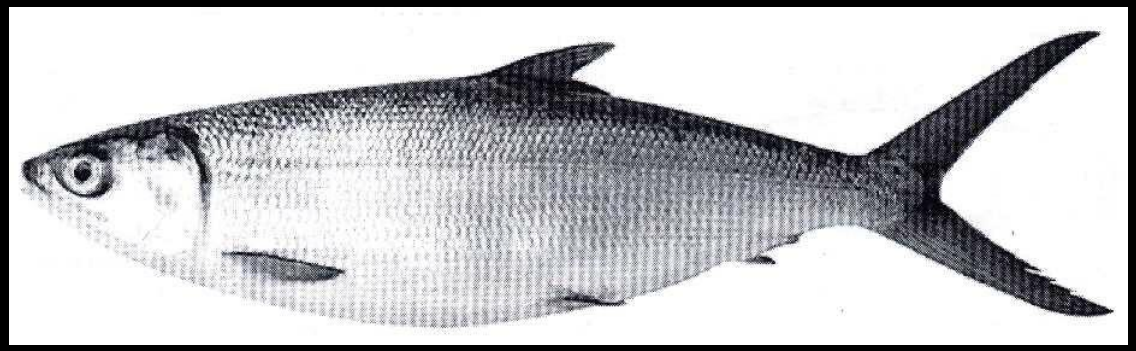
MARINE AQUACULTURE: Alternative Livelihood to Fisheries, Ecosystem Conservation and Adaptation to Climate Change

SACAU Annual Conference, Mahe Seychelles 26th and 27th May, 2015



Aviti John Mmochi

Institute of Marine Sciences, University of Dar es salaam

Outline

1. Marine farming as an adaptation to climate change activities
2. Marine aquaculture development in the world
3. Marine aquaculture developments in Tanzania
    a. Chronological developments
    b. Training in and demonstrations in Mariculture (Project)
    c. Integrated Mariculture Pond System (1996 – 2004)
        i. Finfish farming
        ii. Shellfish and Pearl Farming
        iii. Seaweed farming and value addition
        iv. Emerging mariculture practices
4. Challenges
5. Gaps
6. Way forward

The status of World aquaculture

1. Aquaculture is a fast-growing animal protein supplying industry growing at 8.8% and showing a 12-fold increase over the past three decades (FAO, 2012) producing 90 million t (Mt) in 2012
2. Capture fisheries has levelled at while capture fisheries levelled off at 80 million tons since 1990s
3. Marine aquaculture contribute about 50% BUT this is mostly because of the lower priced aquatic plants which form 44% of the mariculture by volume

Farmed aquatic animal families with a number species and culture environment

	Culture Environment			No of species	
	Fresh	Brackish	Marine	World	Africa
Finfish	115	70	73	142	67
Crustaceans	12	31	29	39	13
Molluscs	1	23	70	72	17

