



Natural resource dependence, livelihoods and development

Mariculture exchange between Kenya and Tanzania

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IUCN Eastern and Southern Africa Regional Office 2008



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This publication has been made possible through funding from KNCF.



Published by: IUCN Eastern and Southern Africa Regional Office 2008

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Citation: Mirera D.H.O and Samoily M.A. 2008. Natural resource dependence, livelihoods and development: Mariculture exchange between Kenya and Tanzania. IUCN ESARO 2008.

Photographs: © Mirera D.H.O and Samoily M.A.

Available from: IUCN Eastern and Southern Africa Regional Office (ESARO)
PO Box 68200, 00200 Nairobi, Kenya
www.iucn.org/esaro
www.cordioea.org

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Acknowledgements

We are grateful to all the institutions that helped to make this exchange visit a success through on the ground organisation: Kwetu Training Centre, Institute of Marine Science of the University of Dar es salaam, ACDI/VOCA-SEMMA project and KIBODO Trust. We appreciate the welcome we received from all the groups that we visited in Kenya and Tanzania during the study tour. We extend our sincere thanks to Dr. Nigel Preston, Dr. Aviti Mmochi, Dr. Betty Nyonje, Dr. Msuya, Mr. Juzar, Mr. Lugazo who helped to organise field visits and provided technical support to the exchange visit participants. We are also grateful to all the community representatives who participated in this learning and experience sharing process.

This study was funded through the IUCN Eastern and Southern Africa Regional Programme project “Building capacity and strengthening policies for coastal communities to manage their marine resources in East Africa”, supported by Keidanren Nature Conservation Foundation (KNCF). Nigel Preston of CSIRO, Australia, funded his own participation in the visit, and Kibodo Trust funded one participant from Kiunga, for which we are very grateful.

Acronyms and Abbreviations

BMU	Beach Management Unit
CORDIO	Coastal Oceans Research and Development in the Indian Ocean
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
GIS	Geographic Information System
IMS	Institute of Marine Sciences of the University of Dar es salaam (Tanzania)
IUCN	International Union for the Conservation of Nature
KES	Kenya Shillings (currency)
KIBODO	Kiunga, Boni Dodori Trust (Kenya)
KMFRI	Kenya Marine and Fisheries Research Institute
SEMMA	Sustainable Environmental Management through Mariculture enterprise
TSH	Tanzania Shillings (currency)
USAID	United States Agency for International Development
USD	United States Dollar (currency)
WAKAPA	Wafugaji wa Kaa Pangani (Tanzania)
WIOMSA	Western Indian Ocean Marine Science Association

Executive Summary

Aquaculture entails rearing aquatic organisms such as finfish, shellfish (crustaceans, molluscs) and seaweeds in a process whereby at least one phase of growth is under the control of human beings. Mariculture is aquaculture conducted in seawater, usually along coasts.

Mariculture holds a great promise in East Africa as a means to furthering economic development, contributing to poverty alleviation and increasing food security. However, poor technical understanding, absence of supportive policy frameworks and weaknesses in intersectoral coordination continues to hinder its development. Indeed, several mariculture initiatives in Kenya and Tanzania Kenya during the last two decades have shown only limited success, in spite of promising mariculture research findings and the availability of sound models for mariculture development from other parts of the world. It should be noted, though, that Tanzania has made progress towards profitability in culturing seaweed, and is now a significant producer. Pearl farming is also developing and appears to hold some promise.

Drawing up national mariculture development plans that are integrated in both poverty alleviation and natural resource management strategies is needed, and must be complemented by development of targeted mariculture guidelines that promote environmental sustainability as well as economic viability. This could help resolve the most fundamental issues that now constrain sustainable mariculture development in East Africa.

This study aimed at fostering discussion between community members, managers, and mariculture experts by exposing them to ongoing mariculture initiatives in Kenya and Tanzania, in order to identify and characterise the various technical, economic and governance constraints and potential associated with mariculture development in East Africa. This was done through a mariculture exchange visit, carried out over one week in May 2008 and involving five community members and 5 resource persons from both government and NGOs.

The mariculture exposure/learning process included visits to mariculture sites around Mtwapa in Kenya and on Zanzibar and in Tanga Region, Tanzania. Two half-day workshops/seminars were also held, one at Kwetu Training Centre in Mtwapa, Kenya, one at the Institute of Marine Science of the University of Dar es salaam, Zanzibar, including presentations from national technical experts and developers.

The exchange visit was a practical learning method that exposed community members to ongoing mariculture projects in the region, giving them an opportunity to observe, ask questions, critique, share ideas and learn from mistakes and successes in an environment similar to where they live and work. The interaction between community representatives, mariculture practitioners, managers, and researchers facilitated networking that can strengthen mariculture development in the region.

In particular, issues related to national policy on mariculture were discussed, clearly illustrating the different levels to which mariculture has been addressed in national policy in Kenya and Tanzania. This study illustrates that there is a need to establish comprehensive mariculture policy frameworks that streamline mariculture development into national development and environmental management plans and that adequately define the legal and institutional frameworks governing mariculture development.

The exchange visit was able to assess how community mariculture can be approached and used to improve the livelihoods of coastal communities, through existing initiatives farming mud crab, milkfish, mullets, prawns, pearl oysters and seaweed. There was clear evidence that research, extension services, management and development need to work together if meaningful community mariculture development is to occur. The provision of seed through hatcheries to supply farmers came out as a very strong need – as yet there is no hatchery in East Africa, though plans for construction are underway in Tanzania.

