

**Assessing links between marine resources and coastal peoples' livelihoods:
perceptions from Tanga, Tanzania**

Melita A. Samoilys and Nyaga W. Kanyange



June 2008

Table of Contents

Acknowledgements.....	3
Acronyms.....	3
Executive Summary.....	1
1. Introduction.....	3
1.1 Study location.....	3
1.2 Marine resource management and coastal community development.....	4
1.3 Study objectives.....	4
2. Methods.....	5
3. Results and Discussion.....	6
3.1 Coastal zone management and fisheries development programmes.....	6
3.1.1 TCZCDP.....	6
3.1.2 IUCN Community Consultation workshop.....	9
Seaweed farming group.....	10
Marine conservation and management areas and conservation committees group.....	10
Small-scale fishers group (<i>wavuvu wadogo wadogo</i>).....	10
3.2 Dynamite Fishing.....	11
3.2.1 The impacts of dynamite fishing.....	11
3.2.2 The history of dynamite fishing in Tanzania.....	12
3.2.3 Dynamite fishing along the Tanga coast.....	12
3.2.4 Legal context of dynamite fishing in Tanzania.....	13
3.2.5 Current initiatives towards control and elimination of dynamite fishing.....	15
3.3 Mariculture activities along the Tanga coast.....	17
3.3.1 Value chain analyses by SEMMA.....	18
3.4 Mariculture site visits in Tanga.....	19
3.4.1 Milkfish culture in Machui village, Pangani district.....	19
3.4.2 Crab and seaweed culture in Kiwavu village, Pangani District.....	20
Lobster aggregating group.....	21
3.5 Challenges facing mariculture production in Tanga.....	21
4. Conclusions.....	21
4.1 Dynamite fishing.....	21
4.2 Mariculture.....	22
5. References.....	24

Photo credits: Melita Samoilys

Acknowledgements

This study was funded through two IUCN Eastern Africa Regional Programme projects: “Building capacity and strengthening policies for coastal communities to manage their marine resources in East Africa”, supported by Keidanren Nature Conservation Foundation; and “Conservation as an Asset for Livelihoods in Eastern Africa”, funded by the International Development Research Centre (IDRC).

We are grateful to all those who agreed to meet with us to discuss and share their knowledge and ideas on the topic of the study. We are also grateful to Hassan Kalombo and the Tanga Coastal Zone Conservation and Development Programme, and Solomon Makoloweka for their support, advice and for background information on the Tanga area.

Acronyms

BMU	Beach Management Unit
CCC	Central Co-ordinating Committee
CMA	Collaborative Management Area
CMAP	Collaborative Management Area Plan
CORDIO	Coastal Oceans Research & Development – Indian Ocean
CPUE	Catch per Unit of Effort
DoFi	Division of Fisheries
EARO	IUCN Eastern African Regional Office
EIA	Environmental Impact Assessment
FAD	Fish aggregating device
IMS	Institute of Marine Science
IUCN	The World Conservation Union
MACEMP	Marine and Coastal Environment Management Project (Tanzania)
MNRT	Ministry of Natural Resources and Tourism
NGO	Nongovernmental organisation
SEEGAAD	Smallholder Empowerment and Economic Growth through Agribusiness & Association Development
SEMMA	Sustainable Environmental Management through Mariculture Activities
TCMP	Tanzania Coastal Management Partnership
TCZCDP	Tanga Coastal Zone Conservation and Development Programme
USAID	United States Agency for International Development
VMT	Village Monitoring Team
WIOMSA	Western Indian Ocean Marine Science Association
WWF	World Wide Fund for Nature

Executive Summary

In Tanzania several marine resource management initiatives have been implemented over the last 15 years. However, despite these initiatives, successes are few if poverty and natural resource health are used as indicators, although the capacity to manage marine resources has improved. This study sought to understand the bottlenecks to good governance of common pool marine resources in Tanga, Tanzania. Tanga Region is situated in northern Tanzania bordering Kenya, with a population of over half a million people who are highly dependent on fishing as their main source of livelihood. Other livelihood activities include mangrove cutting and selling, salt making and tourism, all linked to marine and coastal natural resources.

The objectives of the study were to compile existing information on the link between coastal peoples' livelihoods and marine resource management in Tanga, with a particular focus on two issues pertinent to the area: dynamite fishing and mariculture. The study was conducted in January 2008 and employed a literature review, interviews with fishers, managers and other key stakeholders and field visits.

Fishers in Tanga will have benefited from locally implemented marine resource and fishery management programmes, because these initiatives did result in an improvement in the state of stocks, at least until 2003, and greatly reduced the incidence of destructive fishing methods, including dynamite fishing. However, since 2005 these benefits are now being undermined by an escalation in dynamite fishing which is evading most enforcement efforts. Coral reef ecosystems have high biodiversity and yield highly productive fisheries. Dynamite fishing destroys the very basis of this system - the corals that build the reefs - leading to significant loss of biodiversity and fisheries productivity. The dramatic reduction seen since 2003 in the abundance of fish species that support Tanga's key coastal fisheries, is likely to be linked to the destruction of Tanga's coral reefs in the past from dynamite fishing. The problem cannot be underestimated, yet the practice has resumed, despite increased government led patrols, extensive campaigns from concerned citizens, and at times good local media coverage. It would appear that the nature of dynamite fishing is well understood by the government and the various communities in the region. The failure to effectively tackle this pernicious practice may relate to the very large focus on enforcement as the primary method to address it. Enforcement is invariably a difficult, expensive and unsustainable option. It could be more effective to address some of the other enabling factors that allow this practice to continue in Tanga: easy access to dynamite, an ineffective judicial system and corruption. Tackling these factors can also help build compliance. These factors may also illustrate why this practice does not occur in neighbouring Kenya. Sadly, Tanzania's mainland coast now has a reputation for having the most damaged coral reefs in the region, with Tanga renowned for the most affected. Tanzania is now unlikely to attract the coastal tourism it is trying to interest.

The loss in Tanga's coral reefs and the livelihoods and revenue they used to generate means that the development of alternative livelihoods for coastal communities is now even more pressing. This view was echoed in the national community lessons learning workshop held in Tanga in January 2008. Tanga Region has taken several steps to develop aquaculture among its coastal people. The three dominant mariculture initiatives in Tanga Region, milk fish, crab and seaweed, have evolved in line with the different coastal habitats that occur in the area:

- milkfish pond farming is suited to the salt flats behind the mangroves
- seaweed farming is suited to shallow waters off sandy beaches
- crab fattening is suited to mangroves

All mariculture initiatives in Tanga Region are small scale at the village level and communities have engaged in the practise largely due to encouragement and support from NGO driven programmes.

It is important to note that none of the existing animal-based mariculture initiatives are true mariculture because they are not breeding the organism: there are no hatcheries in Tanzania. Instead all practices harvest organisms from the wild either as fry or juveniles, and therefore operate essentially as grow-out practices. This is relevant if the animal is already being harvested as part of the local fisheries, as in the case of crab and lobster, though is less of an issue for milkfish because it is not a highly targeted fishery species. The crab fattening cages and the lobster shelters should therefore be seen as mechanisms for either value adding to an existing fishery (crabs) or for enhancing fishing efficiency (CPUE) (lobster shelters). Consequently such practices must be managed hand in hand with the sustainable management of the wild stock. They should not be seen as separate mariculture industries as they are not independent. This fact did not seem to be properly assimilated by most stakeholders.

It was clear from the interviews and site visits that community based milkfish, crab and seaweed culture are not yet creating significant and sustainable profits due to the small scales of production, lack of physical and technical inputs, lack of suitable markets and financial constraints. However, the first steps have been taken, skills are developing and the industry has great potential for addressing food security and income generation in the region. Substantial effort is now required to build capacity, provide technical inputs, and ensure small scale mariculture in Tanga is developed through learning lessons from South East Asia and South America where the industry is 10-15 years ahead of East Africa. Notably, the fears of environmental damage from aquaculture and the associated onerous EIA requirements in Tanzania relate back to problems of the 1990s that have largely been addressed by current techniques seen in Asia and South America, due to advances in technology in the last 8-10 years. Technical capacity within District government to provide adequate extension services is limited. Considering the fast pace of development in this industry globally, it is not surprising that local government extension officers are challenged to keep up with the latest information. It is recommended that this situation be recognised and that government outsource this service to NGOs that are specialising in community based mariculture.

Since mariculture is still relatively undeveloped in Tanga region it is difficult to properly assess the impacts of mariculture on coastal peoples' livelihoods. Certainly women have benefited from seaweed farming, which although small, provides them with a cash income which is roughly double what they have might have earned from other activities (eg selling firewood). The young men running a crab fattening group venture in Pangani reported substantial improvements in their incomes, despite running it as a group. Generally, quantitative assessment of whether mariculture has reduced pressure on marine resources by drawing fishers away from fishing is lacking and therefore it is difficult to assess this important question. It is highly recommended that well designed monitoring and assessment protocols are put in place as mariculture ventures ramp up and the industry develops fully.