The status of World aquaculture

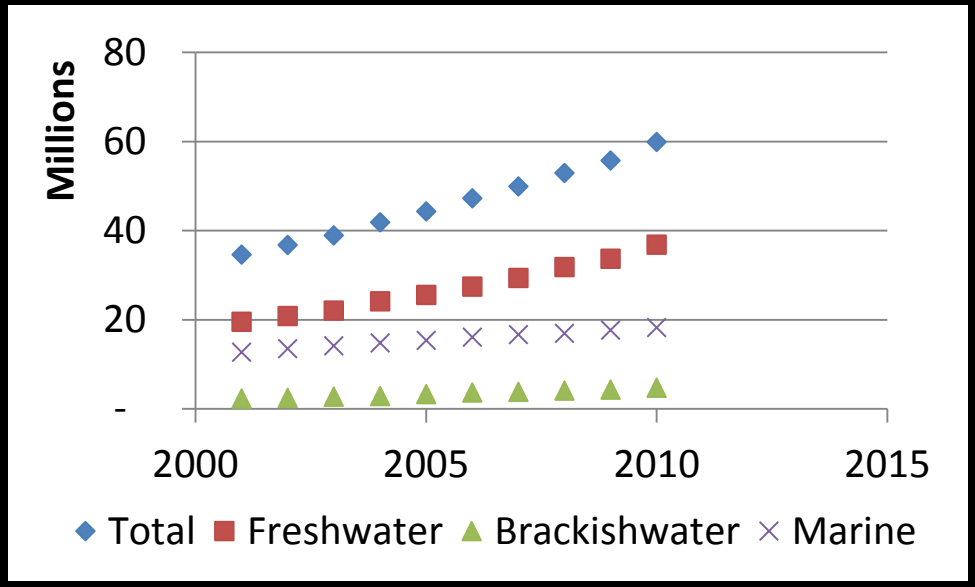


Fig.1. Animal Production by Groups of Organisms and Environments

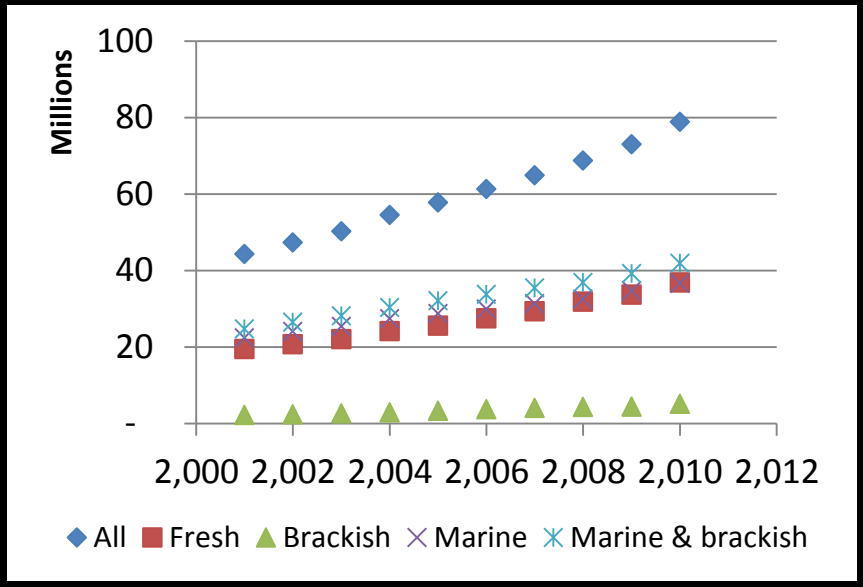
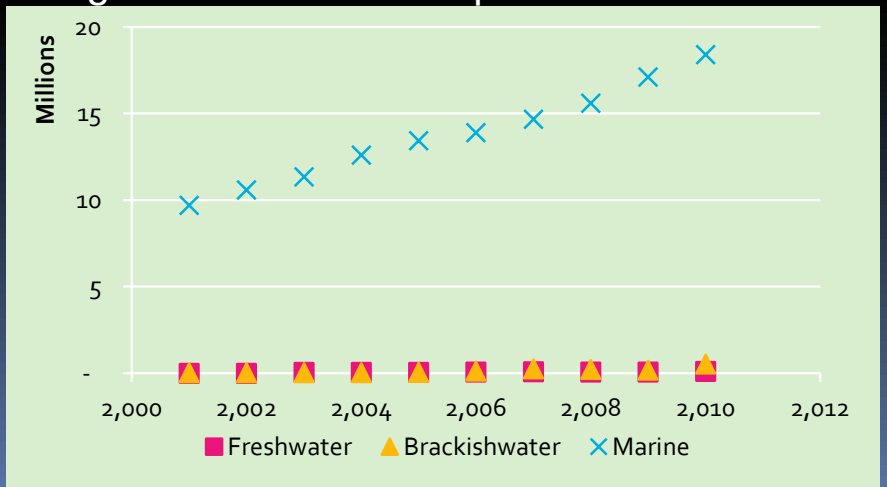
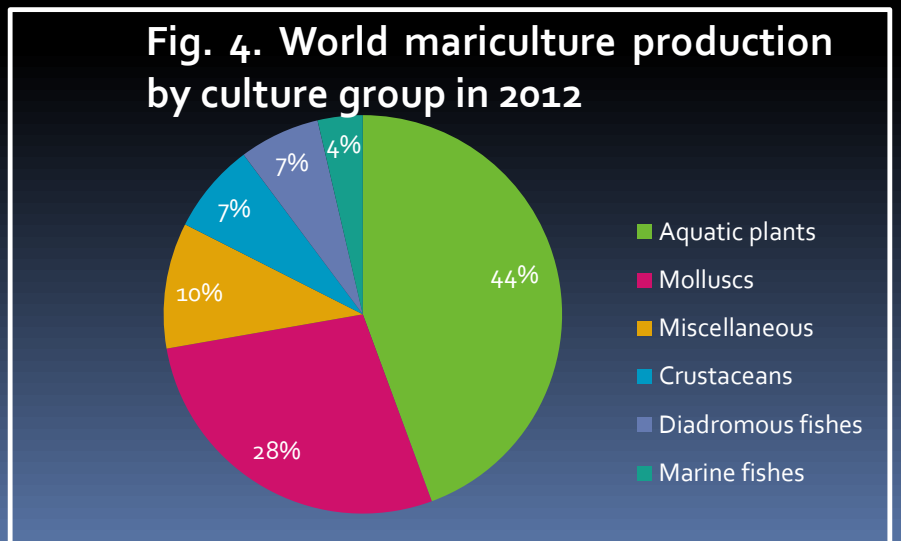


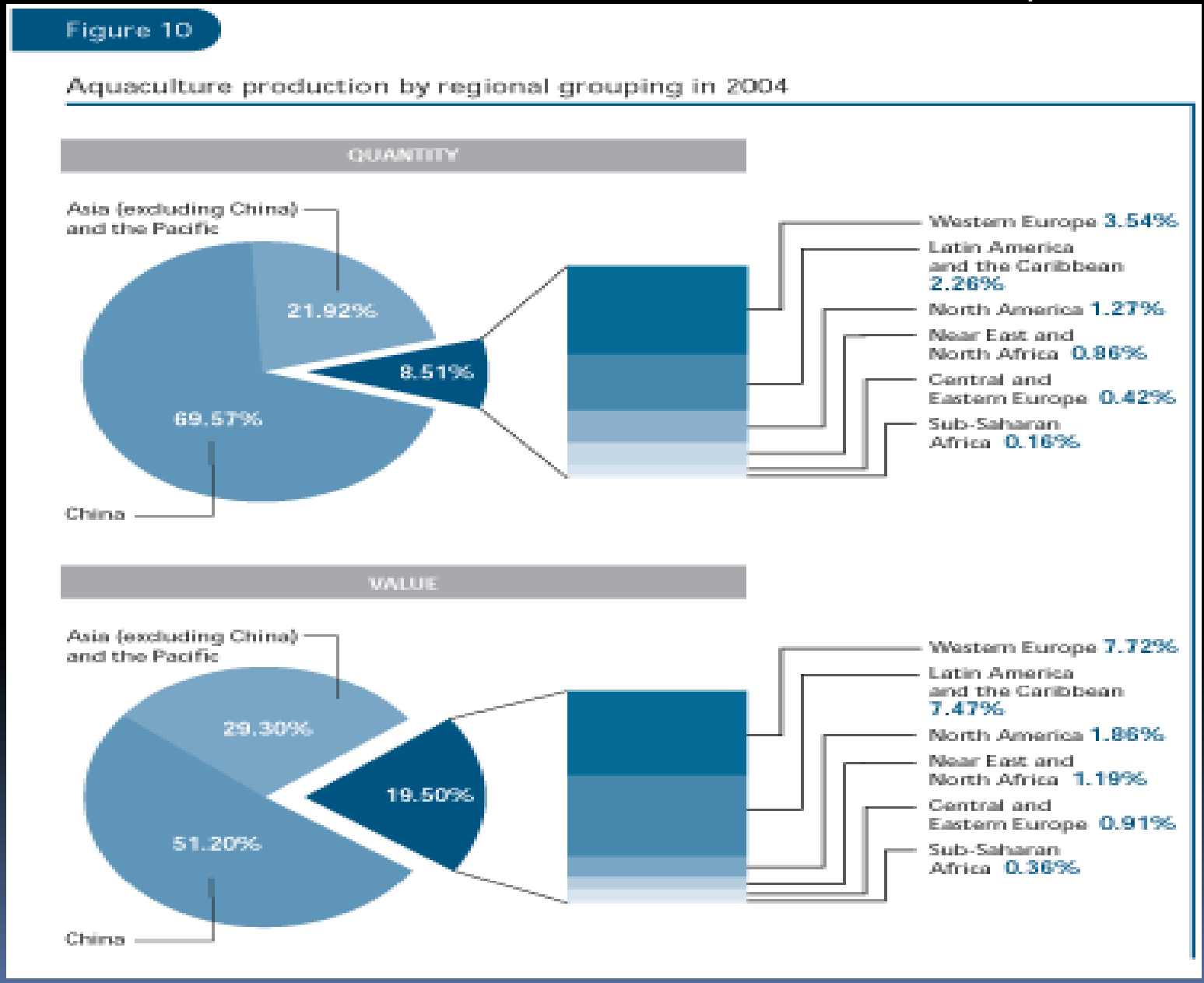
Fig. 2. Total Production of Farmed Aquatic Organisms