In addition, it is clear that mariculture growth is constrained by insufficient technical capacity, limited marketing experience and inadequate infrastructure, which all need to be considered for effective

mariculture development. Notably, extension services should be strengthened through capacity building and partnerships with development NGOs and the private sector. Technical assistance as well as approaches and strategies can be sourced from countries that have successfully developed community-level mariculture, such as Vietnam.

While developing the mariculture industry will require increased financial as well as policy and institutional support from government, this can be greatly augmented through close collaboration with development agencies and donors. Using market mechanisms while ensuring small-scale ventures are safe from exploitation and price dumping (as have at times been the case), including through regulation, establishing trade networks and improving business and fiscal management can further support the development of the industry.

More detailed recommendations are presented in section 5 of this report.

Photo: Chongoleani fishponds under construction, Tanga Region, Tanzania.



1. Introduction

Sustainable use of biodiversity has significant links to human wellbeing and poverty reduction. More than 10 years after the 1992 Rio Declaration on Environment and Development, demographic trends, health epidemics and the pressing need to reduce poverty have strained natural resources and threatened to greatly diminish the world's collective biodiversity. These trends have serious implications not only for future poverty reduction and development, but also for the health and wellbeing of the human population today.

Some 30 million people live in the coastal region of the Western Indian Ocean, many highly dependent on its marine resources and having a significant impact on resource status. A majority of these coastal communities are categorised as living at or below national poverty lines.

Over-fishing and destructive fishing techniques that cause habitat destruction, coupled with a rising population are of increasing concern in East Africa (Obura 2005). This unsustainable development is embedded in poverty and continues because poverty reduction strategies are failing in coastal communities in East Africa. Further, coastal communities remain disempowered in terms of having ownership over the marine resources they exploit, which remain common pool.

To reduce the vulnerability this creates among coastal artisanal fishing communities and the coastal ecosystems that support them, development of alternative or supplemental livelihoods have been proposed, in order to sustain coastal peoples' income and food supply while also restoring declining fisheries (Giasuddin and Alam, 1991; Kador, 1991). One such livelihood activity is community-based mariculture. However, mariculture in East Africa is still limited and undeveloped (Bryceson, 2002) compared to South East Asia where it often forms the backbone of the local economy. The development of mariculture in Africa has experienced several setbacks including low output and high cost (Christensen, 1995); lack of documentation on possible impacts to the environment; lack of appropriate technology; facilities, infrastructure and government policies. To develop the industry these issues need to be carefully examined and addressed.

To support the development of alternative livelihoods through mariculture options in Kenya and Tanzania, an exchange visit was organised to bring together community, managers, mariculture practitioners and experts. The exchange focused in particular on experiences from Mombasa and Kiunga, Kenya and Tanga and Zanzibar in Tanzania.

1.1 Objectives

The objectives of the mariculture exchange visit were to expose community representatives from Kiunga and Tanga to examples of key experiences in livelihood improvement through mariculture; and to facilitate dialogue between managers, mariculture practitioners, and representatives from leading national institutions and to discuss national policy regarding community based mariculture development.

Ultimately it is hoped this can contribute to improving coastal natural resource management and coastal peoples' lives through empowering coastal communities to manage their resources sustainably and by promoting a dialogue that can support decision makers to integrate sustainable marine resource based livelihoods into national poverty reduction strategies.

1.2 Mariculture Exchange Programme

The exchange visit was conducted over one week in May 2008 and involved 5 community representatives, 2 from Tanga and 3 from Kiunga, and five resource people from both Government and non-governmental organisations, representing institutions that are spearheading mariculture development in each country. Dr.

Betty Nyonje from Kenya Marine and Fisheries Research Institute (KMFRI) and Dr. Aviti Mmochi from the Institute of Marine Sciences (IMS) of the University of Dar es salaam, Tanzania, participated to provide information on the level of mariculture developed in their respective countries, and to share information on government mariculture policies and inclusion of mariculture into national development plans. Mariculture practitioners from both Kenya (Kwetu Training Centre) and Tanzania (Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance (ACDI/VOCA) Sustainable Environmental Management through Mariculture Activities (SEMMA) project) participated to provide on the ground situation examples of mariculture and information on existing strategies, institutional, financial and technical support, and challenges. The exchange visit was led by Dr. Melita Samoily, Co-Director of CORDIO East Africa, and Mr. David Mirera, Research, Conservation and Extension officer for Community mariculture and wetlands ecosystems at Kwetu. Dr. Nigel Preston, Theme leader of Breed Engineering at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia, and a leading aquaculture specialist, participated to provide information on international experience of mariculture and recent developments, and to provide technical advice with respect to development of the community mariculture industry in East Africa.

The exchange visit programme as drawn up in consultation with resource persons and participants, is included in Appendix 1. The full list of participants is provided in Appendix 2.

2. Results and Discussion

Exchange visit activities and lessons learned are presented and discussed in the sections below, including success, challenges, strengths and opportunities of initiatives at the sites visited in each country.

2.1. Mariculture seminars

The exchange visit started with a half-day mariculture seminar organized at Kwetu Training Centre, Mtwapa, Kenya. A half-day seminar was also organized during the exchange visit at IMS, Zanzibar. The seminars included presentations to provide an overview of the progress and status of mariculture in East Africa, as well as an international perspective with examples from Asia and South America.

Exchange visit purpose

Dr. Melita Samoily introduced exchange visit, its objectives and how it constitutes a part of a broader programme of work by IUCN, addressing natural resource dependence and livelihood enhancement in coastal communities in Eastern Africa in order to reduce poverty while promoting biodiversity conservation. This will be achieved through integration of development and resource management processes and cross-sectoral planning and management. The purpose of the exchange visit was to focus on mariculture as an important alternative livelihood for coastal communities and to initiate a dialogue between stakeholders on current mariculture development policy and how it can be strengthened.