1. Introduction

Sustainable use of biodiversity has significant links to human well-being 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 food security and the health and well-being of the human population.

In Africa, millions of people depend heavily on the continent's genetic, species and ecosystem diversity to support their livelihoods. This biodiversity contributes both directly and indirectly to human health and nutrition. The direct contribution of biodiversity is seen as an invaluable source of food through fisheries and through ecosystem services. Some 30 million people live in the coastal region of the Western Indian Ocean, with eight million in Tanzania (Obura et al. 2000), 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 particular concern in Tanzania (McClanahan et al 1999, Obura 2005, Wells et al. 2007,a,b). Dynamite fishing remains a contentious issue in Tanga region, even after concerted efforts to control it were put in place (Samoilys et al. 2007). These unsustainable practices are partly embedded in poverty and continue because poverty reduction strategies are failing in coastal communities; though corruption is also a contributing factor. In addition, coastal communities remain disempowered in terms of having ownership of these common pool resources. Reduction of poverty through sustainable livelihood development, which in turn helps maintain biodiversity and improve conservation strategies (Ireland et al 2004, Harrison 2005), is a pressing theme that requires careful analysis, community consultation, and integration of cross-sectoral planning and management. National poverty alleviation strategies tend to neglect the importance of natural resources in peoples' livelihoods.

This report constitutes one of two for a project that seeks to understand the bottlenecks to good governance of common pool marine resources in two localities: Kiunga in Kenya and Tanga in Tanzania. The study is also designed to identify locally appropriate mechanisms for enhancing and diversifying livelihoods for fishing communities.

In this study we asked how dependent are coastal communities on marine resources, and what effect has conservation and natural resource management had on coastal peoples' socio-economic development. We chose Tanga Region in northern Tanzania as a case study because there has been considerable conservation and management intervention in the area over time.

1.1 Study location

Tanga region is situated in northern Tanzania, bordering Kenya, and covers three coastal districts of Tanga Municipality, Muheza and Pangani. The region is hot and humid, with fairly

fertile soils and significant stands of coastal tropical forest. The area covers 1,600km², encompassing numerous islands, surrounded by coral reefs, with extensive areas of seagrass beds, mangroves and also deep channels and drops offs. Tanga is host to the endangered coelacanth fish, thought to be extinct, as well as migratory birds and may still support a small population of dugongs.

Tanga region had a population estimate of over half a million people by 2005, with half living in Tanga town (Wells et. al. 2007a). The main livelihood activity is fishing, though farming is also done on a small scale. Other livelihood activities revolve around trade in fish and molluscs, mangrove cutting and selling, boat building, salt boiling, and charcoal making (Horrill et al. 2001, Ireland et al. 2004). Overall there is a high reliance on marine and coastal natural resources, exerting more pressure as the population grows and demand for food increases.

1.2 Marine resource management and coastal community development

Tanga is renowned for its Tanga Coastal Zone Conservation and Development Programme (TCZCDP) which started in 1995 to address coastal zone and fisheries management in the Region. This long term programme, implemented by the World Conservation Union (IUCN) in partnership with the Tanga Regional and District governments, operated with donor funding until 2007. It continues today as a District and Regional government programme. Despite this significant initiative, fishery stocks are now in decline, the highly destructive use of dynamite fishing has escalated since 2005 and poverty remain an issue of high concern (Samoilys et al. 2007a, Wells et al. 2007).

Tanga coastal region has also made significant efforts to develop mariculture as an alternative livelihood for coastal communities. Initially TCZCDP in collaboration with stakeholders and partners, encouraged and supported fishermen and women to venture into mariculture (Lugazo et al. 2007). This was then taken up actively in 2003 by the Smallholder Empowerment and Economic Growth through Agribusiness and Association Development (SEEGAD) project, funded by USAID, which largely focussed on seaweed farming. In 2005 SEEGAD evolved into the Sustainable Environmental Management through Mariculture Activities (SEMMA) project, active today.

1.3 Study objectives

The objectives of the study were to:

- Compile existing information/knowledge on the link between coastal peoples' livelihoods and marine resource management in Tanga, Tanzania, with a particular focus on dynamite fishing and sustainable fisheries.
- Analyse past work on livelihoods enhancement, particularly aquaculture, and associated capacity building, empowerment and participatory approaches to natural resource management in coastal communities.

In addressing these objectives the study provides a review of the main fisheries development initiatives and interventions in Tanga, as well as their contribution to capacity building and poverty eradication.

2. Methods

The study was conducted in January 2008 and employed four methods: i) a literature review of recent publications and reports; ii) informal interviews with key managers and government officials; iii) informal interviews with key informants and with participants in the national coastal community lessons learning workshop that was held during the same period of the study; (iv) field visits to observe activities in situ that had been mentioned during interviews. Two groups practicing mariculture near Tanga township (15-30 km southwards) and one lobster aggregating fisher group in Pangani District were visited and interviewed.

Information was also synthesised in relation to the national coastal community lessons learning workshop held in Tanga in January 2008 (Becha 2008), another activity of the same IUCN project.

The four methods were structured to answer the following questions regarding the two specific issues, dynamite fishing and mariculture:

Mariculture

- 1) What and where are various mariculture activities in the region?
- 2) Who practices and what is the motivation?
- 3) What are the economic gains – is the practice economically sustainable?
- 4) What are the problems facing each practice (eg milkfish, crab, oyster, seaweed)?
- 5) Has the government or other stakeholders played a part in development of the sector?
- 6) What is the future for the sector and are there any current initiatives?

Dynamite fishing

- 1) Where and when did the practice start?
- 2) Who started it and how?
- 3) What are the initial costs and gains?
- 4) How harmful is it?
- 5) What are the community perceptions about the practice?
- 6) Why has it continued despite its ban?
- 7) Are there any conflicts with other stakeholders, including fishers?
- 8) Where or how do fishers acquire dynamite?
- 9) What can be done to stop the practice?
- 10) What local action has been taken and how effective has it been?
- 11) Why has gear exchange not worked for dynamite fishers?
- 12) Why is dynamite fishing a problem in Tanzania but not Kenya or Mozambique?

3. Results and Discussion

In this section we present and discuss the results of the study in the following sequence. First we provide an overview of past and current coastal zone management initiatives in Tanga Region, second we focus on one of the most critical issues facing the state of Tanga's marine environment – dynamite fishing, and third we present information on alternative livelihood programmes focussing on mariculture. In discussing our findings we discuss the impacts of the various marine and coastal management issues on the socio-economic status of the people of Tanga region.

3.1 Coastal zone management and fisheries development programmes

The TCZCDP is the main programme in Tanga that has been instrumental in coastal zone management primarily addressing fisheries management, and to some extent fisheries development. The Programme was implemented through the District governments with Regional advice. Since the technical agency, IUCN, handed over the Programme to government in 2005 and funding from the donor, Irish Aid, ceased in 2007, the Programme has been integrated within District government workplans and budgets, though with a significantly reduced budget and range of activities. Nevertheless, the reef and fisheries monitoring and enforcement programmes do occur and the status of the reefs and fisheries continues to be assessed by District officers in collaboration with the Village Monitoring Team (Samoilys 2004).

Fisheries Division, though poorly equipped technically and financially, has continued to support fisheries development in the region while the Forest Department facilitates some programmes at the village level, especially those initiated by village environmental committees (Wells et al. 2007a).

The SEEGAAD project's overall aim was to promote activities that drive sustainable economic growth, increase cash incomes and stimulate asset accumulation among Tanga coastal households (ACDI/VOCA 2008a). SEEGAAD concentrated on promoting seaweed farming which was considered successful as illustrated by the high number of farmers and improved incomes especially for women (ACDI/VOCA 2007a). After conducting market assessments that revealed potential ventures for mud crab, lobster sheltering and prawn farming, SEEGAD introduced these new activities during its final year. SEEGAAD evolved into a new programme, SEMMA, with the aim of conserving biodiversity along the Tanzanian coastline through sustainable development of profitable mariculture enterprises (ACDI/VOCA 2008b). SEMMA has focused mainly on crab fattening due to its high potential for economic return. Recent crab fattening trials have been successful and more are still underway (ACDI/VOCA 2007b). These initiatives are discussed in more detail in section 3.3 below.

3.1.1 TCZCDP

The Programme was initiated in 1994 through IUCN-EARO with funding from Irish Aid in response to the Tanga Regional government's concern for an increasing decline in marine resources and reef degradation. The TCZCDP was one of the first coastal management programmes in the WIO to make livelihoods improvement a central objective, and one of the first to start with a community-based approach. A very broad and ambitious tactic was taken, incorporating attempts to trial and implement new livelihood activities, develop and implement

fisheries and mangrove management plans, establish and mainstream new institutional arrangements for coastal management, and build capacity through a major training and environmental education programme (Wells et al. 2007a). The Programme covered over 1,600 km² and encompassed over 200,000 relatively poor people in 49 communities. The Programme was implemented collaboratively by the local government offices of the three Districts of the Tanga Region (Tanga municipality, Muheza and Pangani).

