculture is farming of aquatic organisms. According to Khan, (2011) aquaculture is defined as the farming of aquatic organisms such as fish, crustaceans, molluscs and aquatic plants in water under controlled conditions. Mariculture refers to farming in the marine environment. Fish farming is the fastest growing means of food production worldwide at an annual growth rate of 8.8 % (FAO, 2006). Furthermore, 20% and 77% of all the fish consumed globally in 2009 came from marine and freshwater aquaculture industries respectively (FAO, 2010). The commonest methods of farming are development of fish ponds on land and in the intertidal areas usually behind mangroves and salt marshes where the soil is a mixture of clay, loam and sand and suitable for building dikes, cage farming in the lakes and oceans, and pens/happas.

The candidate species for aquaculture are chosen based on their tolerance to environment and diseases, easy availability of seeds/making hatcheries and the market preferences. From the environmental point of view herbivorous and omnivorous/detritus feeders are preferred aquaculture species against carnivorous fish (e.g. salmon and prawn) because of the latter's higher and costly protein intake as well as poorer food conversion efficiency. Carp is the leading fin fish aquaculture species in the world in terms of volume followed by tilapia and milkfish.

While the contribution of Sub Saharan Africa to aquaculture is a mere 0.16% most of the space suitable for aquaculture outside Africa has been optimally utilized. Further expansion in aquaculture is synonymous to developing aquaculture in Africa. The main reasons for poor development of mariculture in Sub-Saharan Africa are the easy availability of wild catch and consequent low prices of fish. Mariculture in Tanzania is developing slowly due to lack of awareness of its potential in poverty alleviation, poor technology, lack of hatcheries, small prices for the products and its low priority in the national plan (Mafwenga, 1994). According to this author, the main reasons are easy availability of fish from the wild and poor infrastructure making the marketing of fish as well as development of aquaculture costly (Author‘s Pers Observ). In Tanzania both of these are changing with the prices changing from 0.5 in the early 2000's (Dubi et al., 2006) through 1.2 in 2006 (Requintina et al., 2008) to 2 US$/kg (Mmochi, 2011) to date and road networks improving substantially. The prices are influenced by interalia human population growth, change in eating habits with growing consciousness on the effects of red meat, growing tourism, increased number of marine parks and reserves as well as tightened fisheries policies on destructive fishing methods.

The current government policies and strategic plans are towards development of aquaculture in Tanzania. These include development of directorate of Aquaculture with assistant directors in mariculture and fresh water aquaculture respectively, development of the National Aquaculture Development Strategic Plan (NADS) and active sponsorship of aquaculture activities including Marine and Coastal Environment Management Program (MACEMP) and Tanzania Social Action Fund (TASAF). The national aim in aquaculture is to provide alternative livelihoods, to improve food security and generate income all in line with the

Development Goal 7: “Ensure Environmental sustainability in development process” and Tanzania National Strategy for Growth and Reduction of Poverty commonly known as MKUKUTA that insist on environmental conservation as means to reduce vulnerability of poor people. Aquaculture is also looked at as an adaptation to climate change with consequent effects on freshwater supply and possible reduction in agricultural productivity.

2.1 Milkfish and tilapia mariculture

Milkfish farming was started in Philippines and Indonesia about 400 years ago spreading later to most of Far East and Asia in general. Milkfish are known as strong spawners. Eight years old brood stock weighing 6 kg are known to produce 3-4 million fingerlings that have been enough to sustain the industry in these countries with little effect on the environment and fingerling availability. Despite this, collection of fingerlings from the wild is shied upon as unsustainable and environmentally unfriendly. Because of the size of milkfish which can be over a metre long and 12 kg of weight hatcheries are difficult to maintain economically.

The current status of milkfish farming in Mtwara is discussed in the background to this report. UWASA was developed during the end of the ReCoMaP project to try and consolidate fish farming in the district. There are reports of occasional unavailability of fingerlings and UWASA has been thinking of an alternative to fingerling collection from the wild. This can be achieved through proper selection of euryhaline tilapia species. Tilapia is now the second most important farmed fish globally, next to carp, and the most important aquaculture species of the 21st century (FAO 2009).The Institute of Marine Sciences of the University of Dar es Salaam is working on a hatchery and acclimatization of tilapia for farming in the marine environment (Alex, 2011; Hassan, 2011; Portman, 2011). UWASA intends to take advantage of these developments to produce marine tilapia to supplement milkfish fingerlings from the wild. UWASA also intends to study the relative availability of milkfish fingerlings in the different mangrove stands for possible harvesting and transferring to ponds where fingerlings are scarce. Furthermore, UWASA intends to consolidate fish farming in Mtwara through reconstruction/repair or improvement of the existing fish ponds, development of proper and supervised farm management program, develop marine tilapia hatchery through acclimatization of *Oreochromis mosambicus* or Zanzibar tilapia (*O. urolepis urolepis*) both of which are known to survive and grow in marine environment to supplement or replace milkfish fingerlings collected from the wild with consequences to the marine environment.

This report is a result of six days visit to Mtwara District to study the feasibility of consolidating, up-scaling and expanding milkfish farming in Mtwara District

3.0 General Objective

To study the status of milkfish farming in Mtwara and evaluate the feasibility of consolidating and expanding finfish farming in the district.

3.1 Specific Objectives

1. To discuss with the SWISSAID program officer and UWASA Coordinator on consolidating UWASA and finfish mariculture in the district
2. To develop a mechanism for select farmer field schools/demonstration ponds
3. To visit all the villages doing finfish mariculture in Mtwara as the basis for selecting demonstration ponds

4. To provide inputs in to three year finfish mariculture project proposal in Mtwara
5. To evaluate using past records and direct observation the feasibility of finfish project in Mtwara District
6. To submit a report of the activities to the SWISSAID Country Coordinator

4.0 Methodology

The 7 day study was done in 23 sites distributed in 11 villages in Mtwara District. The study included interviews, focused group discussions and direct observation.

4.1 The study area

The study area is the Mtwara District Coastline from Kisiwa in the north to Kilambo in the south (Fig. 1). The list of villages and ponds visited with leaders of UWASA and other selected key informers are listed in annex 1

4.2 Methods

To decide the state of the farms and farming:

1. A questionnaire was developed consisting of key questions that are important in finfish farming and management including the site and pond quality, gender considerations, group harmony and industriousness (Annex 2).
2. UWASA leaders were briefed on the questionnaire and used as examiners.
3. Direct examination was done by the author.
4. Direct discussions were carried out with the Coordinator and SWISSAID Program Officer before and after visiting the sites.