Participant's Expectations

Expectations of the visit among participants included the following:

- The exchange visit should illustrate how mariculture can improve livelihoods. Poverty remains high among coastal communities despite having the sea and its resources at their doorstep, and resource harvesting/capture fisheries is failing to reduce poverty.
- The exchange visit should provide exposure to innovative technologies on marine resource utilization and mariculture to improve livelihoods.
- Participants should have an opportunity to see different mariculture initiatives in the region in order to learn how to improve existing initiatives.

- Participants should gain knowledge that can be disseminated to other community members, enabling them to make informed decisions.
- The exchange visit should help to achieve closer collaboration between mariculture practitioners, donors, researchers and buyers in the region.
- The exchange visit should contribute to improved sharing of experiences and lessons learned from mariculture and related information.

Mariculture initiatives by Kwetu (David Mirera)

Mariculture in Kenya has a relatively short history, with few success stories. Initiatives have largely been un-coordinated, with insufficient sharing of information between projects and institutions. Thus mariculture initiatives are often failing to learn from past experiences.

Kwetu started mariculture trials in 1997 by constructing a 0.8 ha prawn pond. Community extension did not commence until late 2004, when enough information had been collated based on the trials and from research for culturing milkfish, prawns, mullets and mud crabs. The early stages of the mariculture extension work proved difficult due to a lack of tradition in fish culture among coastal communities, but with time there was appreciation from the community that fish can be grown in ponds, and now mariculture is increasingly being adopted. The mariculture inventory survey in Kenya (Mirera, 2007) indicated that by 2007 there were over 20 fish/prawn ponds, and four communities were actively involved in mud crab production.

Kwetu's extension process targets groups in a community rather than individuals since mangrove resources are owned communally under national regulations (Forest Policy 2005). Increasingly communities in Kenya integrate fish, crab, prawn and oyster culture with mangrove conservation using well-designed protocols, and have received a lot of support from a broad range of stakeholders.

The main challenges have been theft, lack of seed stock, and at times unrealistic expectations with respect to the input required in terms of time and labour, as well as profits. The technical advice and intensive monitoring required in the early stages of mariculture establishment has often been underestimated. Lastly, as there are no hatcheries all initiatives to date rely on wild seed, which can be a limiting factor and may further stress already degraded wild stock.

Mariculture development in Kenya (Dr. Betty Nyonje)

Kenya Marine and Fisheries Research Institute (KMFRI) is a national research institute, with a mandate to conduct research on aquaculture and disseminate the findings and technologies to beneficiaries. The challenges of the aquaculture department at KMFRI have been high turnover of scientists, limited access to land for the institution's demonstration mariculture farm, and lack of funds. However, under its current strategy, KMFRI is able to generate revenue from its research, which may help strengthen the aquaculture department financially. Currently KMFRI is focusing on seed production mainly for fresh water aquaculture, as well as on live feed production (e.g. artemia), artificial feed formulation, and ornamental fish breeding. Outreach material and publications are also being produced.

Mariculture development in Tanzania (Dr. Aviti Mmochi)

Mariculture in Tanzania started with seaweed culturing trials in 1973, borrowing technology from the Philippines (Mshingeni, 1973, 1983). Seaweed farming has since then been picked up by several organisations and has expanded tremendously. Tanzania is now a globally significant producer of *Eucheuma* sp. and *Kappaphycus* sp., after e.g. the Philippines and Indonesia.

Marine fish culture in Tanzania started in 1981, with experimental cage culturing of the rabbitfish *Siganus sutor* (Bwathondi, 1981). During rabbitfish pond culture trials in 1998 milkfish (*Chanos chanos*) entered the ponds with tidal flushing, and proved to be tolerant to the variable salinity in the ponds. Thus milkfish farming took off, and by 2007 there were 100 milkfish ponds in Tanzania (Msuya and Mmochi, 2007). A

milkfish culture manual has been developed (Requintina et al., 2007). Other mariculture research trials in Tanzania have focused e.g. on shellfish, including pearl oysters, as well as mud crab (*Scylla serrata*). Small-scale mariculture is now practiced by several communities including in Tanga region, on Mafia Island and on Zanzibar.

The future of mariculture seems bright, with the development of a national mariculture strategic plan for 2023, based on advice to parliament as well as the Minister of Fisheries from the Vice Chancellor of the University of Dar es salaam and the Director of IMS. Extensive economic analysis of milkfish and seaweed culture has also been conducted (Sullivan et al., 2007).

Aquaculture in the world and relevance to East Africa (Dr. Nigel Preston)

Most wild capture fisheries in the world are at or over maximum sustainable yield, and will at current rates collapse within a few decades. Aquaculture will thus be essential to provide seafood products. With the world population expected to increase to 8.5 billion people by 2020, 1.1 billion in Africa alone, an estimated 40 million tons of aquaculture food will be required by 2030. While since the 1950s aquaculture has been the fastest growing food-producing sector in the world, it is still not achieving its potential in places such as Eastern Africa. With improved technologies, mariculture can contribute a more resilient and prosperous coastal East Africa, meeting the food and income demands of the growing population while also reducing pressure on wild stock, without compromising biodiversity and ecology.