Fig. 3 Production of Aquatic Plants





Extracted from The State of World Fisheries and Aquaculture



Farming in seawater have the following advantages over freshwater

1. The availability, quality, amount of seawater is relatively more predictable and reliable than the changes that take place in freshwaters in the extremes of **El-Nino** and **La-Nina** and hence a form of adaptation to **CLIMATE CHANGE.**
2. There are more destructive animals some seeking to drink water and destroying the dikes but even more predators e.g. otters, different animals in the cat family, reptiles etc. most of which do not venture into seawater
3. There is more competition for freshwater through public water supplies, irrigation, livestock keeping etc.
4. There is more seawater (97.2% covering 2/3 of the earth surface) than freshwater.
5. Most of the freshwater and nearshore seawaters are prone to pollution

Mariculture Development Activities in Tanzania

1980s	• **Seaweed culture experiments** • **Research on cage culture of rabbit fish (Siganus)**
1990s	• Commercial seaweed farming by private sector starts in Zanzibar • Seaweed farming introduced to Tanga and Bagamoyo (1992-1994) and to Mtwara, Lindi, Mafia and Kilwa (1995 - 1996) • Integrated mariculture and biofiltration experiments at Makoba
2000-2005	• Mariculture project on milkfish farming • Workshop on "Advances in mariculture" Zanzibar in 2004 • Crab fattening experiments • Shellfish farming piloted • Pilot studies of small-scale / commercial finfish culture in ponds
2006-2014	• Shellfish, pearl farming and entrepreneurship develops • Initiatives to add value to seaweed industry • Sea-cucumber farming experiments in Pemba • Production of prawn post larvae in 2009 • Sponge farming experiments in Zanzibar • Experiments with marine tilapia farming in Zanzibar • Tilapia acclimatization for mariculture

CHRONOLOGY OF PROJECTS BY IMS FOR MARICULTURE IN TANZANIA

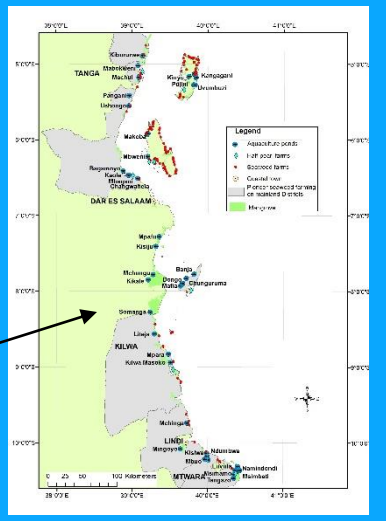
S/N	Title of the project/program	Amount in USD	Duration	Funding agent
1	Integrated mariculture pond system (IMPS)	20,000	1996-1998	GIFRID
2		50,000	1998-2001	WHOI
3		150,000	2001-2005	MASMA
4	Sustainable Coastal Communities and Ecosystems (SUCCESS)	450,000	2004-2009	USAID WIOMSA
5	Training and outreach in mariculture		1990 - Date	Sida
6	Sustainable Milkfish Farming, in Coastal Communities	150,000	2008-2010	ReCoMaP-EU/WIOMSA
7	Development of low cost energy to provide electricity to mariculture	150,000	2009-2011	ReCoMaP-EU/ WIOMSA
8	Mariculture in Mtwara by (UWASA)	230,625	2011-Date	SWISSAID
9	Pan-African Competitiveness Forum-Cluster Initiatives		2012-Date	Sida
10	Capacity Building through Establishment and Strengthening of Aquatic Medicine and Food Safety	155,000	2013 - Date	NORAD
12	Building Stronger Universities Though Integrated Agriculture and Aquaculture		2012 - Date	Danish Min of Foreign Affairs

Aquaculture Based livelihood activities in Zanzibar

Muungoni, Unguja 2001

Kiuyu, Pemba 4 tons/ha, 2008

Finfish mariculture sties



Pearls of Bweleo, Zanzibar since 2005

Eucheuma denticulatum seaweed farm

Makoba Bay Zanzibar, Integrated mariculture pond system (IMPS)