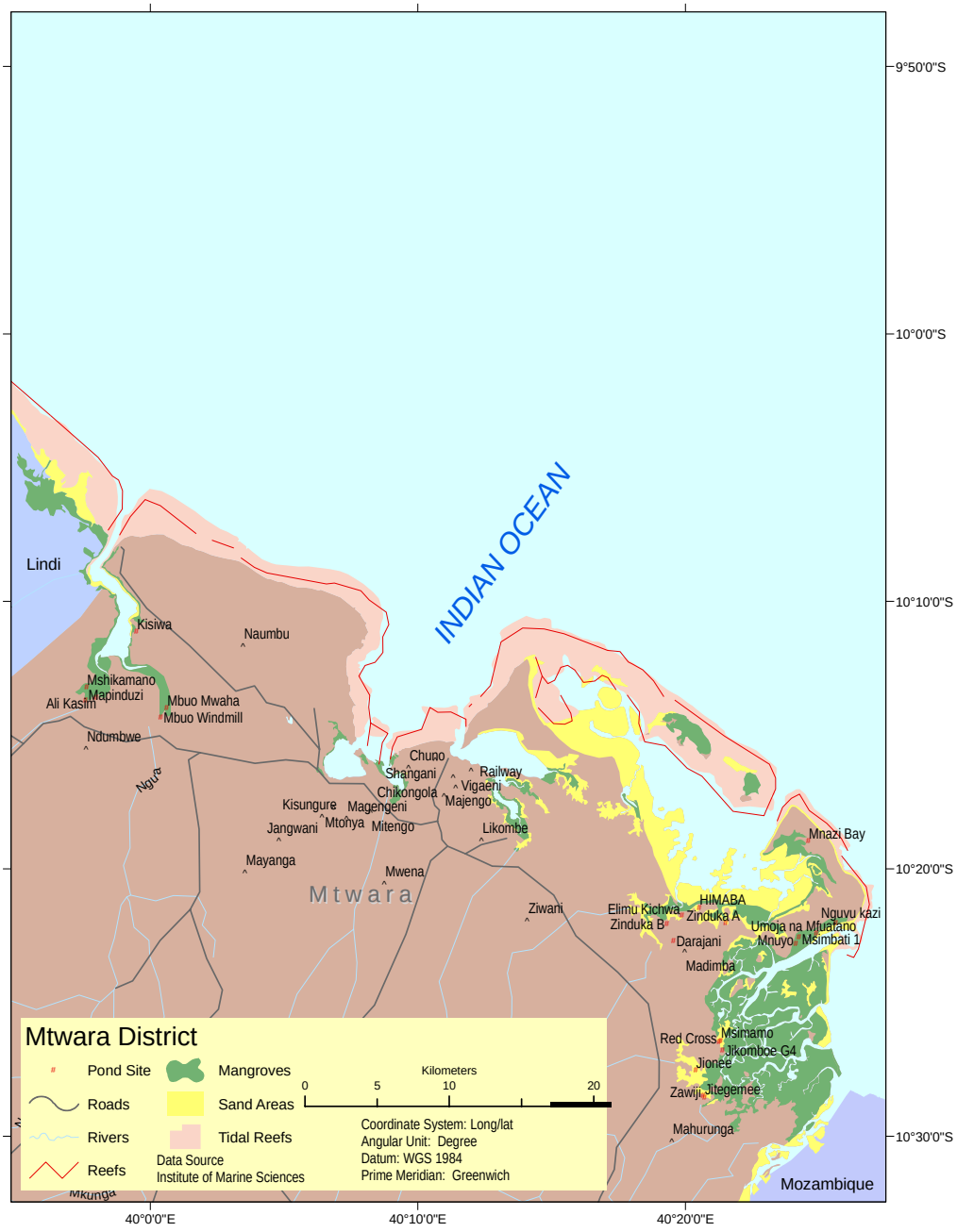


Figure 1: Map of Mtwara showing some of the visited villages and farms

5.0 Project Feasibility

5.1 Current Status

Finfish farming in Tanzania is in its infancy but with very strong indications of becoming economically viable (Mmochi et al., 2001; Mmochi, 2011; Sullivan et al., 2007; Sullivan et al., 2010; Rice et al., 2006; Troell, et al., 2011). With 24 ha of ponds out of the estimated 100 ha in Tanzania, Mtwara District is the fastest growing District in Coastal Tanzania in terms of finfish production. However there are still a lot of problems mainly in the areas of fingerling availability, proper pond, dike and gates construction, feed development and feeding, and

pond management. Furthermore, with expansion of the pond area, at least some mangroves are being cleared directly or are dying due to being covered with mud. The current status of finfish production through mariculture is summarized in table 1. This is already quite successful and comparable to production in seasoned countries such as Philippines and Indonesia (Baconguis, 2007; Chong, et al., 1982; Agbayani et al., 1989; FAO, 1987; Sumagaysay et al., 1990). However, the number of farms achieving the best levels of production is only 3 out of 13 (23%). The less producing farmers have bigger ponds, larger number of members and especially women, the highest stocking densities and lowest survival rates. The same farms records the lowest construction costs probably implying poor construction. Accordingly, efforts need to be done to ensure these more needy people can be reached. This will eventually consolidate aquaculture and raise the harvest.

A number of lessons have been learnt from a former ReCoMaP Project in the districts. These can be used to ensure that the new project is more successful. The following are among the most significant

- Farming groups: Large groups are difficult to manage and a lot of effort is required to mobilize them to work together in trust and transparency. In most of the bigger groups there is a low survival rate indicating either increasing carelessness or uncontrolled/unrecorded fish harvesting by members of the group.
- There is already an extension force in the district which if properly guided can transform the villages to modern aquaculture
- Site selection which is one of the most important aspect of fish farming need to be done properly. Poor site selection can lead to very high construction costs or loss of fish through breakage of the dikes.
- The dikes must be well built to withstand water and wind powers. The soil need to be of the right quality
- Stocking density should start with 1 fish/m^2 and increased systematically to 3 fish/m^2 with increasing management abilities. The farming should therefore be extensive to semi-intensive to avoid adverse environmental impacts
- Fingerlings are not always available at the right time and quantities and hence the need for hatcheries
- It is important to watch over the high spring inter-monsoon tides of March/April and September/October as they can break the dikes or flood the ponds.
- The farmers and extension officers in Mtwara are highly motivated and it is important to capture the moment