Changing behaviours and attitudes, and in particular developing collaborative management arrangements, is a slow process. The long term commitment of funds from Irish Aid over 12 years enabled the TCZCDP to function in an adaptive management process as it developed through four phases during which there was time to monitor, analyse and change the Programme's approach where needed. This was unusual for the East African region and is one of the Programme's great strengths.

Regular monitoring of coral reef health and artisanal fisheries, as well as implementation of alternative livelihood strategies such as seaweed farming by women were two key aspects of the Programme. Fisheries management interventions included the establishment of collaborative management areas (CMAs) which were formally gazetted through village by-laws and approved at national level (Wells et al. 2007c, see below). These contained reefs closed to fishing to serve as fishery reserves. Destructive and illegal beach seines (*juya*) and dynamite fishing were dramatically reduced through surveillance patrols and gear exchange for beach seines (Horrill et. al. 2001). Generally, the Programme led to a significant improvement in reef health, at least until 2003-2005 when both dynamite fishing returned and a reverse in the recovery of fish stocks was seen (Samoilys et al. 2007a,b).

3.1.1.1 Collaborative Management Areas (CMAs)

The main achievement of the TCZCDP has been the development of a collaborative approach to preparing coastal and marine resource management plans (CMAPs) that is broadly satisfactory to both communities and the government, with implementation shared by the villages, District staff and regional/national authorities. There is little doubt that fishers and coastal communities in Tanga Region now have a much greater involvement in, and understanding of, natural resource management and a concomitant greater sense of ownership (Wells et al 2007d).

CMAs are based on resource use, specifically on shared fishing grounds, and therefore involve several villages in each CMA. This has helped reduce conflicts and address the difficulties of managing common pool resources. The CMA approach differs from the Beach Management Unit (BMU) approach introduced by the Fisheries Division to improve community based fisheries management. BMUs consist of a group of people associated with a landing site, a concept borrowed from the Lake Victoria fisheries. We believe the geographic scale of a landing site is too small for managing coastal marine fisheries and is likely to lead to conflict. Regrettably the CMA approach of the TCZCDP was not well considered at the national level when the Fisheries Act was revised in 2003 and the BMU concept introduced.

Despite successes with the TCZCDP CMA approach there were also difficulties. Incentives were important to encourage participation; there was laxity from the authorities in implementing the collaborative plans and a lack of cooperation from some members of the community. However, the major drawback in the long term effectiveness of the Programme is the failure to completely eradicate dynamite fishing in the region (see section XX below).

3.1.1.2 Capacity building within the TCZCDP

Capacity building by TCZCDP in collaboration with other institutions was a key focus of the Programme though its effectiveness is hard to measure (Mzava et al. 2007). The programme included environmental education as extra curricular in schools, youth clubs, adult training in enforcement, business entrepreneurship, environmental awareness, project management and gender issues, among others. Several thousand children and youths benefited from the environmental education programmes, several hundred villagers and local government staff received training and skills development, and women were considerably empowered (Mzava et al. 2007). Activities relating to awareness raising and infrastructure development further contributed to capacity development for coastal management. Individuals in both villages and local government report that they regularly use the skills and techniques gained from the training provided by the TCZCDP, not only in coastal management activities but also in other aspects of their lives.

Stakeholder representation improved through the phases of the Programme: in the beginning there was a forum for stakeholders and regional workshops, and this finally culminated in the Tanga Coastal Consultative Forum, a regional body that meets twice a year to discuss coastal management issues. The TCCF illustrates the broadly integrated and participatory nature of the Programme with members from the national Tanzania Coastal Management Partnership (TCMP), representatives from the national office of the Ministry of Natural Resources, the Ministry of Environment in the Vice President's Office, and ACDI/VOCA. The Programme also forged partnerships with scientific institutions such as CORDIO and the Institute of Marine Sciences (IMS) of the University of Dar es Salaam.

3.1.1.3 Benefits to coastal communities from TCZCDP

The TCZCDP was initiated at a time when the economic outlook was bleak, and took place over a period of considerable economic change in Tanga Region and the country as a whole (Wells et al. 2007d). One of the key changes in the TCZCDP that occurred because of external evaluation was the decision to stop the revenue generating activities in 1998, and to focus on marine resource management only, a decision that was unpopular in the communities. Interestingly, one of the final evaluations recommended that the Programme should re-engage with such activities because the problems of coastal and marine resource management will not be solved unless poverty is addressed. Although the adjustment of the Programme to focus more on fisheries activities was justifiable in terms of available resources, the subsequent difficulties encountered demonstrate that improving the livelihoods of poor coastal communities ultimately requires that attention is paid to all livelihood strategies in use, a point increasingly being made in discussions on sustainable development (Allison and Ellis 2001, Ireland et al. 2004, Ruitenbeek et al. 2004, Wells et al 2007d).

Assessing whether natural resource management interventions in Tanga have resulted in improvements to livelihoods is difficult, particularly because there was no socio-economic monitoring until 2004 and therefore empirical evidence of links between management of marine resources and trends in household income are not available. Many people in Tanga Region, both in the government and in the villagers, perceive that there has been an improvement in the social and economic well being of coastal communities over the last decade (Wells et al. 2007d). For example, one community and some government officials said that more children were going to school and had shoes, and these individuals considered the Programme at least partly responsible. But there could be many causes, as there have been many other changes since the TCZCDP was initiated that affect people's

livelihoods: a general improvement in the Tanzanian economy (Al-Samarrai and Reilly, 2005) and a number of other donor-funded development projects in the three Districts aimed at livelihood improvement for rural populations (Anon, 2005). Fishers have stated in TCZCDP evaluations that their livelihoods have improved, possibly because they now have a much greater control over the resources they use (Wells et al. 2007d).

There is often an assumption, or intention, that by improving the income of coastal communities through alternative livelihoods will result in an improvement in the status of natural resources (e.g. a reduction in fishing, or in the use of destructive fishing methods), or that alternative livelihoods will compensate for income lost if open access for fishers is restricted (e.g. through no-take areas). Such links often fail to materialise (Vincent, 2006). However the TCZCDP did show that fishers (in this case beach seiners) were willing to move into agriculture and thus potentially reduce pressures on marine resources (Wells et al. 2007d).

One of the more interesting observations from the TCZCDP was a simple economic argument made by Lewis and Juma (2005) when doing the final evaluation of the Programme. They estimated that 1 km² of inshore water in Tanga Region has cost about \$500/yr to manage over the last 12 years, based on the average annual budget of the TCZCDP and the total area covered by the CMAs. TCZCDP staff estimate that about US\$130/km² would now be sufficient. Since fish yields of US\$2,500/km²/yr are reported from Tanga (Anderson 2004) the value of investing only \$130/km²/yr is clear. Such economic calculations are, however, not widely understood or accepted by the stakeholders. Fishers as the primary beneficiaries of these valuable fishery yields need to hear and understand these arguments, as do government and those making budget decisions nationally. Other examples that illustrate this point can be seen from neighbouring Kenya where the value of the reefs and associated ecosystems of Kisite Marine Park and Mpunguti Marine Reserve (c. 40 km²) just across the border from tanga region has been estimated at about US\$2 million a year (Emerton and Tessema, 2001); studies from other parts of the world indicate values from just under US\$1,000 to several thousand US\$ per km² of reef a year (UNEP-WCMC 2006).

3.1.2 IUCN Community Consultation workshop

Another initiative being implemented by IUCN linked to the present study was a national workshop that was hosted by CORDIO and EAWLS in Tanga in January 2008 (Becha 2008). The workshop was designed for coastal communities to share lessons in marine resource management to build their capacity and to strengthen policy for the sustainable management of Tanzanian marine resources. Key management and policy recommendations were developed in the workshop by dividing participants into four groups based on common resource management and resource use objectives, activities and interest:

- mangrove rehabilitation and seaweed farming
- marine conservation area and natural resource management
- small-scale fishers
- small-scale traders (commerce and socio-economic development)

Here we list the recommendations made by three of these groups as they have informed the present case study.

Seaweed farming group

- The government should formulate policy guidelines on seaweed farming and trade to safeguard the farmers from unscrupulous investors and traders. The market should be open to increase competition between buyers. It should not be controlled by District Fisheries Officers.
- Seaweed farming guidelines must have provisions to protect the investment in the seaweed farms from illegal and destructive fishing practices such as the use of poison and small-sized mesh nets.
- The government must recognise seaweed farming as an alternative income-generating activity of value to be incorporated into national economic development planning. For example, it should be mentioned specifically in the national policies and programmes for poverty eradication and achievement of the Millennium Development Goals.
- Communities need training in business and investment to increase their production (through more seaweed lines and tools) and to be freed of control by the buyers.