For example, there are new approaches to sustainable mariculture that capitalise on capture and re-use of pond discharged water and avoid antibiotics use in prawn culture. Such technology has been used successfully in Australia, in coastal areas near the Great Barrier Reef, where environmental regulations are very strict. Utilization of modern technologies such as remote sensing and GIS has helped identify areas sustainable for aquaculture. In addition to that Australian mariculture has focused on identifying appropriate species for culture and ensuring supply of juveniles through development of hatchery systems. Experience has shown that mariculture development will not advance unless it is a successful business. The government has also been important in promoting and supporting to the industry.

Much could be achieved by seeking technical assistance from countries with similar environment and advanced mariculture, such as Vietnam. As is currently the case in East Africa, Vietnam used to depend on wild stocks and tidal flushing for aquaculture. However, after 5 to 10 years of development effort Vietnam now has an internationally significant mariculture industry that has helped raise coastal communities out of poverty and greatly contributes to the national economy. Hence East Africa should not be discouraged but continue to take steps forward by learning from countries such as Vietnam.

Dr. Preston noted that prawns and *Tilapia mozambica* are among the most suitable candidate species for mariculture in East Africa. However, he also pointed out that there is a need for establishing hatcheries to supply mariculture initiatives – currently there are none in East Africa, a major impediment to development of the industry. Notably this key recommendation has previously not been made in spite of over a decade and a half of mariculture development in Tanzania.

2.2 Mariculture Site Visits, Mtwapa, Kenya

Kwetu Training Centre mariculture site

Kwetu, an NGO founded in 1996, is a hub of community mariculture initiatives in Kenya. The mission of Kwetu Training Centre is to help local communities make use of available natural resources in a self-sustaining, innovative, and environmentally sound manner. Presently Kwetu has six departments that carry out research and extension to the communities on Mangroves and mariculture; Neem processing; Food processing and solar drying; Organic farming and bee keeping; Outreach and reproductive health; and



Photo: Kwetu mud crab culture site, Mtwapa, Kenya.

Entrepreneurship. Kwetu has pioneered the development of sustainable mariculture in Kenya during the last 10 years, including through trialling oyster culture, pond polyculture and silvofisheries.

The exchange visit participants visited the demo/training mariculture facility owned by Kwetu Training Centre. The facility has 7 fishponds served by a sluice gate, and a set of mud crab drive-in cages with a capacity of holding 100 crabs. The fishponds are currently under a milkfish and mullet culture experiment conducted by David Liti of Moi University.

The mariculture facility is used to carry out basic research. The facility is open to communities for mariculture training, including how to construct various culture facilities and how to culture milkfish, mullet, prawns and mud crab. Kwetu has managed to develop a market for the mariculture products both at the community level and in the local hotel industry, with good prices obtained for e.g. crabs (350 KES/kg, or c. 5.4 USD/kg), prawns (KES 400 per kg, or c. USD 6.2 per kg) and fish (KES 120 per kg, or c. USD 1.8 per kg). Detailed information on mariculture in Kenya spearheaded by Kwetu Training Centre can be found in reports by Mirera (2006, 2007, in press).

Participants noted the simplified and comparatively cheap technology used for mariculture at Kwetu, and expressed willingness to adopt the innovations for development in their respective areas. They also stressed that ensuring market linkages, as demonstrated by Kwetu, need to be developed, e.g. to help mud crab farmers in Tanga, Tanzania.

Majaoni Youth Development Group mariculture site

The Majaoni Youth Development Group started mariculture in 2004 and have since then managed to construct six fishponds with simple and a well-planned water flow system using standard wastewater pipes, which could serve as a model for community mariculture initiatives elsewhere. The initiative initially

struggled as the Forest Act bars any human activity in mangrove forests. However, with the introduction of co-management in the Forest Policy of 2005, communities were allowed to carry out non-destructive livelihood activities in the forest, and activities at the site could develop.

The group has grown milkfish in their 8x10m pond since 2005. However, only a maximum of 15kg has been obtained per four-month culture period. This low production is likely due to the ponds not being stocked to the required density. Consequently the group has not been able to conduct economic return simulations to ascertain profitability. The group also intends to employ a caretaker to keep watch of the stocked fishponds.

A focused, carefully planned and conducted fish production programme would enable the group to attain profitability. The facilities are currently under a milkfish culture research experiment conducted by David Mirera of Kwetu, funded through a grant from the Western Indian Ocean Marine Science Association (WIOMSA).

2.3 Mariculture Site Visits, Zanzibar

Bweleo, Fumba and Nyamazi mariculture groups

The Bweleo, Fumba and Nyamazi community mariculture groups are focusing on pearl oyster farming. The bivalves are implanted with artificial button pearls made from plastic, and hung in sacks on buoyed lines. Upon harvest the pearls that have formed (so called half-pearls, which remain attached to the shell) are used for jewellery, while the meat used for food and/or sold. Exchange participants received a presentation on the activities and were demonstrated the various steps of the process. The potential profits from pearl farming are considerable – the first harvest from Bweleo fetched a lot of money after being sold in the USA at approximately 100 USD per prepared pearl. In addition to Zanzibar, pearl farming is currently conducted also on Mafia Island.

Makoba mariculture fish ponds

Much of the early marine fishpond culture research in Tanzania (rabbit fish, milkfish and mullets) was conducted at Makoba. The ponds were initially used for salt production, but it was abandoned due to high fresh water influx, which made it unprofitable. After conversion to mariculture, the facility has contributed greatly to development of pond construction and fish culture practices.