Table 1:Statistics of milkfish farming in Mtwara District by the ReCoMaP Project

Parameter	Number of Members	Number of Women	Cost of construction USD	Size of Pond m^2	Stocking density	Survival rate	No of Kg harvested	Price/kg USD	Kg/ha	Total USD	USD/ha
Totals	204	96		90107			7584.93		19116.72	9644.87	
Average	13	11	1118.05	5006	1.32	0.45	421.39	1.36	1124.51	507.62	1384.71
StDev	10	5	1159.89	5818	1.03	0.32	566.14	0.40	1938.42	743.87	2531.44
Maximum	28	18	5119.33	25375	3.67	1.00	1800.00	1.67	7500.00	2400.00	10000.00
Minimum	1	2	466.67	1040	0.12	0.06	18.50	0.33	68.52	30.67	113.58
Median	12	11	866.67	3075	1.02	0.39	112.40	1.50	375.00	140.00	343.53
Over 1ton per ha	9	10	2151	4140	0.87	0.81	970	1.24	3160.57	1266.00	4138
Below 1 ton per ha	14	11	840	5339	1.50	0.32	188	1.50	263.12	242.68	326

5.2 Socio-economic Aspects

One of the pre-requisite for fish farming is fish prices. The prices of fish in the Coastal Tanzania changed from 0.5 USD/kg in late 1990s through 1 USD/kg in the 2000s to 2.5 USD today. The current dietary preferences against red meat, rising tourism, population increase and road networks for swift transport of commodities to new and better distant markets are all pre-requisites to rapid expansion of mariculture. Aquaculture is expected to reduce fishing pressure which in turn leads to destructive fishing practices. Furthermore, fish nets in Tanzania are limited by law to $\geq$ 3 inch mesh sizes and fisher forks who were used to smaller fish like anchovy, sardines and the like are now deprived. This has already caused a lot of political disharmony in the MBREMP. The disharmony could be minimized by developing aquaculture in the salt flats which are abundant in the park. Furthermore, the policy on fish net mesh sizes has inter alia lead to rapidly growing fish prices throughout the country. This and the growing dietary practices against red meat and tourism are other factors that may be causing high fish prices. Fish harvesting will be synchronised to the month of September which is the cashew harvesting time in Mtwara (Prices are good) and fish smoking can be done to sell the fish in Nachingwea, Newala, Masasi and Tandahimba. The bulk harvesting will attract the fish traders from the four districts.

5.3 Technical Aspects

Increased production can be achieved through development of demonstration ponds coupled with rigorous training and management program. The training will provide a pool of extension officers or field managers for the villages. The officers will keep a log books of the production system and activities that will enable UWASA and the project to trace and rectify problems in the production process. The training will increase knowledge on hatchery running, fish farming, fish processing and marketing. One hatchery can be developed for marine tilapia including *O. mosambicus*, *O. urolepis* or their cross breeds with faster growing species such as Nile tilapia (*O. niloticus*). The fingerlings will be distributed and stocked in the farms as supplementary to the milkfish to overcome the scarcity of fingerlings. The experiments currently going on in the Institute of Marine Sciences Mariculture Centre in Pangani will be the basis of the hatchery development in Ndumbwe Village.

The ponds need to be re-built and dug to ensure proper depth of at least 0.5 m water depth. The gates need to be built or repaired to ensure that enough water can be harvested during the spring tides and retained during the neap tides. The gates need to be properly constructed to avoid leakages and be easy to open and close to avoid recurrent accidents and loss of fish. The dikes will be rebuilt or repaired to avoid re-current dike breakages especially during the equinoxes (March –May and September –October). The use of tide tables will need to be emphasized for the farmers to develop a proper water exchange timetables as well as anticipate extreme tides that may cause dike breakages and loss of the crop. To strengthen the dikes and check the impact of the winds and waves on the ponds, mangroves (*Avicenia marina*) need to be planted in the outer rim of the dikes. The mangroves will stabilize the dikes and break the waves hitting the dikes.

Pond preparation process will need to be enforced including drying the ponds in the dry months of September and October. The drying of the ponds is important in oxidising the ponds to avoid accumulation of organic matter which makes acid soil as well as reduction of dissolved oxygen consumption in the water column by the organic matter in the decomposition process. The soil will be tilled to kill pests and competitors to ensure fresh

start every year. The farms will be fertilized to ensure growth of bottom algal mat which is an important natural food for milkfish, mullet and marine tilapia. Farmers will be encouraged to start stocking from December through May during the rainy season when fingerlings are plentiful. The length of the stocking period will ensure stocking of enough fingerlings.

Pond management programs will be emphasised and records will be kept on the pond management. Basic equipments for water quality monitoring including refractometres, oxygen and pH meters need to be purchased and the farm managers trained to use them and record the parameters for management and future references. The fish will be fed using formulated feed developed by IMS (Mmochi et al., 2001; Mwangamilo and Jiddawi, 2001). The formulated feed samples will be analysed at Sokoine University of Agriculture in Morogoro to ensure that quality is adhered to.

5.4 Ecological Aspects

The farmers will be trained to plant mangroves (*A. marina*) in the salt flats around their ponds to create wind and wave buffer. A. marina is pioneer mangrove species that grows in all mangrove zones from the landward edge to the seaward edge. Furthermore, it is advised to encourage the farmers to start bee-keeping in the mangroves as a method of mangrove conservation to protect the buffer mangrove zones around the ponds. The bee farming creates some sense of ownership of the mangrove area and the bees themselves discourage mangrove cutting while the honey is an added value to the fish farmers.

5.5 Final discussions with SWISSAID Program Officer and UWASA coordinator

The initial discussions suggested a number of people to be trained as TOT who will later do mass training for the rest. The list includes Messers Mvita Shona, Ali Kassim, Saidi Natembelele, Abdalah Mkwamba and Hassan Mwarabu and Ms Asha Abadalla. However, in the concluding discussions it was suggested to take 2 TOTs from each of the selected demonstration ponds. The selected demonstration ponds were not necessarily the ones that indicated the best performance. I however believe that the best alternative is to take one TOT from each demonstration farm and combine them with the self elected TOTs as well as UWASA elected members and employees. The suggested trainees and their affiliations are listed in table 2.