Marine conservation and management areas and conservation committees group

- Conservation area committees must be well equipped and trained to maximise their enforcement and management capacity. The government should support these committees through specific programmes.
- The government should review marine legislation and increase the severity of penalties for offenders. To this end, the courts and responsible departments must be strengthened and should work closely with local conservation committees.
- The government should ensure communities have better access to information and regulations concerning natural resources such as forests, minerals, fisheries and the environment.
- Fisheries regulations should be properly enforced. Offenders must be prosecuted. Dynamite fishers should be severely punished.

Small-scale fishers group (*wavuvu wadogo wadogo*)

- Communities must acknowledge the problems and assume responsibility for solving them.
- The government must translate the Fisheries Act and regulations into Kiswahili so that the information is accessible to fishers.
- The government should speed up the establishment of BMUs as stipulated in the Fisheries Act 2003. BMUs have the potential to act as strong pressure groups against illegal fishing. They should be involved in boat licensing and enforcement patrols (as done by the Lake Victoria BMUs).
- Training programmes should be initiated to build up the management resource pool for coastal and marine resources.
- The Ministry of Natural Resources and Tourism should expand and sustain awareness and education programmes for fishers on topical issues such as sustainable fisheries practices, including the use of appropriate fish nets and gear.
- Local fishers and local natural resource management committees should be included in the monitoring teams that control foreign fishing vessels.
- To overcome corruption amongst fisheries officers, there should be close supervision and monitoring of the work and performance of the fisheries officers by their supervisors. Local people should participate in monitoring and evaluation.

- Fishers must be helped with alternative income-generating activities and be given easy access to loans.

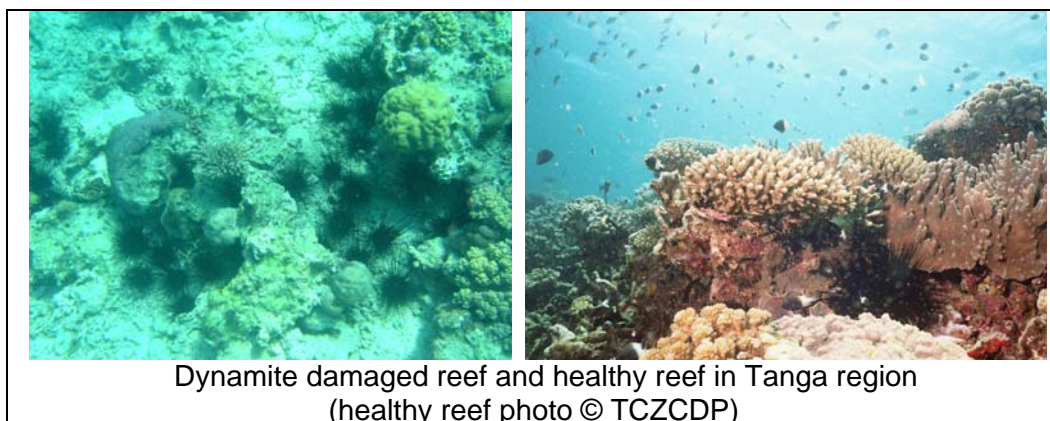
3.2 Dynamite Fishing

Dynamite fishing is the practice used to kill or stun fish for easy collection using either home made explosives or locally available dynamite. Often, a mix of artificial fertiliser and kerosene is used. Due to its harmful nature to aquatic biota, environment and the users, the practice is outlawed in almost all countries in the world. In spite of this, dynamite fishing is still rampant in Southeast Asia and parts of Africa. In Southeast Asia, the Philippines bears the unfortunate reputation for extensive dynamite fishing, dating back to the second World War and American troops making dynamite easily available, reputedly using the methods themselves. In Africa, Tanzania is known for its dynamite fishing which has been in practice since the 1960s (Talbot 1961, Ray 1968, Bryceson 1978, Guard and Masaiganah 1994), despite being prohibited under the 1970 Fisheries Act. By the 1980s and 1990s the practice was rampant with some Tanzanian fishers even venturing into neighbouring Kenya to dynamite reefs in the Kisite Marine Park (Samoilys 1988).

3.2.1 The impacts of dynamite fishing

Environmental, economic and social impacts of dynamite fishing are largely documented from around coral reefs. Blasts destroy corals leading to significant loss of a reef's biodiversity. Dynamite fishing destroys both the living coral tissue and the underlying basal framework of the reef, and is able to destroy the more massive coral forms such as *Porites* spp. and *Pavona* spp. (Samoilys 1988, Solandt and Beger 2000). Continued blasting can completely destroy a healthy reef. The resulting loose rubble is unsuitable for coral planulae (juveniles) to resettle on due to the regular movement of the rubble by wave action. It is not until the rubble becomes a solid substrate for example through the cementing action of coralline algae that coral can re-settle and grow. Sea urchins, particularly *Diadema* spp., appear to favour damaged reefs and are seen in high abundance on Tanga's damaged reefs (Samoilys et al 2007b). In addition, brown macro-algae (e.g. *Sargassum*, *Turbinaria* spp.) often invade damaged reefs and then out-compete young corals. This can result in an ecological phase shift, where coral reefs never recover as coral reefs but become macro-algae dominated reefs (McCook 1999, Samoilys et al 2007b), with greatly reduced fisheries productivity and a loss of biodiversity. This destructive fishing practice is now posing a serious threat to the recently developing coastal tourism sector in Tanzania.

The size of the coral area destroyed by a single blast depends on the size of the bomb and position of the explosion relative to the coral reef (Samoilys and Carlos 1992, Pet-Soede et al. 2000). Each blast completely reduces the reef to rubble within a few metres of the blast site, killing all fish and most other organisms within a 15-20m radius (Guard & Masaiganah 1997). In some areas of the Indo - Pacific, blast fishing is responsible for 50 percent habitat destruction (CCIF 2001, Woodman et al. 2004). On the Tanga coast, an IUCN survey in 1987 found that reefs were extensively damaged, with an average of < 20% live coral cover on most reefs, some with <10% and as little as 1% on one reef (Bensted-Smith 1988). A wider survey in 1995 found that of the 58 coastal and patch reefs studied, 12% were completely destroyed, 64% were in a poor or moderate condition and the remaining 24% were in a good condition (Horrill 1996). The worst damage corresponded to reefs adjacent to the highest human population densities, and most of the damage was attributed to dynamite fishing (Horrill 1997).



Loss of aesthetic value of the reef, risk of physical harm including death to dynamiters and unsuspecting tourists and marine mammals following spontaneous explosions, loss of livelihood by fishers due to habitat destruction and social ostracising of the offenders have all been documented as immediate consequences of dynamite fishing. Short term economic gains are high but diminish in the long term if fishing is done in the same area. A timely single blast in Tanzania can stun and kill fish worth between USD 100, using a blast worth only USD 30 (Riedmiller 2006). Unfortunately, organised dynamite fishing operations are profitable enough to secure the cooperation of local authorities, with systematic enforcement only taking place when an existing dynamite cartel pays for protection from potential competitors (CCIF, 2001).

A recent added twist to the dynamite fishing problem is that gill net fishers in Tanga Region now say they are venturing further offshore to fish in deeper waters because their traditional shallower areas are now unproductive due to dynamite fishing. It is these fishers that have been capturing, incidentally, coelacanths, in significant numbers.

3.2.2 The history of dynamite fishing in Tanzania

Dynamite fishing in Tanzania dates back about 50 years, characterised by phases of appearance and disappearance in some parts of the country. In the 1960s, two people, one a scientist and another a fisher, used dynamite for research and fishing respectively in Tanzania. Since then the practice spread to other parts of the country. A 50 year old resident from Tanga confessed that he grew up while dynamite fishing was going on but did not know exactly when it started.

3.2.3 Dynamite fishing along the Tanga coast

The use of dynamite to catch high numbers of coral reef fishes in Tanga region appears to be an organised practice: the boat and the dynamite are provided by a “business” man or middle man (no women were reported to be engaged in this practice), who employs the fishers as crew on his boat. Tanga cement, Mbuguni Tanzanite mining in Kilimanjaro and the Defense Forces were stated to be sources of dynamite.

When the TCZCDP was initiated in 1994 a strong monitoring, surveillance and control programme was set up to address this highly destructive practice as well as control other illegal fishing practices. Shortly thereafter the Navy was brought in to be part of the

TCZCDP's patrol units. This effort resulted in reducing blast incidences from over 180 a day in 1995 to zero in the following year, with very low incidence persisting thereon for around eight years (Verheij et al 2004). Awareness of the long-term negative effects of dynamite fishing by communities reportedly resulted in more requests for enforcement against the few persistent dynamite fishers. This eventually led to the perception that TCZCDP had brought this practice to a near halt by 2000 (Verheij et al. 2004). However, with the withdrawal of the Navy in 2004, and winding down of the donor funded programme (TCZCDP) in 2005, dynamite fishing resurfaced (Samoilys et. al 2007a). Incidences reported by various local civil society networks (see below) were said to be very high, in the order of 30-50 per month in certain areas (Fig 2). Increasing incidences were particularly noted in the villages of Kigombe, Sahare, Tongoni and Chongoleani. Note that these refer to the reefs off these villages, not the village of origin of the dynamite fisher. A villager from Kigombe reported hearing 10 blasts a day in January 2008 and also insisted that dynamiters are now not even deterred by the personal physical consequences that include loss of limbs, blindness, deafness and even death. We were also told of a recent development whereby dynamite fishers are using silencers to subdue noise levels from blasts to avoid detection, though we were unable to verify this. This may lead to underestimation of blasting frequencies, as reported by local community networks (see below) who record the number of blasts heard.