The expansive pond area of about 10 ha is owned by the Tanzania Prisons Department. In 1992 six ponds were constructed with technical advice from IMS and later the Prisons Department constructed five more. Most ponds vary in size between 10x12m to 12x15m, with one relatively large pond of c1.5 ha. Two water reservoirs in front of the ponds regulate water supply through sluice gates. A set of smaller concrete ponds of 8x8m were constructed for growing out fish fry to a size where they can be separated by species before stocking of culture ponds.

Mariculture research in the area has focused on e.g. rabbit fish, seaweed, shellfish, milkfish and mullets, including using milkfish fingerlings imported from Philippines for culture. The IMS mariculture team has formulated local fish feeds using coconuts husks, maize bran and trash fish, which have been tested in the ponds. To ensure effective operation of the mariculture pond facility, one technical staff from the prisons department and a local community member were trained in Israel. However, at the time of visit the pond facility was poorly maintained and not functional, despite the resources used to develop the facility and the human expertise in place. It was noted that this was due to the restricted access to the site as it is a security zone, as well as inability by the prisons department to utilise the expertise developed within their department.

The ponds have been created by conversion of mangrove forest, which is inferred e.g. from high concentration of sulphate in the area. Participants were advised by Dr. Nigel Preston that such areas are not suitable for mariculture since the soil chemistry commonly leads to high mortality of culture organisms. Thus there is no need to cut mangroves for mariculture – in addition to production being limited by mortality it is expensive and environmentally unsustainable. A more suitable area for mariculture is behind mangrove areas, beyond the highest tide level where land is usually relatively flat, although this may occasionally require some water pumping. To improve areas that have already been cleared either for culture of fish/prawns or for salt production in an environmentally acceptable and not expensive manner, mangroves can be planted along the dykes and lime can be added to help neutralise the sulphuric acid.

The Makoba site visit provided important information to the participants as some were planning to establish mariculture by cutting mangroves. However, participants felt that the state of the facility indicated failure in part due to a poor perception of mariculture in the region, and that it was unfortunate that the expertise developed at Makoba prisons department was not utilised to continue production after the IMS research concluded. Participants suggested that allowing the community to use the Makoba pond area would help maintain it, making it useful for developing mariculture further as well as generating income.

Kidoti seaweed farming initiatives

Tusife Moyo Women's group at Kidoti was established in 1991 by 21 individuals culturing seaweed in shallow water. In 2006 the group was incorporated into the Sida-supported Zanzibar cluster initiatives that bring seaweed women groups' together for support and further training on seaweed value addition. Activities have since expanded to farming seaweed both in shallow and deep waters under guidance from IMS, and each individual within a group now manages 2-3 plots of 200 lines of seaweed. There has also been an increasing focus on value addition, initially through production of seaweed soap, which is now made in six varieties: seaweed, eucalyptus, cinnamon, lemongrass, clove and basil. This has also led to further diversification of activities, including making mats and establishing a tree nursery.

However, seaweed production in Zanzibar is still lower (8,000 Tons/year) than the demand from buyers (20,000 Tons/year). The main challenges of seaweed farming mentioned by the Tusife Moyo Women's group include the heavy work involved during seaweed harvesting; the limited labour force which limits production capacity; and low prices for seaweed, which discourages local investment in the industry in spite of a price increasing from TSH 50 to 160 per kg (from c. UD 0.04 to 0.13 per kg) since 1995.

The approximate earnings from seaweed farming was said to be between TSH 200,000 and 400,000 per person per six-month period (c. USD 167 to 333 per person per six-month period), depending on the investment made. A higher the number of lines leads to higher production, but also requires more time and effort.

Participants in the mariculture exchange were impressed by the activities of the group and the level of success reached, and felt that seaweed farming may be possible to take up also in other areas. However, it was noted that the seaweed farmers did not seem to understand how seaweed is used after they sell it. Increasing the awareness of this among producers as well as policy makers may help create incentives to develop the industry further, including e.g. ensuring high quality products that can fetch a good price and increase returns.

Photo: Women's group making soap, Kidoti.



2.4 Mariculture Site Visits, Tanga, Tanzania

Sustainable Environmental Management through Mariculture Activities

The USAID-supported Sustainable Environmental Management through Mariculture Activities (SEMMA) project seeks to conserve biodiversity along the Tanzanian Coastline through sustainable development of profitable mariculture enterprises. The seaweed mud crab, and milkfish mariculture activities supported by SEMMA in Tanga region, Tanzania, are intended to substantially increase the incomes of some of Tanzania's poorest communities, resulting in poverty reduction and increased food security for at least 10,000 people in the coastal region of Tanga.

Seaweed

Seaweed farmers in Tanga are commonly given farm inputs, such as lines, by buyers. These are then repaid from the seaweed harvest. To avoid dependency on buyers for farm inputs, SEMMA has started a pilot project in one of the communities at Mikocheni, where the farmers buy their own lines using small bank loans. An association of seaweed farmers ensures that inputs received have been put in the sea and that harvesting is carried out. The association has laid down bylaws of how to operate, and it is hoped that over time it will streamline the seaweed industry in Tanga. SEMMA provides such associations with training in business skills, bookkeeping, entrepreneurship and group management.

Each farmer is anticipated to own 400 lines with a continuous harvesting of 200 lines every month at low spring tides for profitability. To reduce the workload involved in carrying seaweed during harvest, SEMMA has purchased small plastic boats with a capacity of 10kgs to help farmers. Already seaweed has been shown to contribute greatly to the livelihoods of coastal people, having risen from less than a dollar per person per month to the current USD 30-50 per month. The projected production of the project is 370 metric tons per month at the end of the project from a total of 850 farmers in Tanga, with total revenue of USD 547,000 per year.