Table 2: The suggested list of TOTs, their positions and affiliations

Name	Affiliated farm	Uwasa position	Farms remarks
1. Mvita Shona	Ushirika, USA	Secretary, UWASA, District	UWASA leader
2. Ali Kassim	Namondo	Secretary, UWASA, Ndumbwe	Self appointed trainer
3. Said Natembelele	Ushirika		Hard working
4. Abdala Mkwamba	Elimu Kichwa		Industriousness
5. Hassan Mwarabu, Representative	Jitegemee/Tangazo		WWF appointed mariculture supervisor
6. Asha Abdala Mnengo	Nguvu Kazi		Good women representing group accessibility and Asha is a Female entrepreneur
7. Hassani Samli		Field Officer	UWASA leader
8. Hadija Malibiche		Coordinator	UWASA leader
10. Mr. Masudi Kuota	Kisiwa	Chairman, UWASA	UWASA leader
11. Ms. Hadija Mwendo	Kisiwa	Member, UWASA	UWASA leader
12. Mr. Abdala Chimila	Ushirika, USA	Member, UWASA	UWASA leader
13. Representative	Maendeleo, Ndumbwe		Good women representation, central
14. Representative	Msimbati Mnuyo		Good women representation, accessible, good diking
15. Yahaya Ali	Mwaa, Mbuo		1 man, Industriousness

5.6 Delivery Mechanism

The capacity built to UWASA will ensure sustainability and expansion of the fish farms. The increased fish production will improve food security, income and alternative livelihoods to the farmers. UWASA is currently only represented in the villages of Ndumbwe, Mbuo, Kisiwa and Namgogori all outside the marine park. Already six villages from the park have applied for membership and many more are expected to join. Fish farming is very important to the marine park as an alternative livelihood to those whose activities in the park have been stopped or minimized by the park regulations. Accordingly, while the farmers in the park with limited number of alternative livelihoods/income generating activities are willing to develop aquaculture, the marine park has been supporting regulated expansion of sustainable mariculture in the park. MBREMP has always encouraged sustainable fish farming in the

park. UWASA will work with MBREMP to ensure sustainable milkfish development and expansion in the park.

Six of the former trainees during the ReCoMaP project are working in the farms that produced more than one ton per ha. While four of these (Mvita Shona, Ali Kasim, Saidi Natembelele and Yahya Ali Seif) came from the villages outside the park, three (Abdala Mkwamba, Hassan Mwarabu and Ms Asha) are from the park. Some have become trainers of trainers (TOTs) supervising new comers in to fish farming. The most successful of these, Mr. Hassan Mwarabu was facilitated by WWF Mtwara Project to manage and supervise 27 fish farmers groups all in the marine park. The other, Mr Ali Kasim of Ndumbwe earned a total of 483 US$ planning pond development for different farmer groups for 5 days at an average of 80.56$\pm$ 66.60 per day. This extension force can be facilitated to lead the expansion of the project.

The project partners are new to the office and hence with no coherent experience. Both the executive office and the NGO are new. However as individuals the executive and the UWASA members have been working together in the execution of the ReCoMaP project conducted by WIOMSA through Mtwara Umbrella Organisation (KIMWAM), with more than 3 years of working together. They also have a number of indispensable partners including the IMS, MBREMP, Fisheries Officers, the village government and the fish farming groups. The executive, UWASA and the farmer groups relationship need to be cemented to ensure harmony and transparency

6.0 Conclusions and Recommendations

Fish farming is on brink of happening in Mtwara District. Some of the farms are already comparable to those in highly experienced countries in the South East Asia. Unlike other forms of farming in Tanzania there is no single institution mandated with the technology development, training and dissemination (Technological and Research Park). The current developments are based on 2 years project which is already closed. The project though successful has left a lot of gaps and discontinuity.

The Mtwara fish farmers are among others who have been trained using similar project packs. Recipients of the same project and trained by the same trainers did not have as good results. At different times, trainers, projects and using different organizations, some people or groups from all the coastal districts in Tanzania have been trained in milkfish farming and have developed milkfish ponds. Mtwara District stands head and shoulders above the rest with Pemba Island a distant second. The self appointed TOTs whether paid or volunteers indicate retention and transfer of technology.

To my knowledge UWASA is the second fish farmers association that I know country wide. The first in Pemba is family oriented and has ten members. UWASA can therefore be nursed and facilitated to develop and transfer technology to farmers across the district and beyond. Finfish mariculture in Mtwara District is feasible technologically, socially and economically.

Recommendations

- Finfish mariculture is feasible in Mtwara District. It needs training and adherence to technical and ecological principles which are already known by some of the farmers.

The infrastructure and markets are excellent compared to elsewhere in Tanzania. Non of the problems that are facing mariculture development in Mtwara is insurmountable

- Most of the ponds are not dug. They need to be at least 0.5 m deep at the lowest water in a fortnight before being replenished by the next spring tide. These need to be dug.
- UWASA and the project are new. They need to be trained, nursed and guided to take their role in this development.
- Training is required on record keeping, transparency and crisis resolution among the groups and also UWASA.
- It is necessary to study the different estuaries, seasons and methodologies to ensure optimal fingerling collections.
- A finfish hatchery needs to be developed to supplement fingerling collection from the wild
- The farmers need to be trained on methods to combat predators and increase the survival rate of the stocked fish
- Further training is required to find other species that can be cultured in polyculture with milkfish including tilapia, mullet and prawns
- Harvesting and marketing strategies need to be coupled with development of packaging including refrigeration and development of kilns to increase shelf life as well as advertisements before and during harvesting.
- Lastly, economic viability and value chain analysis studies need to be made and disseminated to financial institutions, politicians and general public to encourage them to finance aquaculture activities.