A number of reasons were reported as causes of the renewal of dynamite fishing in Tanga, though responses from villagers varied considerably. Resurgence could have been associated with easier acquisition of dynamite from construction of the bridges on the Tanga-Mombasa road. The withdrawal of the Navy also apparently greatly reduced the effectiveness of the local patrol units. Other reasons given were: an ineffective judicial system, corruption among authorities responsible for policing such illegal activities, increasing poverty and ineffective and inadequate patrol and monitoring by the government. Given the magnitude of these problems, it would appear that poverty may not be a root cause but a facilitator, although villagers cite it as a major cause.

3.2.4 Legal context of dynamite fishing in Tanzania

Interviewees in Tanga unanimously stated that judicial procedures are ineffective and inefficient in Tanzania. Many who were interviewed also said that they felt this was deliberate. Sentences and fines are too light while cases take a very long time to finalise. Sometimes no action is taken even when communities' notify authorities that dynamite fishing is occurring and patrols boats are close by. Judicial processes are lengthened through the fact that fish brought to court as evidence have to first be taken to the chemist laboratory for approval.

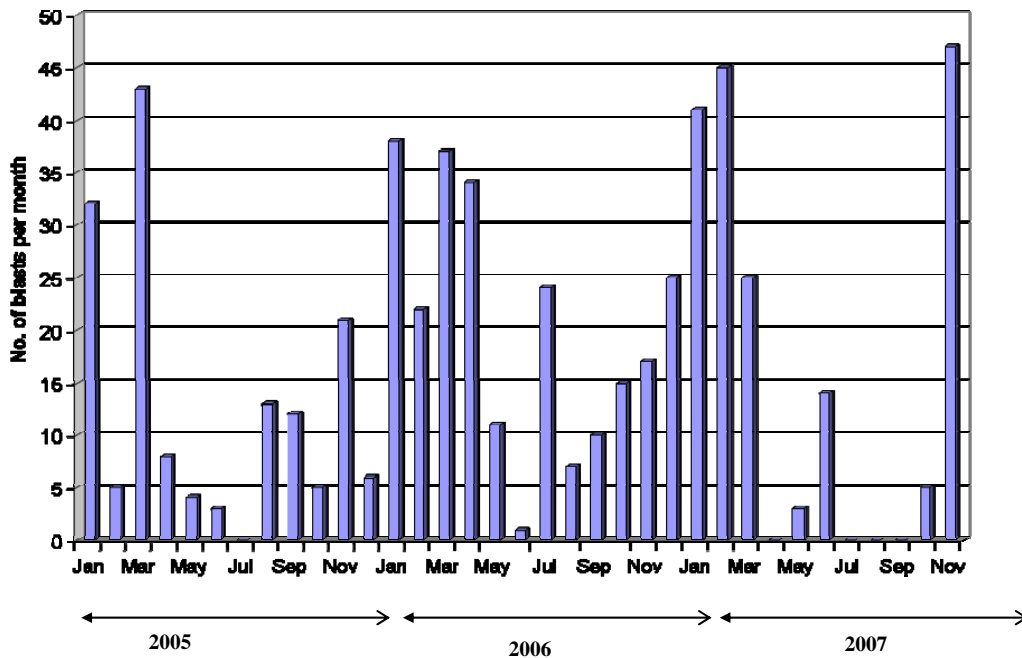


Figure 2. Number of reported dynamite blasts from 2005 to 2007, Kigombe, Mwambani & vicinity, Tanga Region. (Chart adopted from Tanzanian Dynamite Fishing Monitoring Network)

Even after villagers apprehend the culprits themselves, the courts are reluctant to investigate cases, while villagers live in fear of reprisals against informants.

A dynamite fisherman taken to court is potentially faced with four counts of crime: illegal possession of dynamite, fishing without a license, using an illegal gear and fishing with dynamite, all of which can result in around five years in jail. However, few go to jail, and a village representative from the heavily fished Kigombe area confessed not to have known anyone jailed for even six months. Instead fines of as little as Tsh 40,000 (around USD 70) are known to exist while 'severe' fines ranging between Tsh 100,000 to 200,000 (around USD 80 to USD 160), are rarely imposed. Further, interviewees stated that these fines are paid for by the business man in charge of the operation.

Individual and local group initiatives fighting against blast fishing stated that they are often frustrated by the government's apparent inaction. Back in 1995 Scheinman and Mabrook cite the major impediments to eradicating the vice as an inadequate judicial system and government officers in Tanga rendered ineffective through intimidation or bribery. It would appear that this has not changed. Scheinman and Mabrook (1995) went on to equate those organising dynamite fishing as criminals similar to urban drug dealers, an analogy used by Tanga residents today.

Procedures such as tagging dynamite for unique identification have been proposed by some government officers as control measures. The issue of readily available dynamite and the

insecurity this poses to the tourism industry was also raised by several people interviewed, noting that the Tanzanian government does not seem to be taking this issue very seriously.

3.2.5 Current initiatives towards control and elimination of dynamite fishing

In recognition of the renewed intensity of dynamite fishing in Tanga since 2005, various initiatives have been set up, either by individual groups or by the government. Despite national and international attention posed by these initiatives, control on the ground remains elusive.

3.2.5.1 Government Patrols

In recognition of the seriousness of the dynamite fishing problem in Tanga the government set up a specific patrol unit to address this problem in Tanga in 2006. Despite this villagers from heavily fished areas around Mwarongo and Kigombe villages said that patrols were inadequate and ineffective. They stated that the unit is not armed and depends on the Police Department in order to operate and also to be able to carry out any captures of offenders or prosecutions. Despite several scheduled meetings we did not succeed in meeting the patrol unit personnel. They appeared to be too tired and uncertain about sharing information with us. An officer at TCZCDP conceded that they are not in a position to patrol or respond to hotline calls due to inadequate staff and resources such as boat fuel.

Further factors were put forward during interviews that contribute to the difficulties in curbing dynamite fishing in Tanga region. Usually, one days notice is required before the patrol takes place, information is quickly leaked, giving illegal fishers enough time to organise themselves and avoid capture. We were told repeatedly that there seems to be direct collusion between the dynamiters/investors and the Police Department. We were told that a trust fund for the investors in dynamite fishing, the business men, has been created, where members contribute money and pay for the culprits' court fines. We were told that dynamite fishers are also known to operate from boats owned by fisheries officers. On the other hand we also heard that many fisheries officers are intimidated and therefore with reluctance do not take action.

3.2.5.2 Community vigilance

Dynamite fishers were reported by village representatives to have migrated southwards from Tanga town, partly explaining why the southern reefs of Mwarongo and Kigombe are experiencing heavy blasting, compared with the already heavily dynamited and damaged northern reefs where blast levels these days are lower. At the community level, villagers are setting up patrol committees and also trying to persuade dynamite fishers to abandon the practice. In some villages, dynamite fishers have been banned from the village and are said to have sought refuge in the neighborhood where they continue with the practice. However, these efforts are said not to be succeeding; villagers stated they needed more support from the government. According to a representative from Kigombe, fines were higher and surveillance was intense before the redeployment of the Naval unit in 2004. From the villagers perspective, catches have declined tremendously in the last decade, a trend also reported from scientific monitoring (Anderson 2005, Samoilys et al 2007a, Wells et al 2007b). Community representatives also stated that the use of environmentally friendly gears such as

fences (*uzio*) has stopped completely. Fishing has now become unsustainable in these villages with fishermen earning on average Tsh 1,760 (around \$1.3) in a day.

3.2.5.3 Tanzanian Dynamite Fishing Monitoring Network (TDFMN)

The TDFMN was set up in 2005 by a group of people from conservation organisations, community and private sector, government, donors, marine resource users, including representatives of Village Environmental Committees and the commercial fisheries and tourism industry. The network was established to assist formal government procedures in halting the dynamite fishing by exposing and monitoring its occurrence in Tanga Region.

The TDFMN collects blasting information through personal observations. Information collected includes date/time, location, other details such as vessel registration, number of blasts, which is then passed on to government authorities in Tanga for action. Detailed data are also circulated in a newsletter through emails to a broad list of members who include researchers, tourists, private investors and donors, some overseas, to enable discussion. The data show clearly high levels of blasting and an increase since 2006 (fig. 2). The TDFMN has generated a black list of offenders comprising government officers, fishermen and village heads, which has been given to the Tanga patrol unit and other authorities. The network has not, however, operated without critics – the network was strongly criticised by the Zanzibar government at a meeting in 2006 who stated that the network was circulating statements that are 90% incorrect (Yussuf, 2006).