Mud crab fattening

SEMMA is also involved in training farmers in mud crab fattening after receiving initial training from Kwetu Training Centre in 2004. A simple mud crab culture manual has been developed and disseminated to communities in both Kiswahili and English. Young or juvenile crabs are harvested from the wild and then fattened in cages to market size. The mud crabs are sold to individual buyers/exporters, who are also helping the farmers with feed (octopus remains). The initiative has been recorded to provide an average of USD 72 per person per month to the farmers.

Milkfish culture

Milkfish farming has only recently (late 2007) been given priority within the SEMMA project and is still under development in one community. However, the viability of the practice is uncertain due to the dependence on collection of fingerlings from the wild for stocking, which is unreliable. SEMMA is now developing a milkfish manual in both Kiswahili and English for use by farmers.

Exchange visit participants expressed appreciation of the approach of SEMMA to develop community livelihood alternatives, and noted that such initiatives should increasingly receive support from the government as well as donors.

Pangani crab farmers, Pangani, Tanzania

The Pangani crab farmers group Wafugaji wa kaa Pangani (WAKAPA) was initiated in May 2006 in Pangani district in Tanga Region, Tanzania by 10 people. The group obtains crab seed stock, small crabs of 200-350g, from fishermen at a price of TSH 1400 per kg (c. USD 1.2 per kg). A first stocking in 2005 placed

600 crabs in drive-in cages with individual compartments (1x1x1ft) made of mangrove chelipeds, each costing TSH 1000 or just over USD 0.8 per piece. However, due to high mortality and escape no harvest was made. In January 2007 activities were restarted using cages of 5x6m with individual crab compartments as above. These can be made in on to three days by between five and ten people. From the 400 crabs stocked 250 were harvested in May the same year, with a total weight of 120 kg. Further innovation has greatly improved the crab culture. By introducing plastic buckets costing TSH 1200 each (c. USD 1) as individual cage compartments cutting of chelipeds has been reduced, and from a stocking of 800 crabs a harvest of 600kgs was obtained in December 2007.

The crabs are fed on octopus remains twice a day. The feed is obtained from the main buyer of the crabs, Sea Products, a seafood processor in Tanga. In addition to octopus spillage/remains, farmers are also given ice to preserve the feed and avoid spoilage. Crabs are now sold to Sea Products at TSH 6000 per kg (c. USD 5 per kg).

As theft of crabs is a significant concern the group has been forced to employ a watchman, increasing the operational costs by TSH 60,000, c. USD 50, per month. Although the initiative appears profitable a hatchery may be highly beneficial, to ensure supply of stocks and to prevent over dependency on the wild stock, which may get depleted.

Participants in the mariculture exchange felt that this was a good community initiative and could serve as a model for groups elsewhere. They also urged WAKAPA group members to expand the production further.

Chongoleani fish farming project

The Chongoleani group, initiated in 2006, involves 15 members, 10 men and 5 women. Pond construction was initiated in a mangrove area was previously cleared for salt extraction, and salt pond experts were hired to assist with construction. However, the project came to a halt due the group trustee falling ill. In spite of

Photo: Chongoleani fish ponds.



this, when the ponds were filled the incoming water brought wild milkfish that stayed in the ponds from the time work was halted until April 2008, and grew to provide a total of 93 kg when the ponds were drained for further construction. Construction of 10 ponds was restarted in 2008, however not following good procedures and techniques, and some of the ponds are prepared without outlets and poor drainage, which does not allow water to drain completely from the ponds.

The experience highlights the need for sound technical advice to avoid unnecessary delays and expenses. It was noted that this community group had not been given correct advice by local government extension officers, nor had they heard of the SEMMA project described above. Consequently the group now have to redo the drainage system for the ponds again. Such experiences can be very discouraging for communities attempting to develop mariculture, but can be avoided through ensuring good guidance is provided. It should be noted that the cost of such guidance before and during development is likely to be much lower than the cost of failure and frustration to the community.



Photo: Pearl harvest at Tawalani.

Tawalani Village Pearl farming

Tawalani Village Pearl farming is a pioneering pearl farming initiative in Mkinga District, Tanga Region. The community has improvised in the use of buttons for pearl production rather than importing special plastics, which could be expensive as well as inaccessible. The aim is to produce gold-coloured pearls, which fetch high prices, although depending on the buyer other colours may also be good. The pearl harvesting observed during the exchange visit yielded 60 pearls from 35 bivalves, but quality was variable and only some looked to be of very good quality. The oyster meat obtained from pearl harvesting can be eaten or sold to the local market to provide extra income, although the price is very modest at TSH 200 or less than 0.2 USD per cup.

It was noted that the project was good but would benefit from further advice and expertise on how to develop high quality pearls. However, the simple low-tech approach was seen as a strength that may make the initiative easily replicable elsewhere.

3. Community views and perceptions

Perceptions and views of mariculture exchange participants and community representatives are synthesized below, as expressed in discussions and feedback sessions during and after the exchange.

Information and expertise

Much important information was provided that can be readily applied in the region, and it is important that these messages reach out to communities. It was observed that good papers have been written about mariculture in the region but what is seen on the ground does not reflect the good results portrayed in the scientific papers. This implies that there is a problem of translating research into development. Also, there may be a need to get mariculture expertise from outside the region to facilitate development that is both financially and environmentally sustainable.

Starting mariculture

In most areas it may be difficult to start prawn farming due to the limited mariculture knowledge and dependency of wild seed stock. Growing more hardy species such as milkfish may be an easier starting point, and milkfish ponds can later be converted to prawn ponds. Other species of fish like red snapper, mullets and tilapia also present opportunities. However, for most if not all species, there is a need for hatcheries, especially as the industry grows.