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ANNEXES

Annex 1:Villages visited, contact persons, examiners and contacts in the MBREMP

Group names	Village	Contact Person	Trips/day	Examiners	Contacts in the MBREMP
Namondo	Ndumbwe	Ally Kasimu	1. Mbuo, Ndumbwe, Kisiwa and Namgogori	1. Masudi Kuota 2. Yahaya Ally 3. Ally Mgeni 4. Hadija Mwendo 5. Abdala Chimila 6. Samli Hassani	Abdala Mkwamba and Hassani Mwarabu
Nambili	Ndumbwe		2. Msimbati, Mngoji and Namindondi		
Maendeleo	Ndumbwe				
Tujitume	Ndumbwe	Chairman	3. Litembe, Kilambo and Tangazo		
Azimio	Ndumbwe				
Jitegemee	Ndumbwe				
Mshikamano	Ndumbwe				
Ushirika	Mbuo				
Matumaini	Mbuo				
Mwaa (Yahaya)	Mbuo	Yahaya			
Ufugaji	Kisiwa	Chairman and Hadija Mwendo			
Mapinduzi	Namgogori				
Mapambano	Namindondi	Ustadhi			
Mgeni Family	Ndumbwe				
Jitegemee	Tangazo	Mwarabu			
Zawiji	Tangazo				
Gangamaa	Tangazo				
Msimbati One	Msimbati				
Mnuyo	Msimbati				
Jitegemee	Mngoji				
Elimu Kichwa	Mngoji	Mkwamba			
Imani	Kilambo				
Tumaini	Litembe				

Annex 2: Score sheet on the important group and pond quality

Uthamini wa Bwawa/**Fish farm evaluation**	Nzuri sana **Very good**	Nzuri **Good**	Wastani **Average**	Mbaya **Bad**	Mbaya sana **Very bad**
Jina la kikundi/**Name of the farm**					
Upatikanaji wa maji/**Water availability**					
Aina ya udongo/**Suitability of the soil**					
Uwezekano wa mafuriko/**Protection from flooding**					
Upatikanaji wa vifaranga/**Avilability of fingerlings**					
Wanyama au ndege waharibifu/**Presence of predators**					
Uharibifu wa ukuta na Kaa/**Distruction of the dikes by crabs**					
Uwiano wa kijinsia/**Good gender balance**					
Ushirikiano na uongozi bora/**Good group harmony**					
Kiwango cha uzalishaji/**Good fish harvests**					
Kufikika/**Easy accessibility**					

Annex 3. Results of the field visits

Score Sheet Results

The 10 villages were reduced to 4 sites for aquaculture because of proximity and that some of the villages had only 1-3 ponds. The results of the clustering and the average scoring are shown in figures 1 a-d and the leading ponds are indicated below the respective figure, while the overall comparison of all the farms in the study area are shown in figure 2. The farms ranked by productivity are shown in table 1. According to these, Yahaya, Ushirika, Tujitume and Zinduka are indicated to be the best ponds.

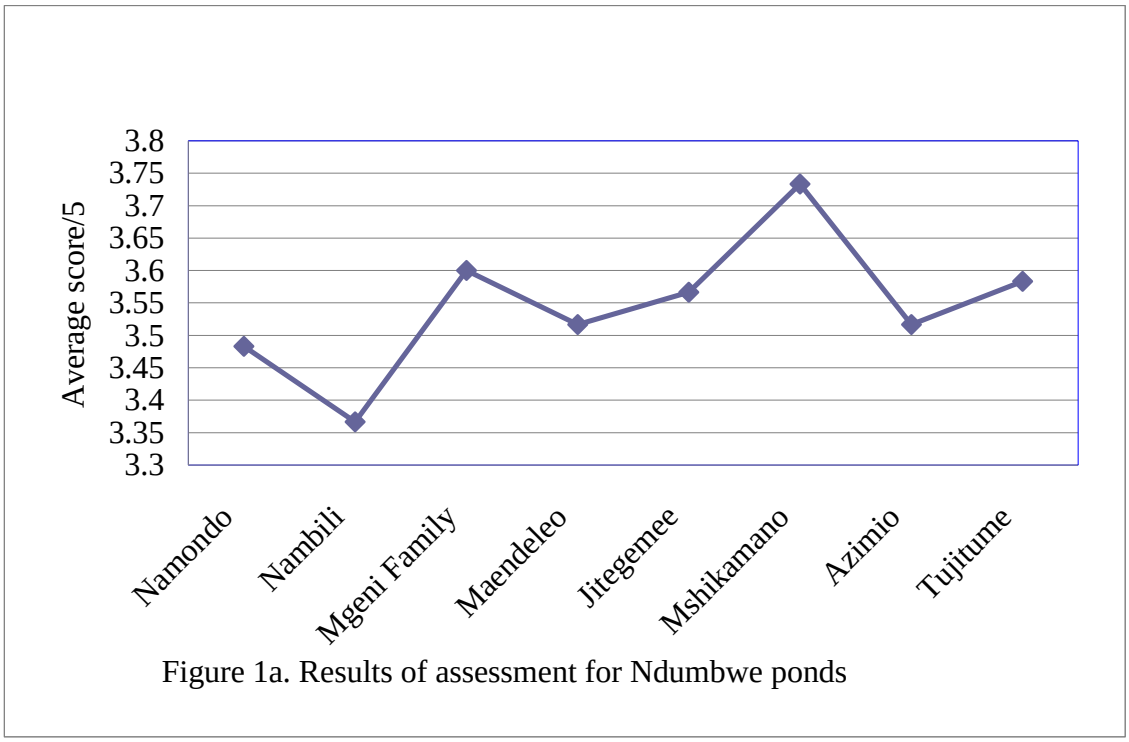


Figure 1a. Results of assessment for Ndumbwe ponds

The leading farms in Ndumbwe were Mshikamano and Mgeni Family. The construction of the dikes for Mshikamano family was the main factor that lead to its selection. The pond has been harvested once. Mgeni Family has two newly constructed 50x50 m^2 ponds each that are shown in plate 1 below. Mgeni also owns a milling machine in Mbuo Village. His farm was ranked highly as a possible demonstration pond because it is well constructed and Mgeni himself is very industrious. Owning a milling machine and being industrious he could also be facilitated to produce fish feed to sell to other farmers.