3.2.5.4 Friends of Maziwe Island in Pangani and Friends of Coral Reefs in Tanga

Maziwe Reserve is a national gazetted no-take zone, though prone to fishers using destructive gears. Joint patrols are held by committees comprised of villagers from Ushongo and Pangani, council personnel and private investors, mainly hoteliers (Tides, Emayani, Coco Beach, Pangani beach resort, Protea and a few camps). Each tourist visiting the reserve is charged TSh 3,000 (\$2.4) that goes into community welfare, as well as supporting patrols. However, following continued poaching in the Reserve, tourists have now refused to pay the contributions because blasting has continued. Tourists have also reported observing the Fisheries patrol boat crew selling fuel to local fishermen.

Friends of Tanga Coral Reefs was formed in Tanga, largely supported by local tourist hotels, and they are linked to the wider TDFMN in efforts to combat dynamite fishing.

3.2.5.5 Donor and government action

A high level meeting of government and concerned organisations was organised in December 2007 which was supported by the British Consul, WWF, Fisheries Department, IUCN, and a \$60 million World Bank funded Marine and Coastal Environment Project (MACEMP), currently operating in Tanzania. WWF have identified Tanga as an 'Ecoregionally' important seascape within WWF's East African Marine Ecoregion (EAME), and are taking several steps to bring this critical issue to the attention of decision makers high in government. The high level meeting generated significant press coverage at the time, and the government stated that it would have "zero tolerance" for offenders. The Tanga patrol unit was said to now have more "teeth" and there was a short decline in incidences of dynamite blasts. However, this action has not been sustained and high levels of blast fishing have

continued to be reported on the TDFMN network in 2008. However, recently (May) sources state that the TDFMN black list is now being being targeted by the patrol unit providing some hope for the future.

3.3 Mariculture activities along the Tanga coast

Many programmes have focused on mariculture as a way of diversifying livelihoods and reducing pressure on marine resources. The TCZCDP demonstrated considerable potential for mariculture in Tanga Region, and contributed to an awareness among communities and the Districts of the potential for mariculture activities with aspects of mariculture introduced to an estimated 1,575 people, including 220 women. Over 20 individuals received training to the level that they could train others and pass on their experience. In addition, the TCZCDP developed a preliminary knowledge base as a result of the trials with tilapia and oysters (Wells et al. 2007d, Zuberi et al. 2007).

Seaweed production has increased dramatically in Tanga over the last 10-15 years due in large measure to the overall growth in the industry nationally and promotion by the private sector. By 2003 seaweed farming had benefited 305 people in Tanga Region, the majority being women (Zuberi et al. 2007). Currently Tanzania is the third largest producer in the world after the Philippines and Indonesia. The practice involves farming two species of algae introduced into Tanzania from the Philippines (*Eucheuma spinosum* [also known as *denticulatum*] in 1989, and *Kappaphycus alvarezii* [previously called *cottonii*] in around 1996; Zuberi et al 2007).

Seaweed farming, however, probably does not take pressure off marine resources, which are exploited mainly by men, as it is carried out predominantly by women, although it may reduce other activities traditionally undertaken by women, such as reef gleaning and collection of firewood. In general, fishermen in Tanga region were found to not be interested in seaweed farming because income from it was lower than that generated from fishing, and it involves hard labour. However, if prices improve, more men may become involved and reduce their fishing activities (Wells et al. 2007d).

Trials were also done by TCZCDP, though unsuccessfully, for milkfish, prawn, tilapia, oyster and fish aggregating devices (FADs). Natural substrates were successfully introduced for lobster attraction. Lack of seed, market and technical expertise were among some of the reasons for the lack of success. However, the main reason TCZCDP did not continue with mariculture and other AIG activities was due to advice to stop these activities in 1998 during an external review of the Programme.

The Division of Fisheries provide limited support to mariculture development largely due to a lack of technical knowledge and experience.

In 2003 ACIDI/VOCA, a US based NGO funded by USAID, established the SEEGAD project in Tanga which has played a pivotal role in mariculture training (Savoie 2005, ACIDI/VOCA 2007,a,b) focusing mainly on seaweed and mangrove crab (*Scylla serrata*) culture. This has resulted in many women engaging in seaweed farming, which has improved their economic status. SEEGAD evolved into the Sustainable Environmental Management through Mariculture Activities (SEMMA) programme in 2005, still implemented by ACIDI/VOCA, which has continued to support seaweed farming and is now doing successful trials for crab fattening (ACIDI/VOCA 2008b). SEMMA suspended support for penaid prawns (shrimp) and milkfish (*Chanos chanos*) following seed, technical and market constraints, although some

community groups are still practising milk fish farming. SEMMA's main conclusion regarding culture of these animals is that hatcheries are essential if mariculture is to be properly implemented. Currently there is no hatchery in East Africa though there are plans to construct one for in prawns in Bagamoyo, and SEMMA are applying for funds for a mangrove crab hatchery in Tanga.

3.3.1 Value chain analyses by SEMMA

Before further promoting and putting a lot of effort in mariculture along the Tanga coast and Tanzania in general, SEMMA strongly suggested conducting value chain analyses to identify constrains and possible solutions for various mariculture schemes, preferably from private leaders who must be willing to invest in the chain.

SEMMA concluded that seaweed farming is economically viable if conducted on a large enough scale so that farmers are able to individually produce enough harvest, and as long as they invest their own farming inputs (lines) rather than rely on the buyers. Typically local communities farm 100 lines (Table 1). SEMMA are now recommending more commercially sized farms of 400 lines, planted in four 100m blocks which are harvested in sequence over a two month period (J. Sachak pers. comm.). 400 lines will produce 1 t. of seaweed per farmer worth around USD 55. SEMMA are promoting this among 850 farmers and hope to yield 370t/month worth a total of \$547,000 per year, which would provide each farmer with around \$644 per year. SEMMA are now also promoting the deeper water raft system for growing seaweed which is said to enhance growth. Seaweed farming to date has resulted in an average increase in income of \$470/person/year (J. Sachak pers. comm.). Although not a great sum, this must be viewed in the context of labour input – seaweed farming involves about 10-12 days work per month, ie six months per year, and therefore can be viewed as a supplementary livelihood.

Compared to seaweed farming, economic analysis has shown that crab farming has higher returns than seaweed farming (Table 1).

Table 1. Individual economic returns for crab and seaweed farming in Tanga (ACD/VOCA 2007a; ACDI/VOCA 2007b)

	Tsh	USD	No. Units	Invest. days
Crabs	125,400	114	100 crabs	45
Seaweed	44,000	20	100*20 m lines	30

Commercial crab production demand in Tanga is relatively high due to a local private buyer/exporter who is willing to purchase 500 crabs a week weighing between 500 gm to 1000 gm each (Sachak pers comm.). Another buyer from Dar es Salaam is now buying large (>1000gm) crabs for export (per. obs.). SEMMA commissioned a stock assessment by TAFIRI which established adequate crab larvae reservoir and supply in Putini and Pangani basins (Mahika et. al. 2005). On the strength of this SEMMA have promoted crab fattening whereby young crab are captured in the wild and then fattened in individual wooden cages which are constructed in the mangroves (see plates). To increase profits and optimise time consumption as a resource, farmers are being encouraged to fatten crabs individually rather than in a group.



Mangrove crab fattening in Kiwavu and Pangani

Members of Bweni women, Pangani District have increased their profits by 50% since they embarked on crab fattening in 2006, compared with what they used to earn from activities such as selling firewood. However, other groups stated they had not made sustainable profits from milkfish, crab or seaweed culture due to the small scales of production, lack of physical and technical inputs, lack of suitable markets and financial constraints.

3.4 Mariculture site visits in Tanga

Seaweed farming, crab fattening, milk fish farming and lobster aggregating devices are all mariculture related activities currently active in Tanga. Two community groups were visited in Pangani District who practice milk fish pond farming, crab fattening and seaweed farming on a small scale, in tandem with their other daily activities. Discussions were also held with a third fisher group dedicated to lobster enhancement. This involves constructing shelters from local rocks to make hides within the fishing grounds, to create an ideal habitat for the lobster. Lobsters aggregate in these shelters because they provide protection for them. Fishers reported improved catches following the practice. The two site visits provided a useful picture of typical locally operated mariculture initiatives and their constraints.