USAID FROM THE AMERICAN PEOPLE

RECOMAP INDIAN OCEAN

Sida

WIOMSA

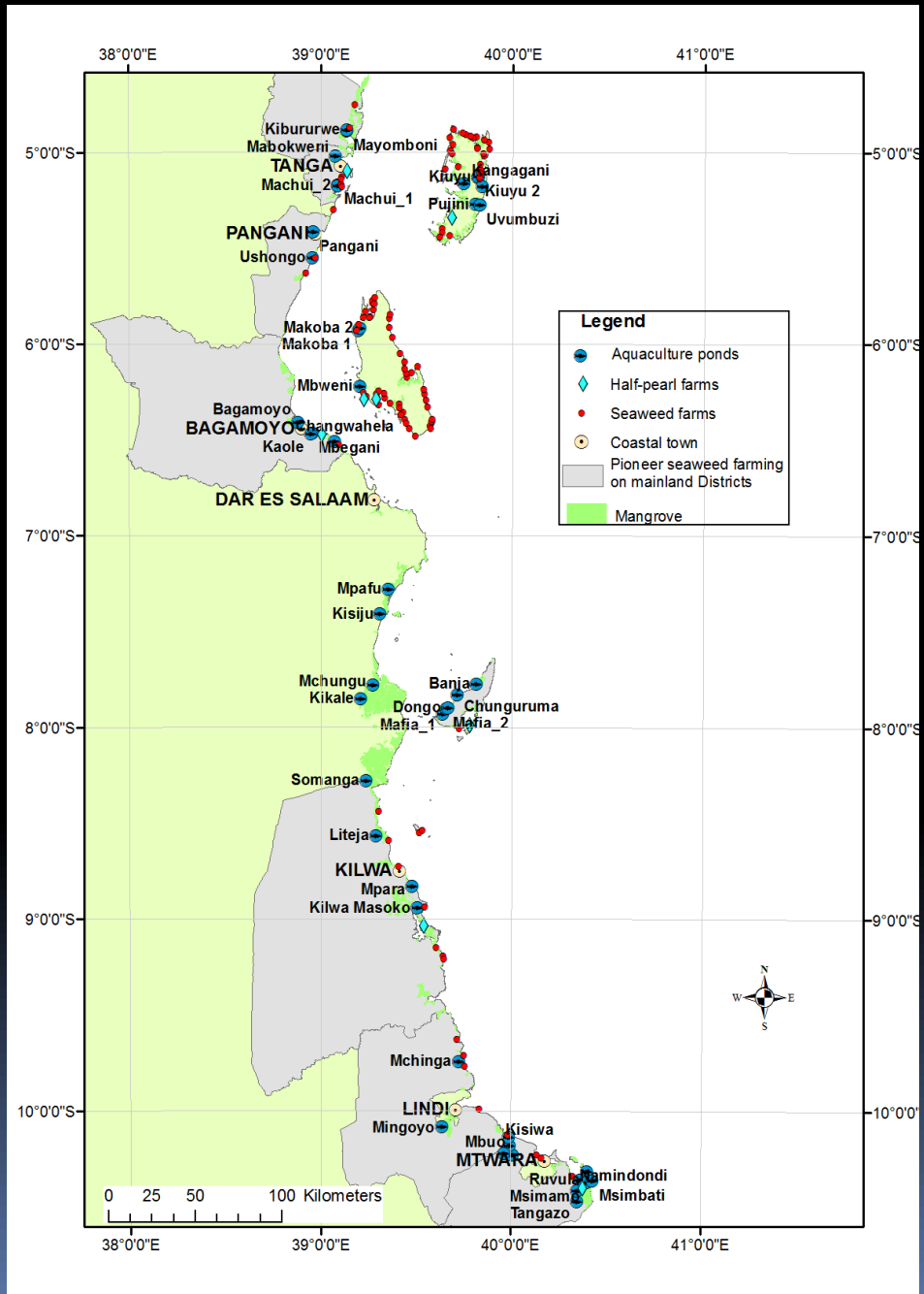
Integrated Mariculture Pond System

- The set up
  - Three pond flow through system with finfish, shellfish and seaweed.
  - It was a field school for IMS
  - The finfish were milkfish (*Chanos chanos*), Rabbit fish (*Siganus sutor* and *S. canaliculatus*) mullet (*mugil cephalus*) and Zanzibar tilapia *Oreochromis urolepis hornorum*)

  - Shell fish (*Pinctada margaretifira*, *Anadara antiquata* and *Isognomon isognomon*
  - Seaweed *Ulva reticulata* and *Glacilaria crassa*). 2 PhDs, 1 MSc, 1 Mphil 9 papers
  - The end of the project stakeholders workshop to disseminate the results. Fish farmers and fisheries officers

THE LEARNING BY DOING

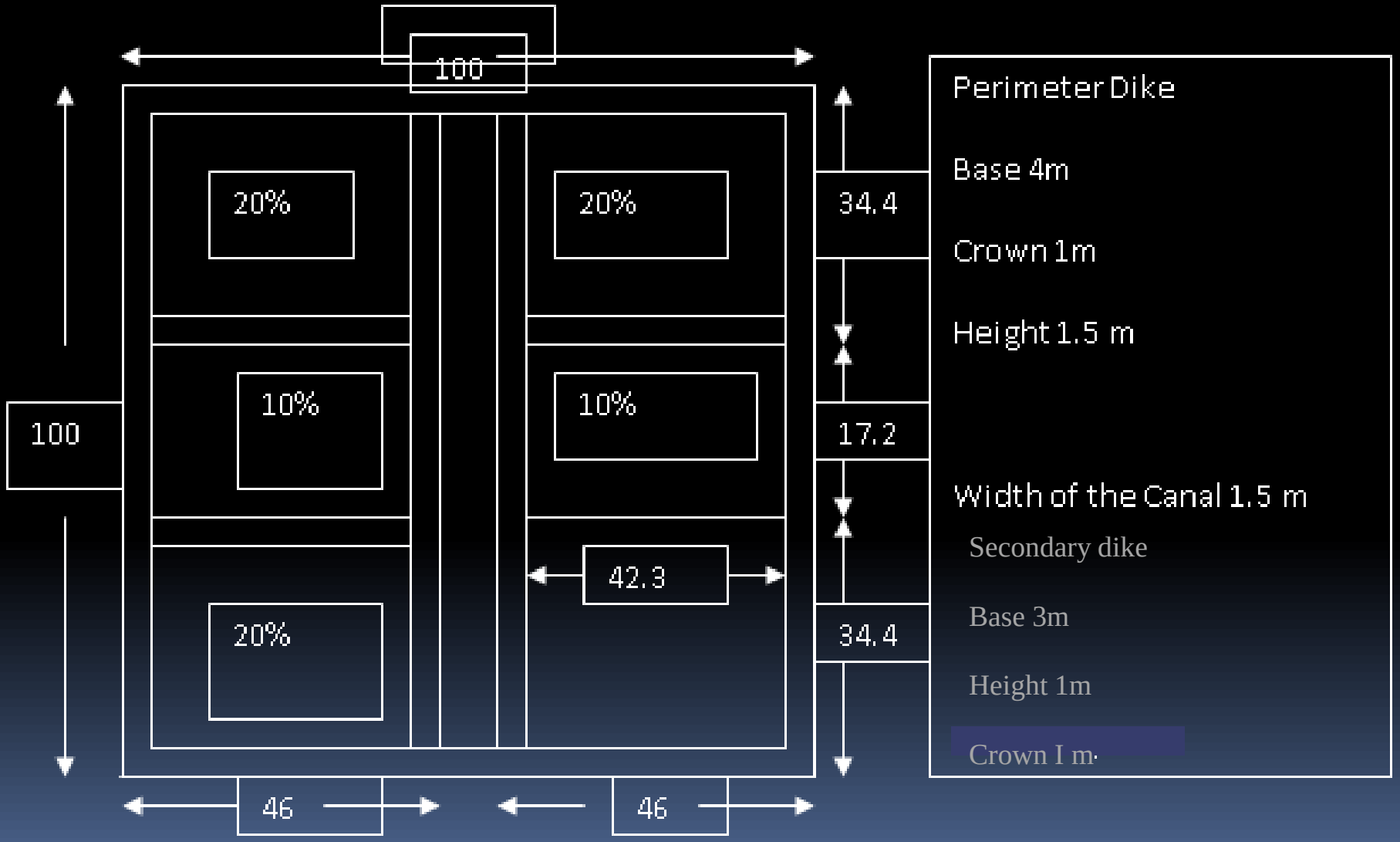
Aquaculture activities 2004 Date



FINFISH MARICULTURE

This Milkfish pond officially Launched by Hon. Jakaya Mrisho Kikwete, President of the United Republic of Tanzania in 2009 was aided by IMS Project

The model 1 ha ponds



Finfish Milkfish and tilapia Feed

Feed used for Milkfish

Feed for Tilapia fingerlings

Tilapia in concrete ponds

Grow out fish feed

Feed ingredient	% Ingredient	% cost
Oil cake	17.5	2
Protein	28.5	48.9
Carbohydrate	34	16.6
Ulva	15.2	28.9
Cassava flour	4.8	3.6
Total	100	100