Plate 1 Mgeni family finfish ponds at Ndumbwe

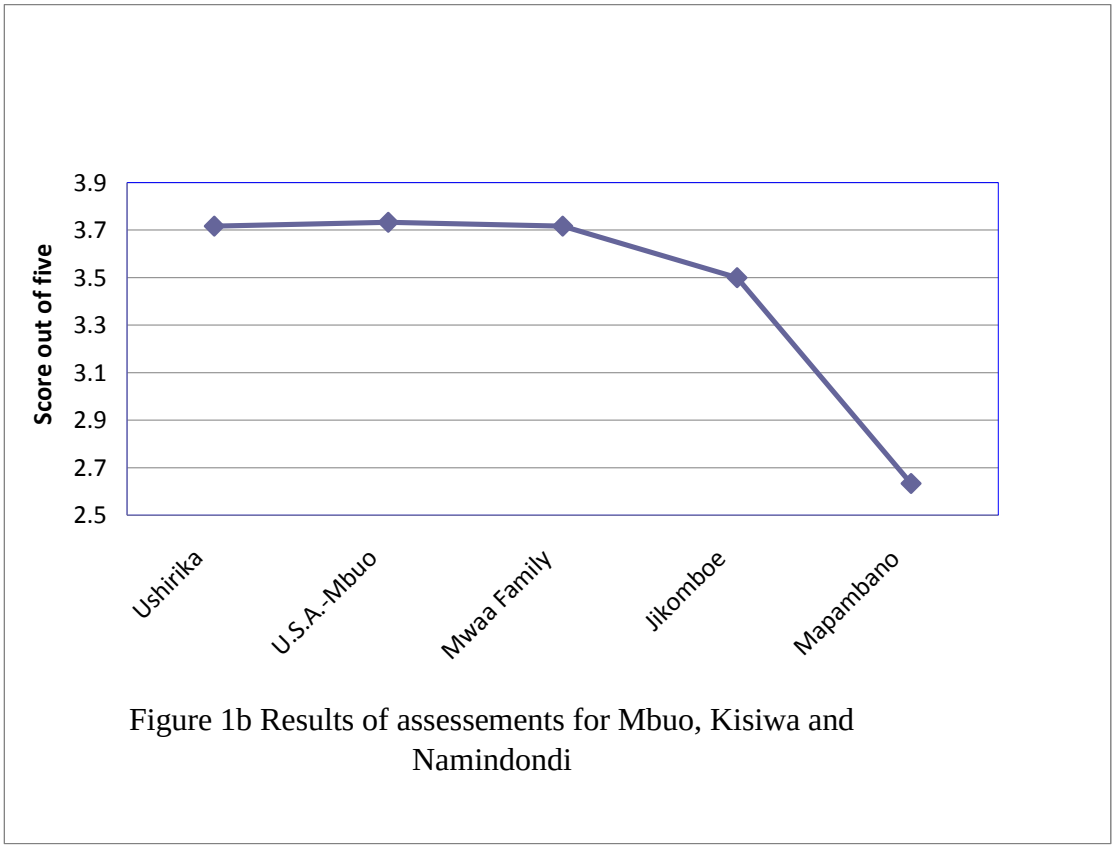


Figure 1b Results of assessements for Mbuo, Kisiwa and Namindondi

In Mbuo, Kisiwa and Namgogori Villages the leading farms were all in Mbuo. The first pond in Mtwara District was built in Mbuo in 2004 and the demonstration pond by ReCoMaP including a wind turbine is Ushirika. The efforts seem to have made the village the most successful.

Ushirika and Ufugaji Samaki (Usa) groups.

Ushirika was the demonstration farm that was developed by ReCoMaP (Plate 2). The farm did very well and eventually attracted funding from MACEMP to build a second set of ponds in the same area. The demonstration pond also has a wind turbine constructed by ReCoMaP 2 project to provide light and run a water pump to fill the ponds. The Ushirika group with 22 members has three very industrious people namely:

- Mr Mvita Shona who is the Secretary to UWASA, the Mbuo Village Secretary for Environment and a treasurer to a local group developing water wells supplying others with water at a fee.
- Mr Abdala Chimila is an old man of over fifty also doing solar salt mining in the same estuary. Mr Chimila and his group also attracted money from MACEMP to improve the solar salt mining ponds. Abdala and Mvita are also members of the USA farm in the same estuary
- Mr Said Natembelele is hard working young man who helped a lot in construction activities in the Ushirika pond
- The three of them are extension officers trained by ReCoMaP. Because of their industriousness their ponds are also the only one with coconut fronds that are important in increasing the surface area for growth of plankton (periphyton). It is also the only pond whose fish are being fed using formulated feed.



Plate 2. Ushirika demonstration farm and the wind turbine

Mwaa

Mr Yahaya is an individual owner with a 2.5 ha of ponds at Mbuo that are nicknamed Mwaa. Mr Yahya was a solar salt miner with Makonde Salt Mine. He did his first fish farming experiments using one of his salt evaporation ponds where he had the best harvest of 7.5 tons/ha which is the current record in milkfish farming. Following his successes he concluded that fish farming is more profitable than solar salt mining. He narrated his story which was subsequently published in WIOMSA Magazine (www.wiomsa.org). Mr. Yahaya's new pond requires three gates, digging out the pond and reinforcement of the walls to be complete. Mr Yahaya is a treasurer to UWASA.