Constructing mariculture facilities

For construction of mariculture facilities such as ponds, expertise should be called in and advice taken to save money and time. There are examples of communities refusing to take technical advice and end up using more resources to correct mistakes that could have been avoided. In some cases communities are not aware of where and how to source technical advice. However, there are also examples of good community innovation, e.g. the use of plastic buckets for crab drive-in cages. Participants also learned that ponds for farming fish can often be established in areas where salt extraction is taking place, and that cutting mangroves for pond construction should be avoided due to soil chemistry often making these areas unsuitable for mariculture.

Carrying out mariculture

Regular monitoring of mariculture initiatives by experts together with communities is important for continued production and to rectify problems, and personal investment and dedication from mariculture practitioners is vital for continuity. Also, trust within communities is essential for success, as was seen e.g. with pearl farming in Tanzania, where theft could be very detrimental to the business. In some cases facilities need to be guarded.

Profitability

Profit can be realised from seaweed culture but very large quantities must be farmed. Value addition such as soap production can improve income, and can be done with relatively small investments, for example the introduction of simple machines. In some cases currently unutilized resources could bring additional income or serve as a source of food, e.g. bivalves which are thrown out as waste in Kiunga but have high value at Bweleo. It was noted that following best practice is likely to increase profits.

Financial support

Participants reiterated that most community projects still need financial as well as technical support to get started, to ensure success and to serve as models for further development. An efficient and proactive approach to supporting mariculture was requested from governments.

4. Recommendations

Based on the mariculture exchange, site visits, presentations, and discussions, the following recommendations are made:

Policy Development

Mariculture in Kenya has barely begun, in Tanzania it is further advanced but the two countries lag far behind much of the rest of the developing world in terms of mariculture development, notably Southeast Asia and South America. National policies and strategic plans for mariculture development need to be drawn up for each country, including guidelines on how to identify suitable mariculture sites and species. Tanzania is in the final stages of developing their mariculture strategy for 2023 and Kenya should follow suit.

Notably such policies and strategies must recognize the new technologies and approaches available to reduce or eliminate negative environmental impacts of mariculture.

Addressing bottlenecks to conducting Environmental Impact Assessments or Strategic Environmental Assessments for mariculture is also required so that these can be used as tools to facilitate sustainable development. Similarly, as the mariculture industry needs to be business-based, assessment of economic feasibility and impact on livelihoods should be required, and facilitated.

Policies also need to be developed in order to protect small-scale mariculture farmers against unfair competition and cartels among mariculture product buyers. The buyers of mariculture products are seen to have created a network through which product prices are agreed and set by the buyers, thus placing individual producers in an unfavourable position and leading to exploitation when prices are set too low.

Hatcheries

To scale up mariculture development in East Africa in the future, hatcheries for candidate culture species need to be developed. Existing practices rely on wild stock for seed and are thus technically ranching (milk fish, prawns) or value addition to existing fisheries (e.g. crab fattening). Seed availability is unreliable and collection may lead to resource degradation. Hatcheries could reliably provide seed of high and consistent quality, which helps to maintain the quality of the product, and they would prevent over harvesting of wild stock.

Lessons Learning and Information Sharing

A more concerted approach to information sharing on mariculture is needed from governments as well as development projects. Mariculture knowledge should not just end up in books or good scientific papers but needs to be translated into practical outputs. Similarly, communication between national experts and communities needs to be improved. Site visits such as the one on which this publication is based may serve as one useful model to exchange information and experiences. Relevant information could also be brought to a broader audience and the general public e.g. through newspaper articles as well as audiovisual media. The mariculture forum housed by WIOMSA could also be built on further.

Technical advice

It is clear that communities are frequently not receiving sufficient technical support for mariculture development, in part because they do not know where to find such advice and in part because it is not accessible enough, and there are many examples where no or wrong information has killed the morale of a community seeking to initiate mariculture. There is need to have expertise much more closely at hand for communities, including through a network of experts and extension officers based in the areas where mariculture technology is needed. This can provide training, and advice communities in the use of appropriate approaches. There is also a need to prepare process guidance in a format that is useful to communities. Close collaboration with NGOs and private sector companies specializing in this industry is recommended.

Development Assistance

While much can be achieved simply by providing the right information, start-up financing is often needed for mariculture development, or to enable farmers to increase their output. Governments should increasingly address this by developing structures through which mariculture can be supported, e.g. provision of loans. Pilot mariculture projects that can serve as replicable models should be identified and, where needed, supported through small grants. Partnerships with the industry as well as development organizations would be beneficial.

Capacity building

The mariculture industry moves rapidly and current initiatives in East Africa can benefit by learning from the innovations and technology tried elsewhere. Expertise should be called in from areas where it is available, and specific trainings organized, especially for extension workers/Fisheries Division officers, who can then more actively provide sound technical advice. There is also a need to organise seminars for policy makers, including visits to mariculture ventures to help them understand the industry and its potential. Exchange visits for communities and practitioners need to be maintained for community learning as they provide good exposure to different approaches and interaction with mariculture experts.

Photo: Pearl oyster with plastic button pearl.