Fish feed and fish drier

Achievements

- A total of 75 farmers/extension officers in finfish farming trained in Mtwara, Pemba and Tanga
- **Production at an average of 1.8 ton/ha**
- 1. Acreage change from 2 ha in 1996 to 100 in 2008 and 143 in 2013 for finfish farming
- 2. A total of 355 farmers (162 = 46% women
- 3. A total of 81 ponds making a total of 30 ponds
- in the project

Statistics of milkfish farming during the project

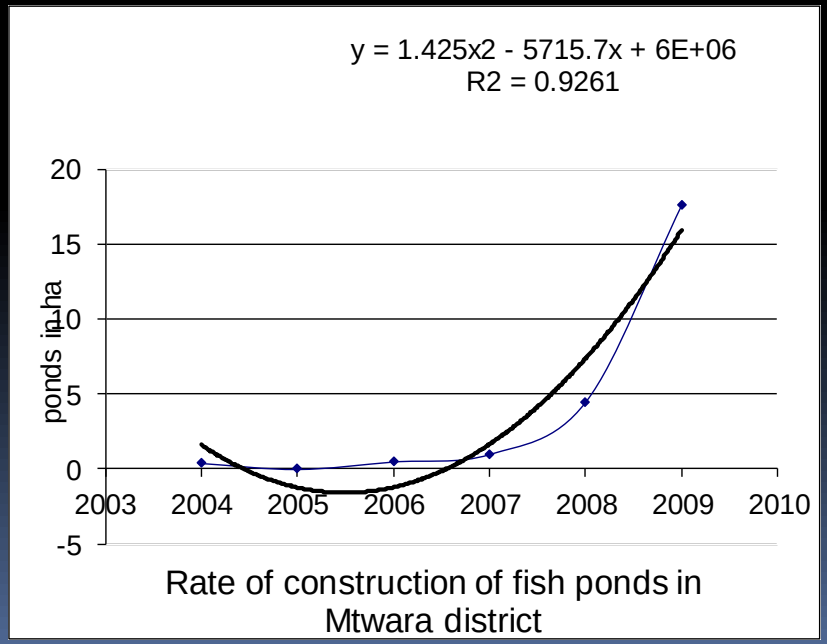
	No. of Members	No. of Women	Stocking density	Survival	Price/kg USD	Kg/ha	Total USD	USD/ha
Total	276	123					20666.87	
Average			1.41	0.42	1.28	1895.30	794.88	1492.74
Median			1.05	0.39	1.33	585.22	197.33	634.62
StDev			1.02	0.30	0.43	3398.20	1265.35	2337.69
Max			3.67	1.00	1.67	7500.00	4506.67	10000.00

More achievements

Fish farm plaque at Ndumbwe village, Mtwara

Wind turbine at Mbuo, Mtwara

Launching of a demonstration pond at Mbuo, Mtwara



ReCoMaP to UWASA

- Following advise from ReCoMaP two NGOs for finfish farming were registered in the period namely:

1. Pemba Organisation for Sea Inhabitants and Mangrove Conservation (POSIMCO) - 2010
2. Umoja wa Wafugaji Samaki Mtwara – UWASA (Mtwara Fish Farmers Association) – 2011

- UWASA wrote a proposal and secured a 7 year support from SWISSAID, an NGO from Switzerland at 70,000 to 150,000 USD per year applied for annually

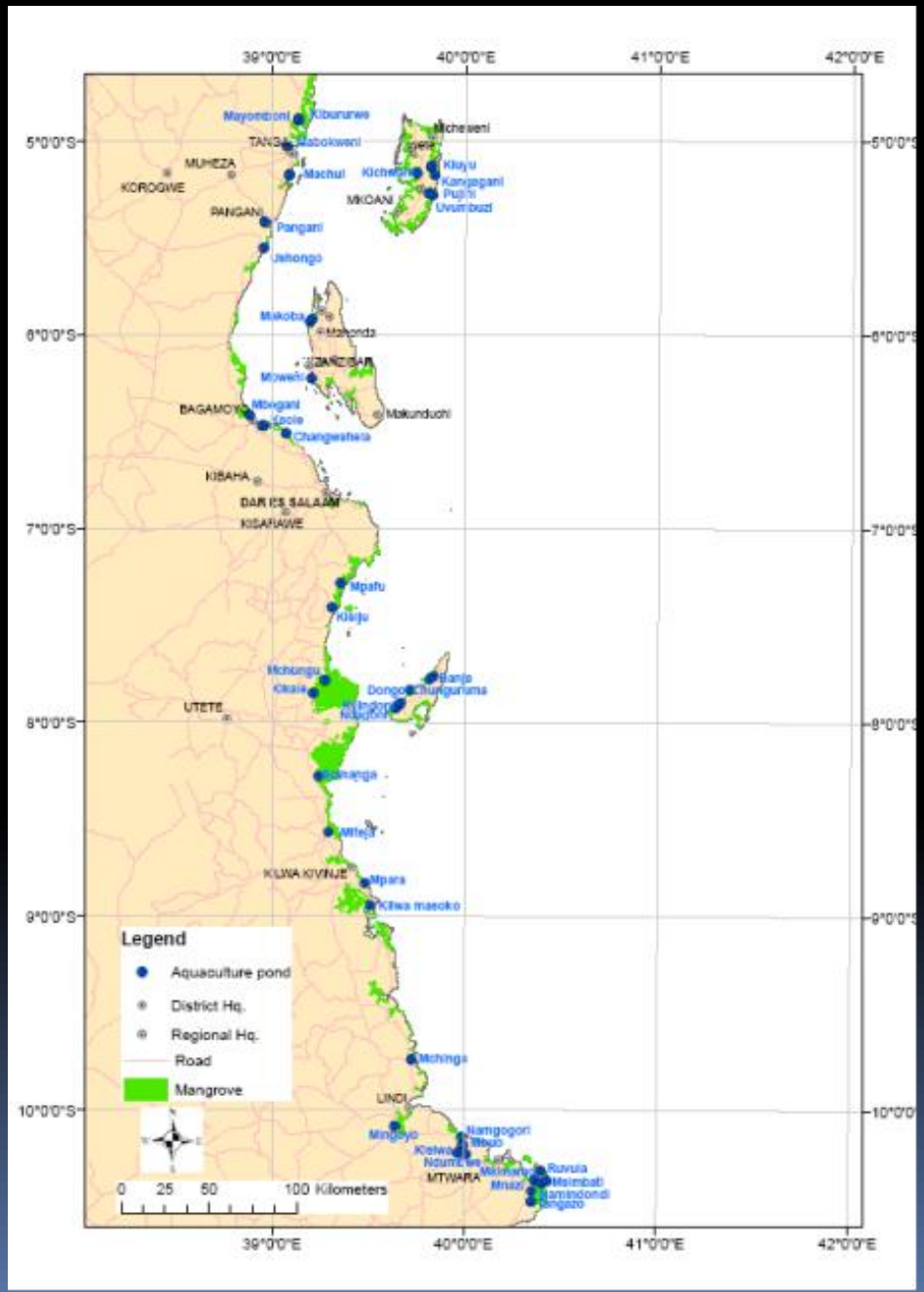
Three Swahili fish farming manuals have been produced one each on milkfish farming, Tilapia farming and protocols and tables for recording finfish farming activities

SWISSAID
Inspiring courage.