3.4.1. Milkfish culture in Machui village, Pangani district

Villagers from Machui village started a welfare group in 2005 with the majority being women, though more men joined later. Previously, the villagers were actively engaged in mangroves cutting and salt making to earn their living, alongside fishing. The five milk fish ponds occupy a former saltpan. According to the villagers, TCZCDP was involved in the beginning though no assistance was given to ensure proper pond construction. Currently the Tanga Municipality Fisheries Officer is providing technical support and occasionally assisted in the



Old salt pans converted to milk fish ponds in Tanga region

transport of fish to market. Drainage is a problem, and dykes collapse quite often as villagers used their masonry skills to construct the ponds. Pond construction requires different skills altogether, especially in ensuring that the dykes are well compacted and elevated at proper angles, and that the pond bottom is compacted and flattened correctly.

Production is below levels that should be possible at this site (Table 2). Members suggested the need for more financial and technical assistance in the construction of more ponds and repair of the current ones, though did not provide any suggestions on how to obtain financial report, instead indicating an expectation that the government should provide handouts. SEMMA is playing a relatively minor role in milkfish farming because there is no hatchery available and many of the existing ponds in the region have been poorly constructed and therefore require substantial overhauling to get them into proper production.

3.4.2 Crab and seaweed culture in Kiwavu village, Pangani District

Crab culture started in Kiwavu village in 2005 with 11 members, of which 3 are men. Both crab and seaweed farming are perceived to be feminine jobs in this village, probably due to their small scales of production associated with low incomes. Crab fattening started off with 14 crabs, with assistance from TCZDP, which grew to 200 in the next stock. Unfortunately the crabs were stolen making the group members lose hope in the activity. To date they are still unsure whether to proceed, and at the time of our visit, the cages were still empty. The villagers were also discouraged by low crab prices of Tsh 990/kg (\$0.8/kg) that was largely due to failure to meet quality requirements.

Table 2. Milkfish and Seaweed production by two groups in Pangani district, Tanga

Group name	Members	Village	Mariculture type	No. Units	Invest. period	Tsh	USD
Machui women group	65	Machui	Milkfish	two 30*40m ponds	6 months	211,200	192
Amasa Women group	11	Kiwavu	Seaweed	<100 lines	45 days	49,500	45

The women also engage in seaweed culture although production is still low, and consequently the returns (Table 2). However, they intend to continue with seaweed having developed the required skills to culture seaweed. Again, they expressed a need for financial inputs, expecting government handouts rather than discussing options of loans, investment in

the business etc. Their understanding of business seemed poor, but it may also have been because they perceived our visit as an opportunity for soliciting for donor funds.

Lobster aggregating group

The project was initiated in Kigombe, Pangani district by TCZDP, not as a mariculture initiative but to enhance fishing by aggregating lobsters through construction of shelters. The three month lobster peak periods of capture occur twice a year, in which members reported total catches of about 500 kg, worth Tsh 10 million, equivalent to Tsh 5,556 (\$4) per day per member (for 6 months). Vandalism and conflict with other gear users were reported as major challenges.

3.5 Challenges facing mariculture production in Tanga

A number of challenges are evident in the mariculture activities currently occurring in Tanga Region. The following were listed as major challenges for the area (Match Maker Associates Limited/EPOPA Tanzania 2005):

- Harsh weather conditions and poor soils (high permeability in some areas)
- overexploitation and depletion of coastal resources
- biodiversity and wetland (including mangroves) habitat loss
- inefficient use of resources including time, low literacy levels and lack of entrepreneurial drive
- disparities in gender equity against women and
- absence of stock assessment of marine products

Our investigations revealed further rather specific problems and challenges, depending on the type of culture. Lack of attractive market was a common challenge experienced by all players. While seaweed culture remains labour intensive and a potential source of conflict, inadequate access to farm inputs was a major constraint to expanding production. To realise profits, production of one tonne of dried seaweed is required, equivalent to 400 lines of 10 m each. Common among milkfish, shrimp and crab was inadequate seed and failure to meet market requirements. Milkfish and prawn culture initially require high labour inputs especially in pond construction and stocking. Currently, there is fear of disease outbreak in prawn culture ponds that can eventually spread to the wild, causing threat to the wild stock and healthy seed availability. However, such fears are often unfounded and are spread by commercial interests in an attempt to put off competitors. Even if all the conditions are favourable, continuous capacity building is still needed to elevate aquaculture knowledge and business skills among the interested parties in the region as the practice is still relatively new (ACDI/VOCA 2007b).

4. Conclusions

4.1 Dynamite fishing

Tanzania's large artisanal fisheries are intimately linked to its coral reef ecosystems which have (or had) high biodiversity and are (were) highly productive systems. Dynamite fishing destroys the very basis of this system - the corals that build the reefs - leading to significant

loss of biodiversity and fisheries productivity. Continued blasting can completely destroy a healthy reef which may never recover but shift to an algal dominated reef which lacks the diversity of species and whose productivity in terms of fisheries is greatly reduced. This destructive fishing practice is now also posing a serious threat to the recently developing coastal tourism sector in Tanzania.

Dynamite fishing in Tanzania dates back about 50 years, and is an organised practice whereby the boat and the dynamite are provided by a “business” man or middle man who employs the fishers as crew on his boat. Yields are high compared with traditional fishing methods. The renewal of dynamite fishing in Tanga in 2004/5, having been almost eliminated for nearly 10 years through effective enforcement patrols coordinated by the TCZCDP, appears to be linked to easy access to dynamite, the withdrawal of the Navy as part of the local patrol units, the withdrawal of the large donor funded TCZCDP, an ineffective and inefficient judicial system, corruption among authorities responsible for policing such illegal activities, increasing poverty and ineffective and inadequate patrol and monitoring by the government. It should be noted that it is reputedly a minority that engage in this practice, as most fishers are strongly opposed to it and are well aware of its long term destructive impacts.

Recent responses by government and concerned citizens have resulted in increased government led patrols, local community networks which publicise the issue and monitor the blasting, and a highly publicised high level meeting of government and concerned organisations in December 2007. Despite this, high levels of blast fishing have continued. It would appear that the nature of dynamite fishing is well understood by the state and the various communities in the region. But the failure to tackle this pernicious practice effectively may relate to the very large focus on enforcement as the primary method to address it. Enforcement is invariably a difficult, expensive and unsustainable option. Rather, mechanisms for encouraging compliance are likely to have greater effect in the long term. We would recommend that the authorities address some of the other enabling factors that allow this practice to continue in Tanga: easy access to dynamite, corruption and an ineffective judicial system. These factors may also illustrate why this practice is widespread in Tanzania but does not occur in neighbouring Kenya or Tanzania. The community consultation lessons learning workshop (section 3.1.2) called for an increase in the severity of penalties for offenders so that dynamite fishers are severely punished. To this end, the recommended that the courts and responsible departments must be strengthened and should work closely with local conservation committees. Community representatives also recommended that to overcome corruption amongst fisheries officers, there should be close supervision and monitoring of the work and performance of the fisheries officers by their supervisors, and that local people should participate in monitoring and evaluation.

4.2 Mariculture

The three dominant mariculture initiatives in Tanga Region, milk fish, crab and seaweed, have evolved in line with the different coastal habitats that occur in the area:

- milkfish pond farming is suited to the salt flats behind the mangroves
- seaweed farming is suited to shallow waters off sandy beaches
- crab fattening is suited to mangroves

Thus communities have selected which activity to engage in based on the habitats in which their villages are situated. Often the milk fish ponds are converted salt ponds. All initiatives are small scale at the village level and communities have engaged in the practise largely due to encouragement and support from NGO driven programmes (TCZCDP, SEMMA), with fairly minimal government support.

It is important to note that none of the existing animal-based mariculture initiatives are true mariculture because they are not breeding the organism: there are no hatcheries in Tanzania. Instead all practices harvest organisms from the wild either as fry or juveniles, and therefore operate essentially as grow-out practices. This is relevant if the animal is already being harvested as part of the local fisheries, as in the case of crab and lobster, though is less of an issue for milkfish because it is not a highly targeted fishery species. The crab fattening cages and the lobster shelters should therefore be seen as mechanisms for either value adding to an existing fishery (crabs) or for enhancing catching efficiency (CPUE) (lobster shelters). Consequently such practices must be managed hand in hand with the management of the wild stock, and should not be seen as separate mariculture industries as they do not enhance production in the marine environment. This fact did not seem to be well comprehended by most stakeholders. The plant based seaweed farming is an exception as the plants are imported from the Philippines, and are therefore not using local wild species. However, there is potential for invasion by these exotic species in Tanzania's marine environment. To date, there is no evidence of this occurring, there has been no spreading, and it is generally assumed that the two species do not have invasive tendencies and are outcompeted in the wild by locally occurring species, though specific research on this has not been done.