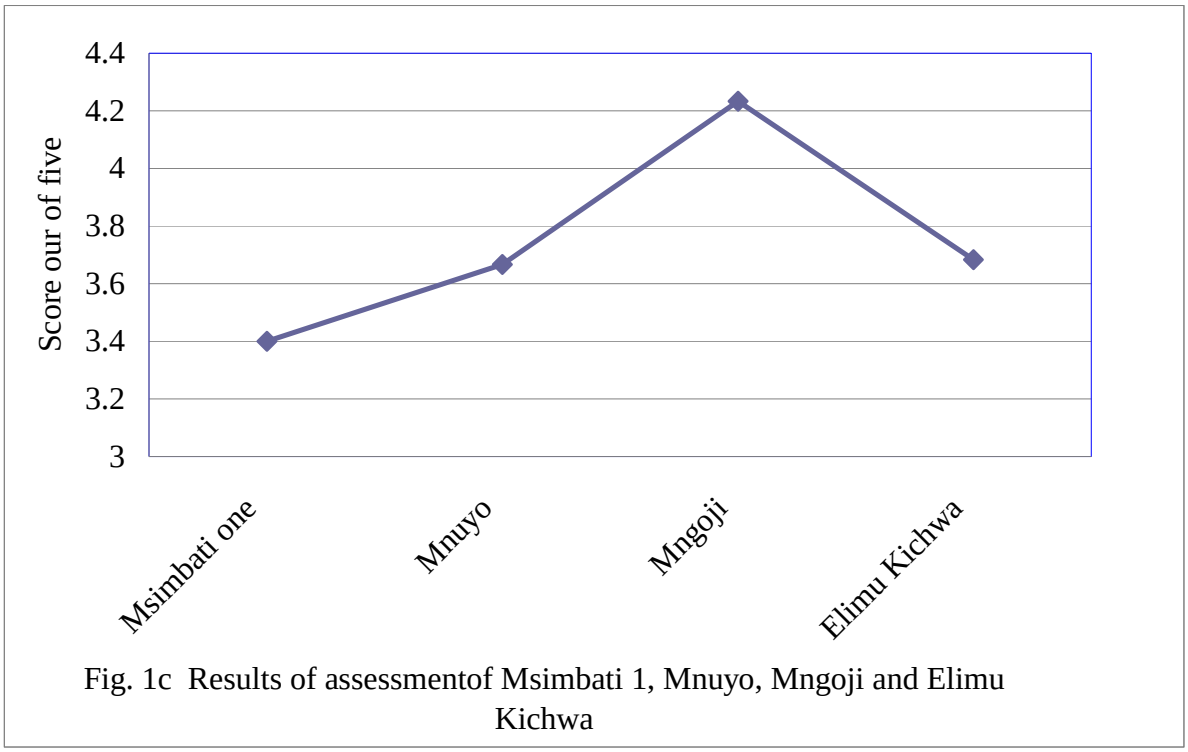


Fig. 1c Results of assessmentof Msimbati 1, Mnuyo, Mngoji and Elimu Kichwa

Mngoji and Elimu Kichwa are both in Mngoji Village the first to establish milkfish ponds inside the marine park. While Mngoji is owned by a group Elimu Kichwa is owned by Mr Mkwamba. The Mngoji pond is new and was ranked the best due to very well constructed dikes. Mr Mkwamba on the other hand owns four ponds, without gates. Mr. Abdalla Mkwamba seems to be one of the few farmers who camp in the field when he feels that the fish can be stolen. The cover picture shows umbrella shaped construction that he climbs in and hide. He is very serious and industrious person. For example taking a 4 days training at IMS on half pearl (MABE) farming, he is now the best pearl farmer in the country with more than 600 pearls to his credit which is several folds more than his colleagues including his trainers have achieved. He is a self appointed extension officer to most of the ponds in Mngoji and Kilambo villages. He is also a self appointed extension officer for the Mkubiru pearl farming group.

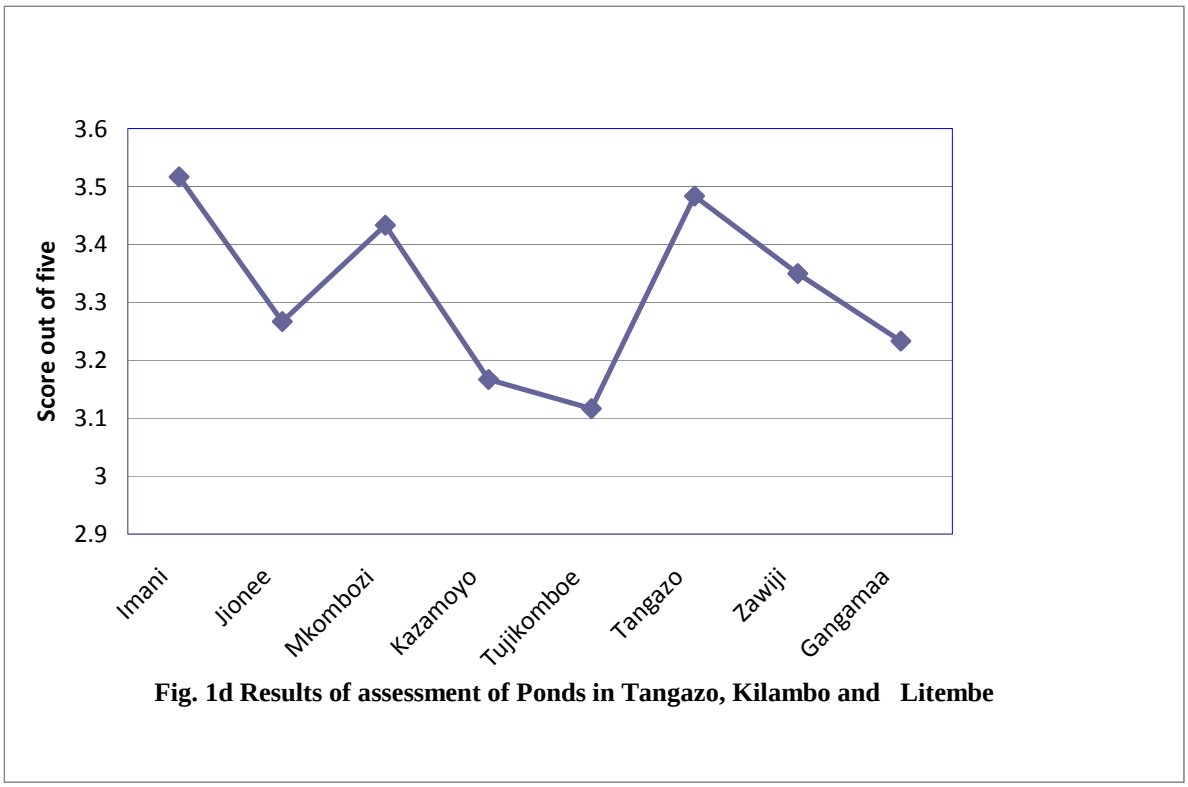


Fig. 1d Results of assessment of Ponds in Tangazo, Kilambo and Litembe

Imani and Tangazo were the leading groups in Tangazo, Kilambo and Litembe Villages. Imani is a newly developed pond and like all newly developed ponds the dikes are well constructed. Mr Mwarabu, the extension officer facilitated by WWF belongs to Tangazo group also known as Jitegemee. Mr Hassan Mwarabu was trained in the 8 days workshop conducted by WWF and the 6 weeks training by the ReCoMaP. Hassan was later facilitated by WWF to support all the ponds in the marine park. His facilitation will probably end in December when the WWF project ends.

The evaluation of all the farms together is shown in figure 2. Mngoji was selected the best of all ponds followed by Mshikamano in Ndumbwe Village and USa in Mbuo with Ushirika and Mwaa tied at the fourth position making the best five.