Results of a project fish farming on Pemba

Farmer groups	Pond size ($m^{2)}$	No. of fish/m^2	Harvested weight (kg)	Harvested Weight (kg/Ha)	Total Revenue (US$)	Revenue/Ha (US$)
	6150	0.81	417	677	555	903
	6150	1.63	500	813	667	1084
Mkulima	8000	0.63	500	625	667	833
Kichakaa si Shangi	10000	2.75	2800	2800	3724	3724
Total	40300		8724		11607.31	
Average	8060	1.46	1744.8	1884	2175	2361
Minimum	6150	0.63	417	625	555	833
Maximum	10000	2.75	4507	4507	5994.31	5994

Status of Community Based Finfish/prawn ponds in Tanzania



Pemba (Milkfish and Marine Tilapia)

- Kiuyu (3), Kangagani, Pujini (3), Kichuwani, Nangugi, Makoongwe, Masota, Kinyasini, Kwale and Kiwani
- 141 farmers, 66 women with a total of 55 ponds making 11 ha

Tanga (Milkfish and Prawns)

- Ndaoya, Hemed, Kigomeni, Kwa Waarabu, Bweni, Kivindani and Machui (3)
- A total 9 Ponds

Coast Region (Milkfish and tilapia)

- Kaole, Changwahela (2), Magereza, Mpafu (7), Kisiju, Kikale and Mchungu

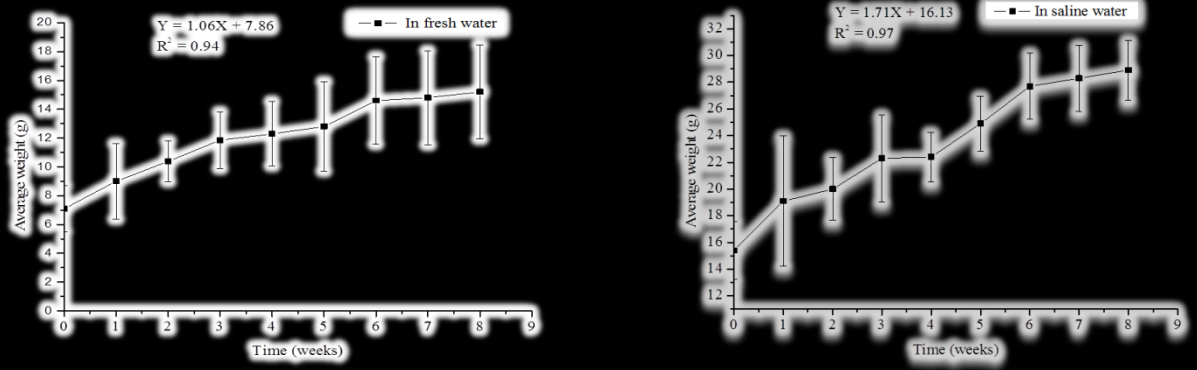
Mtwara and Lindi

- Kisiwa, Nguvu Kazi, Umoja, Mnazi bay, Msimbati, Mafuatano, Namondo, Azimio, Tujitume, Zinduka B, Ushirika, Yahya, Zinduka and Elimu Kichwa.
- 214 farmers 96 women 16 ponds11. 5 ha

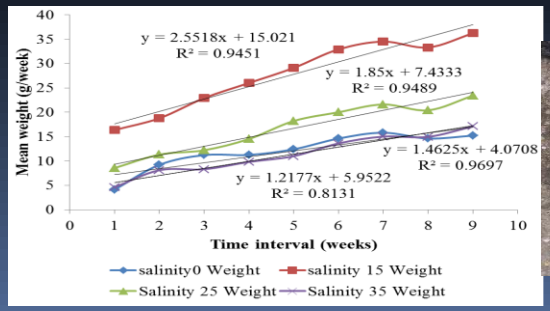
UWASA ponds (Mtwara)

Marien tilapia farming experiments

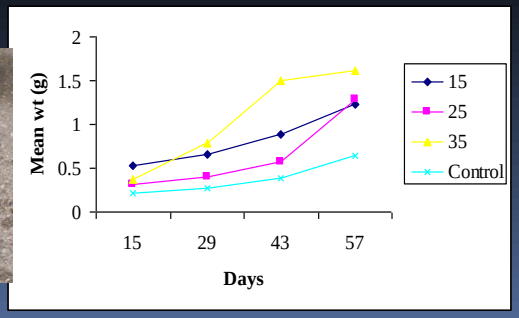
1. 3 species of tilapia (*Tilapia zillii, Oreochromis urolepis urolepis, O. urolepis hornorum, O. pangani*) have shown higher growth rates in estuarine and marine waters than in freshwater including hatching in the waters



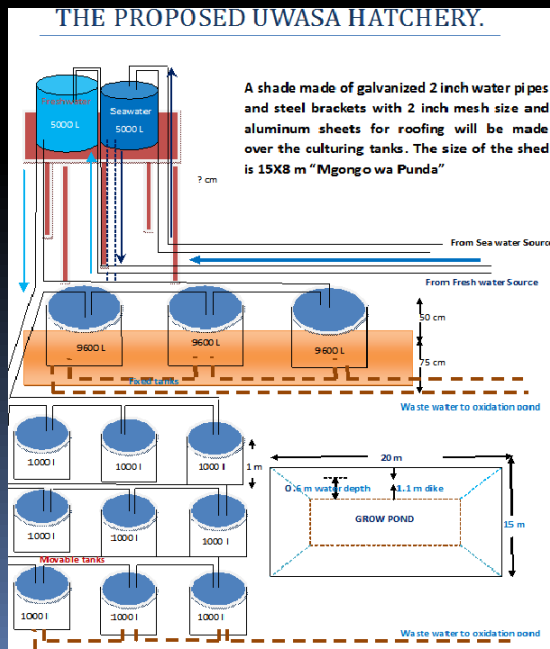
Growth rates of *Tilapia zilii* in freshwater and sea water



Growth rate of Pangani tilapia



Growth rate of Rufiji Tilapia



Integrated Agriculture Aquaculture (BSU)

1. Fertilization of ponds for aquaculture is a common practice in aquaculture in Tanzania.
2. The fertilization can be carried out by carrying organic fertilizers to the farms or making animal sheds close to the pond for continuous fertilization
3. The nutrient rich water can be used to irrigate and fertilize high value plants ensuring livelihoods from animal husbandry, aquaculture and plant husbandry in one.