5. References

- Bryceson, I. (2002). Coastal aquaculture developments in Tanzania. Sustainable and non-sustainable experiences. *Western Indian Ocean J. Mar. Sci.* 1: 1-10.
- Bwathondi, P. O. J. (1981). The culture of rabbit fish (*Siganus* spp) in Tanzania. IFS. Stockholm, Sweden. 36pp.
- Christensen, M. S. (1995). Small scale aquaculture in Africa: Does it have a future? *World Aquaculture* 26: 30-32.
- Giasuddin, M. and M.F. Alam. (1991). The mud crab (*Scylla serrata*) fishery and its bio-economics in Bangladesh. In: C.A. Angel (Ed) *The mud crab: A report on the seminar convened in Surat Tahi, Thailand, November 5-8 1991.* pp 29-40
- Kador, A. (1991). Mud crab – A potential aquaculture resource of Bangladesh. In: C.A. Angel (Ed) *The mud crab: A report on the seminar convened in Surat Tahi, Thailand, November 5-8 1991.* pp 95-102.
- Mirera H. O. D. (2006). Silvofisheries gain momentum in the mangroves of Kenya. *WIOMSA Newsbrief* (September 2006. www.wiomsa.org)
- Mirera H. O. D. (2007). In the face of poverty mangrove wetlands are lifelines: Viability indicators in assessing polyculture of milkfish (*Chanos chanos*) and mullets (*Mugil cephalus*). *CORDIO Status Report.* 2007.
- Mirera H. O. D. (in press). Experimental polyculture of milkfish (*Chanos chanos*) and Mullet (*Mugil cephalus*) using earthen ponds in Kenya. *Journal of Aquatic science.*
- Mirera H. O. D. (in press). Mud crab (*Scylla serrata*) culture: Understanding the technology in a silvofisheries perspective. *WIO Journal of Aquatic Sciences.*
- Mirera, H. O. D. (2007). Community Mariculture Initiatives by Kwetu Training Centre along the Kenyan Coastline. *Samaki news.* Vol. 2.
- Mshigeni, K. E. (1983). *Mwani: ukulima wake baharini na manufaa yake kwetu.* Tanzania Publishing House, Dar es-salaam. 43 pp.
- Mshigeni, K. E. (1973). Exploitation of seaweeds in Tanzania. The Genus *Euchemia*, and other algae. *Tanzania Notes and Records,* 72: 19-36.
- Msuya, F. E. and Mmochi, A. J. (2007). Inventory of small scale mariculture in Tanzania. 34 pp.
- Obura, D. (2005) East Africa – Summary. Pp. 25-31 In: *Status Report, Coral Reef Degradation in the Indian Ocean.* CORDIO/IUCN/SIDA.
- Requintina, E. D., Mmochi, A. J. and Msuya, F. E. (2007). A guide to milkfish culture in the Western Indian Ocean region. 52 pp.
- Sullivan, K. A., Mmochi, A. J. and Crawford, B. (2007). An Economic analysis of milkfish farming in Tanzania: Potential for economic development and policy issues. Sustainable coastal communities and ecosystems. Coastal resources centre of the University of Rhode Island and the WIOMSA. www.crc.uri.edu.23p.

Appendix 1. Exchange Visit Programme

Date	Time	Activity
Thu 22 May	08:00-09:30	Arrival of participants at Kwetu
	09:30-09:45	Welcome to Kwetu / Overview of community activities
	09:45-10:00	Overview of the exchange visit purpose and objectives
	10:00-11:20	Kwetu community mariculture and silvofisheries initiatives
	10:10-10:30	The mandate of KMFRI in mariculture and challenges
	10:30-10:50	Tea break
	10:50-11:10	Mariculture progress in Tanzania
	11:10-11:30	Mariculture initiatives by CSIRO, Australia
	11:30-11:40	Discussions
	11:40-12:30	Field visit to Kwetu mariculture site
	12:30-13:30	Lunch break
	13:30-14:00	Travel to Majaoni Youth group mariculture site
	14:00-14:20	Overview of the group history and progress in mariculture
	14:20-15:40	Tour of the Majaoni mariculture site and sampling of fish
	15:40-17:00	Discussion
Fri 23 May	08:00-08:30	Travel to KMFRI
	08:30-09:50	Brief meeting at KMFRI
	09:50	Travel to airport and then Zanzibar
	12:00-15:00	Arrival at Zanzibar and lunch
	15:00-17:00	Discussion
Sat 24 May	09:00-13:00	Travel to Bweleo to meet Fumba, Bweleo and Nyamanzi groups, discuss bivalve and pearl farming and shell polishing
	13:00-13:30	Packed lunch
	13:30-15:30	Travel to Kisakasaka by boat to see and discuss seaweed seaweed and bivalve farming
	15:30-17:00	Discussion
Sun 25 May	09:00-11:30	Visit Makoba mariculture site for milkfish/mullet farming
	12:30-13:30	Packed lunch
	11:30-16:00	Visit Kidoti Seaweed farming and value addition project
	16:00-17:00	Discussion
Mon 26 May	09:00-12:30	IMS visit and brief of IMS community target sites in Zanzibar
	12:30-13:30	Lunch
	14:35	Travel to Tanga
	16:00-17:00	Discussion
Tue 27 May	09:00-09:30	Overview of SEMMA mission and community initiatives
	09:30-12:30	Travel to community milkfish farms and interaction with farmers
	12:30-13:30	Packed lunch
	13:30-15:30	Travel to a community mud crab culture site and interaction with farmers
	15:30-17:00	Discussion
Wed 28 May	09:00-12:00	Travel to pearl farms and harvesting of pearls
	12:00-13:00	Packed Lunch
	1:300-16:00	Pearl farm visit continued
	16:00-17:00	Discussion
Thu 29 May	09:00	Travel home

Appendix 2. Exchange Visit Participants

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IUCN builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.



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