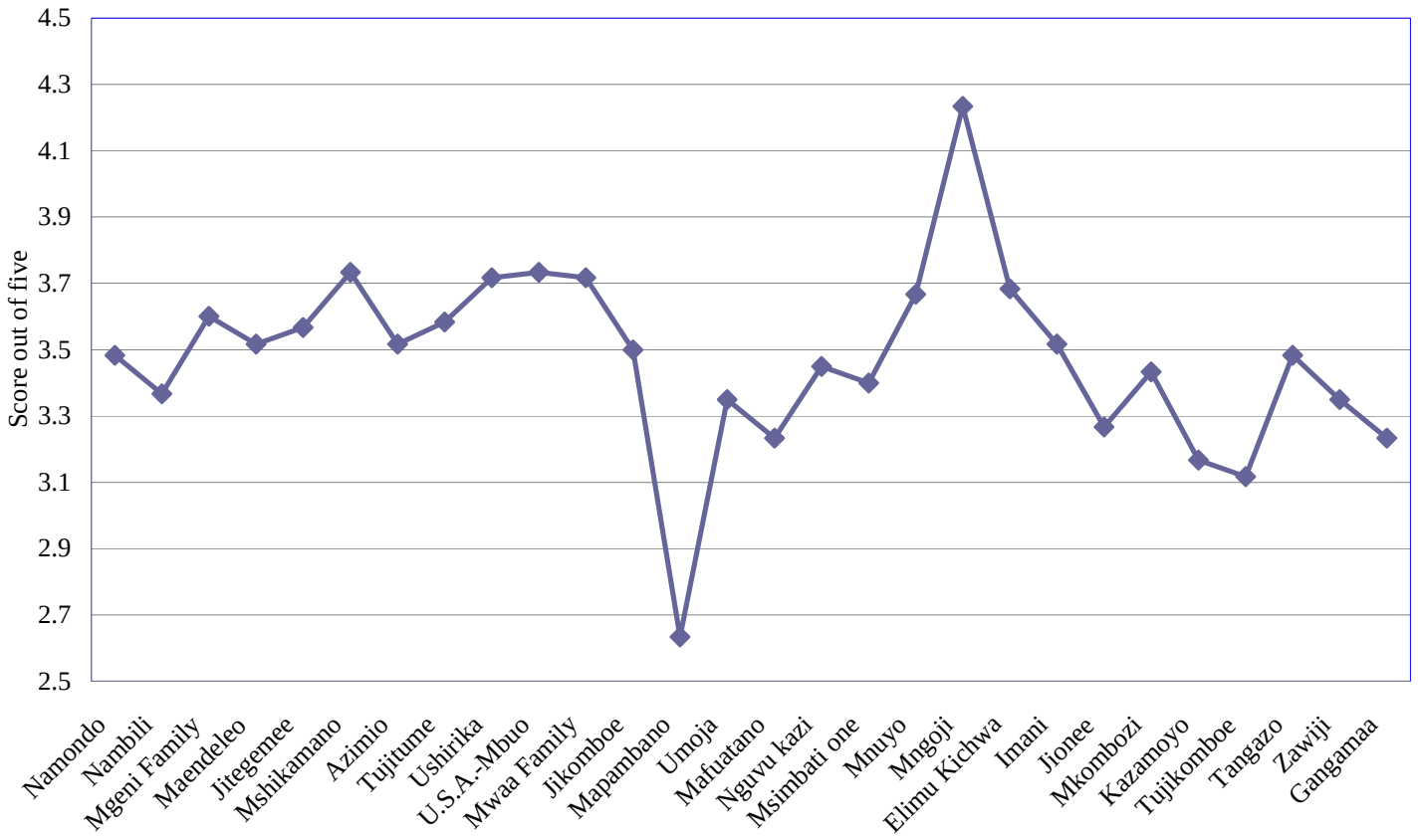


Fig. 2 The score of all the villages visited by team in the whole study

Table 1: Ranking of the farms by productivity 2009-2010

SN	Village	Name of the group	No of members	No of men	No of women	Kg/ha	Total Tsh
1	Ndumbwe	Yahaya	1	1	0	7500	3600000
2	Mbuo	Ushirika	22	12	10	1222.5	2445000
3	Mtwara	Tujitume	6	6	0	1142.86	600000
4	Mngoji	Zinduka B	8	4	4	834.44	375500
5	Mngoji	Elimu kichwa	1	1	0	446.98	352000
6	Msimbati	Mnazi bay	26	13	13	375	99000
7	Mngoji	Zinduka A	20	7	13	253.33	79800
8	Ndumbwe	Azimio	10	10	0	128	240000
9	Msimbati	Mafuatano	25	7	18	114.55	100000
10		Msimbati 1	18	16	2	112	210000
11	Ndumbwe	Namondo	5	5	0	106.67	200000
12	Msimbati	Nguvu Kazi-Msimbati	20	9	11	83.33	50000
13	Mtwara	Umoja	28	13	15	68.52	46000

Other examples of individuals who can be trained and used for extension services

1. Ali Kassim, Namondo, Ndumbwe

Mr Ali Kassim and his group have a 1.5 ha pond which is still under construction and requires a number of gates to be completed. However, Mr Ali after completion of the ReCoMaP training has helped in designing, construction and supervision of a number of ponds from Ndumbwe to Lindi (Table 2) earning him quite a lot of money per unit time.

Table 2. Ali Kassim per day earnings in advising and designing fish pond construction

SN	Farmer group	Pond size	Tsh	US$
1	Makame Family	4000	150000	125.00
2	Mgeni Family	5000	150,000	125.00
3	Shuka village (Lindi)	1800	200000	166.67
4	Mshikamano	2,500	20000	16.67
5	Jitegemee	4800	50,000	41.67
6	Tujitume	2500	10000	8.33
7	**Total**	**20600**	**580000**	**483.33**
	Average	**3433.33**	**96666.67**	**80.56**
	STDev	**1345.61**	**79916.62**	**66.60**

2. Msimbati Mnuyo and Msimbati 1 groups

These are probably the best ponds (Plate 3) in terms of dike construction and pond digging, but however they have not been very productive. The Chairman of the Mnuyo group was later elected the Chairman of the Village probably indicating his leadership abilities. The other person is Mr Mkahiti who is a self appointed extension officer for the two ponds belong to Mnuyo group. The two ponds are an effort of Mr Mkahiti a member of Msimbati 1 group. Mr Mkahiti was trained in 8 days training workshop sponsored by WWF.



Plate 3: Mnuyo farm with SWISSAID Program Officer admiring the dikes

3. Nguvu Kazi, Msimbati

This group own two ponds at Msimbati. The gates were a support from IMS. The largely women group draws inspiration from Ms Asha Abdala Mnengo who has been working very hard on the group coercion. They also belong to the same Village Cooperative Bank group which does bee-keeping. Unfortunately, their ponds have not been very productive.