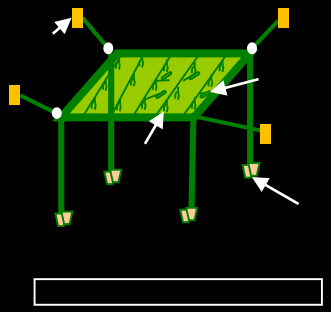
Integrated aquaculture, with ducks and passion

Integrated aquaculture with banana

Seaweed Farming

- Two phyla namely *Euchema E. denticulatum and striatum)* with lower price compared to Kapaphyicus (*K. alvarezii)*
- Traditionally seaweed is farmed in a peg and line system at the intertidal with high dynamics of temperature and salinity
- Mortalities especially for *K. alvarezii* necessitated development of deeper water floating line system
- While technology is ready and being experimented on Pemba the few women want to work in the deeper waters

Shallow water farm



But the price is on the low side. May be we can use it locally, www.secitz.com

Seaweed Salad

Seaweed powder

1 kg of dry seaweed is sold at USD 0.3 (400 Tsh.);
1kg of seaweed powder is sold at USD 6.2 (10,000 Tsh.)

Seaweed Jam

Seaweed Cake

Seaweed Pudding

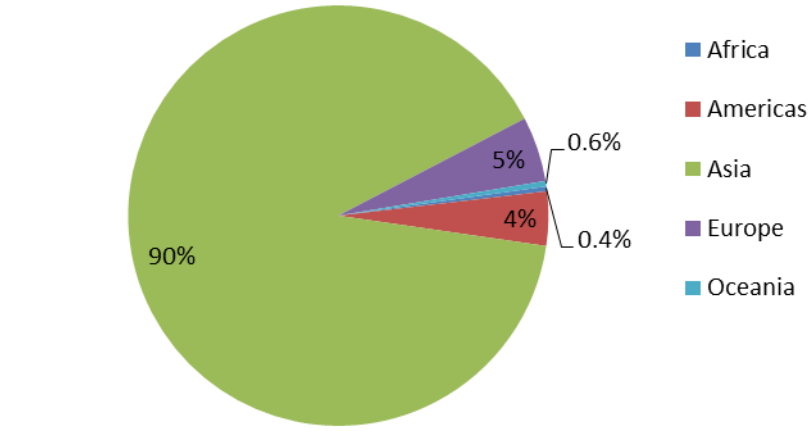
Seaweed Juice

Seaweed Body Cream

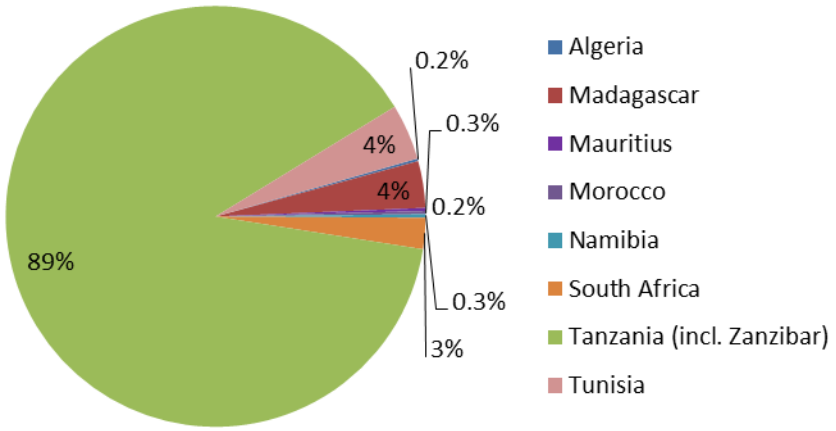
Seaweed Scrub

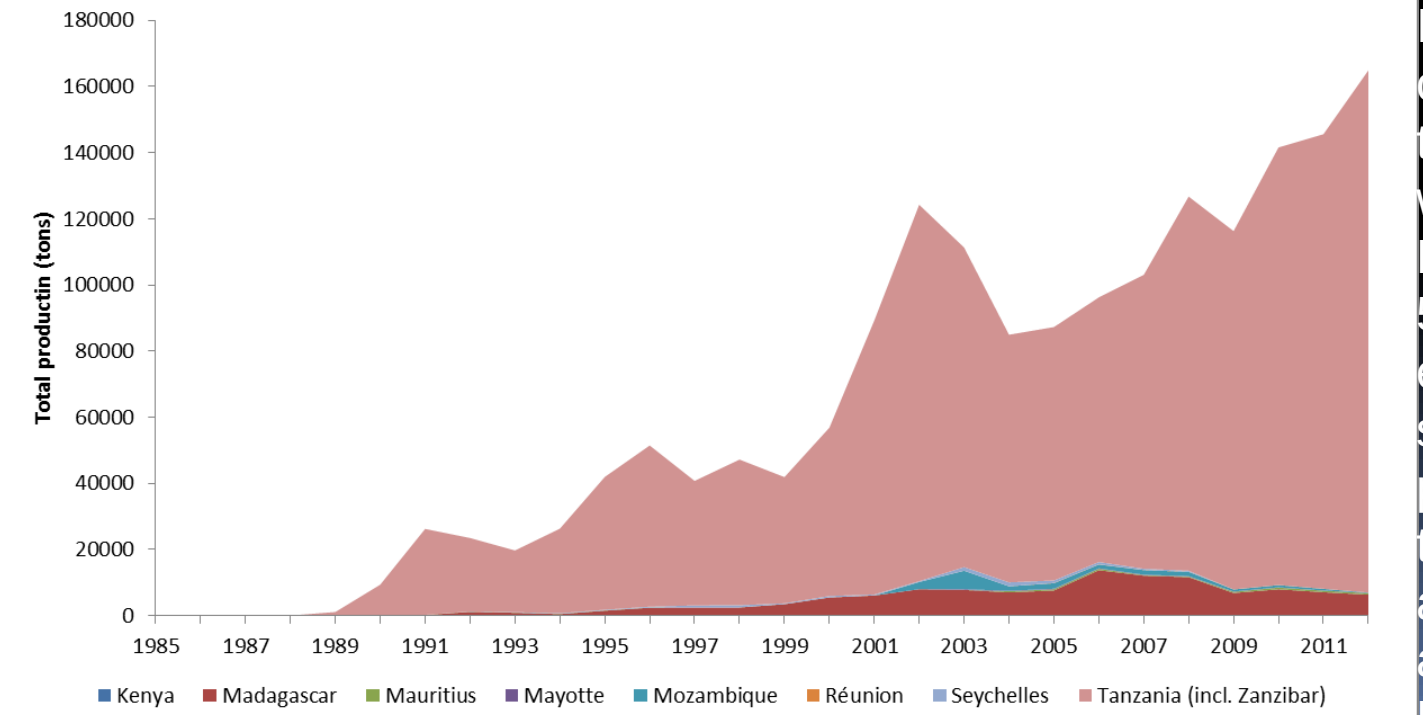
Photo: Dr. Flower Msuya, Institute of Marine Sciences

Mariculture production by continent in 2012



Mariculture production by the 8 leading African countries in 2012





In 2012, a wet weight of 160 thousand tonnes of seaweed was reported to the FAO, ranking Tanzania 5th and 9th largest exporter of red seaweeds and aquatic plants respectively in the world and the 3rd aquaculture producer after Egypt and Nigeria in 2008

PEARL FARMING

Pearl farming and shell polishing

- Activities started in 2004 with collecting of spats from the wild
- Followed by spat collection from the wild, establishment of no take zones and establishment of hatchery technology
- Already farmed in Mtwara,Kilwa, Mafia, Zanzibar, Bagamoyo and Tanga
- Markets are difficult to access

Shellfish and pearl farming, shell ornaments and entrepreneurship

Shellfish farming enclosures

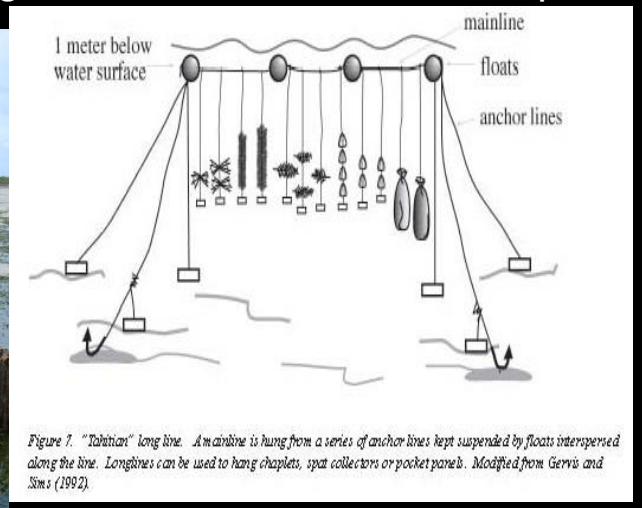


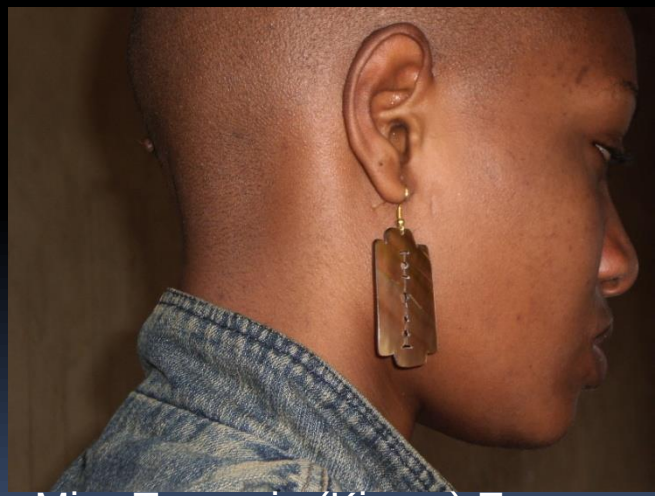
Figure 7. "Tahitian" long line. A mainline is hung from a series of anchor lines kept suspended by floats interspersed along the line. Longlines can be used to hang chaplets, spat collectors or pocket panels. Modified from Gervis and Sims (1992).

Long lines pearl farming

Our first pearls

Training on shell polishing

Kisura and Ally Remtula at Bweleo



Miss Tanzania (Kisura) Emmy Melau modeling with our shells ornaments

Wind turbines at Mbuo, Mtwara and Fumba, Zanibar

Success stories

- Villagers especially women highly motivated selling polished products in tourist markets in Zanzibar and Kilwa
- Exhibitions in trade fairs including DITF, Nanenane, Jua kali (Nairobi, Kigali and Arusha)

A group of locals visited US for 1 month to learn to exchange and to sell

The biggest problem is the market especially for pearls

Bivalve farming

Acknowledgements

Community members of Fumba Peninsula, Fisheries Department, Doe, IMS MSc students, MENAI BAY, Local Govt, Village heads, Regional and district commissioners, Village councillor, Sida-sarec TCMP, And all those not mentioned, To all thank you

SHELLFISH FARMING, HALF PEARL FARMING, AND MAKING SHELL AND PEARL ORNAMENTS

Uanzishaji wa maeneo tengefu Fumba

National and International Expositions

- Our trainees have participated in:
  - Dar es Salaam International Trade fair
  - Jua Kali in Nairobi, Kigali and Arusha
  - The annual ZIFF activities in Zanzibar
  - 10 villagers visited USA for six weeks to study related activities .
  - 20 villagers 3 on pearl and shells polishing, 2 on fisheries, 2 on seaweed, 1 on crab and 12 on finfish farming from Zanzibar visited China for one month on mariculture activities
  - 2 farmers won money and training in the Believe Begin Become (5000 USD) University of Dar es Salaam Entrepreneurship Centre (4000 USD)
  - At least 2 jewellery shops have been developed in stone town from the jewelry activities
  - Three offices cum shops were developed in the villages of Fumba (2) and Bweleo (1) for the marketing of pearls

Aggressive farmers

- People are now:
  - Doing crab fattening in single crab cages
  - Doing sponge farming in floating rafts
  - Doing turtle recapture and return to sea
  - Developing tilapia hatcheries and supplying fingerlings
  - Trying lobster ranching under cages
  - Trying octopus and cuttle fish farming
  - Trying prawn farming mixed with milkfish
  - Trying tilapia polyculture with milkfish
  - Trying mullet polyculture with milkfish
  - Trying Sea cucumber ranching

Challenges/Opportunities

- Discontinuity of the programs based on short term financing
- Lack of extension personnel forcing the scientists to turn to outreach
- Poor cooperation among institutions on this highly multi-disciplinary venture
- Lack of motive or inducement among scientists based on the structure of promotion
- Lack of coerced technological park /centre and product incubation programs where business/communities, governance/policies and academia can meet and work together on common goals
- Value addition, packaging and marketing

Asanteni Sana

I would like to take this opportunity to thank the Southern African Confederation of Agricultural Unions for inviting me and financing the trip, the organisers for a well coordinated travel and conference and all of you for listening

Thank you Very Much