It was clear from the interviews and site visits that community based milkfish, crab and seaweed culture are not yet creating significant and sustainable profits due to the small scales of production, lack of physical and technical inputs, lack of suitable markets and financial constraints. All of these constraints were mentioned in the community lessons learning workshop (section 3.1.2) and recommendations for addressing them provided, largely through calls to government for national policies to recognise the industry as a mechanism for addressing poverty, and for government to have less control over buyers and markets. The industry has great potential for addressing food security and income generation but substantial effort is now required to build capacity, provide technical inputs, and ensure small scale mariculture in Tanga is developed through learning lessons from South East Asia and South America where the industry is 10-15 years ahead of East Africa. Notably, the fears of environmental damage from aquaculture and the associated onerous EIA requirements in Tanzania relate back to problems of the 1990s that have largely disappeared in current practices seen in Asia and South America, due to advances in technology in the last 8-10 years. Technical capacity within District government to provide adequate extension services is limited. Considering the fast pace of development in this industry globally, it is not surprising that local government extension officers are challenged to keep up with the latest information. Even in developed countries government extension officers in aquaculture are rarely adequate (e.g. Australia, pers. obs.). It is recommended that this situation be recognised and that government outsource this service to NGOs that are specialising in community based mariculture. SEMMA is perfectly situated in Tanga town to provide such a service and should be recognised as such.

Since mariculture is still relatively undeveloped in Tanga region it is difficult to properly assess the impacts of mariculture on coastal peoples' livelihoods. Certainly women have benefited from seaweed farming, which although small, provides them with a cash income which is roughly double what they have might have earned from other activities (eg selling

firewood). The young men running a crab fattening group venture in Pangani reported substantial improvements in their incomes, despite running it as a group. Generally, quantitative monitoring of the impacts of mariculture in terms of reducing pressure on marine resources is lacking and therefore it is difficult to assess this important question. It is highly recommended that well designed monitoring and assessment protocols are put in place as mariculture ventures ramp up and the industry develops fully.

5. References

- ACDI/VOCA. 2007a. Quarterly Project Report, January-March 2007. SEMMA, Tanga, Tanzania.
- ACDI/VOCA. 2007b. Quarterly Project Report, April-June, 2007. SEMMA, Tanga, Tanzania.
- ACDI/VOCA. 2008a. SEEGAAD: Alleviating Poverty & Countering Environmentally Unsustainable Practices.<<http://www.acdivoca.org/acdivoca/PortalHub.nsf/ID/tanzaniaSEEGAAD>>
- ACDI/VOCA. 2008b. SEMMA: Developing Economically Viable & Environmentally Sustainable Income-Generating Activities.<<http://www.acdivoca.org/acdivoca/PortalHub.nsf/ID/tanzaniaSEMMA>>
- Al-Samarrai, S. and B. Reilly. 2004. Education, employment and earnings of secondary school leavers in Tanzania: evidence from a tracer study. PRUS Working Paper No. 31, Poverty Research Unit, University of Sussex, UK.
- Anon. 2005. Tanga Integrated Rural Development Programme (TIRDEP), Tanzania. Summary Ex-post Evaluation. Country Case Study. BMZ Evaluation Report 007, Division of Development Education and Information, Sustainability of Regional Rural Development Programmes (RRD), Federal Ministry for Economic Cooperation and Development.
- Becha H. 2008. National workshop for building the capacity of coastal communities and strengthening policy for the sustainable management of Tanzanian marine resources. Workshop, 28 – 31 January 2008, Tanga Regional Coastal Resource Centre. Workshop Report. CORDIO/IUCN. 32pp.
- Bensted-Smith, R. (Ed). 1988. The Coastal Resources of Tanga Region, Tanzania. Report of a Preliminary study in October 1987. Regional Natural Resources Office, Tanga Region and IUCN-EARO. 51 pp.
- Bryceson, I. 1978. Tanzanian coral reefs at risk. *New Scientist* 80: 115.
- Conservation and Community Investment Forum (CCIF). 2001. Analysis of Destructive Reef Fishing Practices in the Indo-Pacific. CCIF Marine Program, San Fransisco, USA.
- Guard, M. and M. Masaiganah 1997. Dynamite fishing in southern Tanzania, geographical variation, intensity of use and possible solutions. *Marine Pollution Bulletin* 34(10): 758-762.

Harrison, P., (2005) A Socio-economic Assessment of Sustainable Livelihoods Regimes for Communities of Mnazi Bay Ruvuma Estuary Marine Park, Tanzania: Incorporating livelihood intervention strategies and proposals for the development of Alternative Income Generating Activities. IUCN EARO, Nairobi.

Horrill, J. C. 1996. Coral reef survey: summary report. Tanga Coastal Zone Conservation and Development Program, Tanga, Tanzania.

Horrill J. C. 1997. Case study of collaborative fisheries management in Tanga Region, Tanzania. IUCN Wetlands Programme, Gland, Switzerland.

Horrill C. 2003. Tanga Coastal Zone Conservation and Development Programme: A Case Study of Collaborative Coastal Management in Northern Tanzania. Second International Tropical Marine Ecosystems Management (ITMEMS) Symposium, March 24-27, 2003, Manila, Philippines.

Horrill J. C., Kalombo, H. and S. Makoloweka. 2001. Collaborative reef and reef fisheries management in Tanga, Tanzania. IUCN EARO, Nairobi. 37pp.

Horrill J. C., Kamukuru A. T., Mgaya Y. D., Risk M. and J. Church. 2000. Northern Tanzania, Zanzibar and Pemba. *In: McClanahan T. R., Sheppard C. and Obura D.O. (eds.) Coral Reefs of the Western Indian Ocean: Their Ecology and Conservation.* Oxford University Press, New York.

Ireland C. Malleret D. and L. Baker. 2004. Alternative Sustainable Livelihoods for Coastal Communities – A Review of Experience and guide to Best Practice. IUCN-EARO, Nairobi.

Mahika C., Mhithu H. and B. Kuboja. 2005. Rapid Assessment of Abundance and Biomass of the Mangrove Crab (*Scylla serrata* L.) and its Mariculture Development on The Tanga Coast. ACDI/VOCA, Tanga.

Makoloweka S. and K. Schurcliff. 1997. Coastal Management in Tanga, Tanzania: a decentralized community-based approach. *Ocean and Coastal Management* 37: 349-357.

Match Maker Associates Limited/EPOPA Tanzania. 2005. Sub Sector and Value Chain Analysis for Mud Crabs Tanga Coastal Belt. Final Report, Tanga.

McClanahan, T.R., Muthiga, N.A., Kamukuru, A.T., Machano, H., and R. Kiambo. 1999. The effects of marine parks and fishing on the coral reefs of northern Tanzania. *Biological Conservation* 89: 161-182.

McCook L.J. 1999. Macroalgae, nutrients and phase shifts on coral reefs: scientific issues and management consequences for the Great Barrier Reef. *Coral Reefs* 18: 357-367.

Mzava E., Mbura M., Bwindiki J., Uronu G., van Ingen T., and S.Wells. 2007. Capacity development *In: Wells S., Makoloweka S. and Samoilyls M. (eds.) Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Tanzania.* IUCN-EARO, Nairobi.

Obura D., Suleiman M., Motta H. and M. Schleyer. 2000. Status of Coral Reefs in East Africa: Kenya, Mozambique, South Africa and Tanzania. *In: Wilkinson C. (ed.) Status of Coral Reefs of the World: 2000*. Australian Institute of Marine Science, Queensland, Australia.

Pet-Soede C., Cesar H. S. J. and J. S. Pet 2000. Economic issues related to blast fishing on Indonesian coral reefs. *Indonesian Journal of Coastal and Marine Resources*. 3(2): 33-40. Correction in the text--Pet-Soede et al. 2000

Ray G.C. 1968. *Marine Parks of Tanzania*. Conservation Foundation, Washington D.C.

Riedmiller S. 2006. Dynamite fishing rampant in Tanzania's north coast (opinion and Analysis). *The Citizen*, Friday, 3 Nov, 2006. Tanzania.

Samoilys, MA (1988) Abundance and species richness of coral reef fish on the Kenyan coast: the effects of protective management and fishing. *Proc. 6th Int. Coral Reef Symp.* 2: 261-266.

Samoilys M.A. and G. Carlos 1992. Development of an underwater visual census method for assessing shallow water reef fish stocks in the south west Pacific. ACIAR Project PN8545 Final Report, April 1992. 100pp.

Samoilys M., Wells S., Anderson J., Horrill C., Kalombo H. and E. Verheij. 2007a. Fisheries and their management in Tanga region. *In: Wells S., Makoloweka S. and Samoilys M. (eds.) Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Northern Kenya*. IUCN-EARO, Nairobi. pp.46-76.

Samoilys M., Horrill C., Kalombo H, Kabamba J, and S. Wells. 2007b. Coral reefs and mangroves: maintaining ecosystem health. *In: Wells, S, Makoloweka, S, and Samoilys M. (eds.) Putting Adaptive Management Into Practice: Collaborative Coastal Management in Tanga, northern Tanzania*. IUCN Eastern Africa Regional Office. pp: 77-102.

Savoie, R. 2005. SEEGAARD. Progress Report, January-March, 2005. Tanga, Tanzania.

Scheinman D. and A. Mabrook. 1996. *The Traditional Management of Coastal Resources*. Consultancy report to TCZCDP. 77 pp.

Solandt J-L. and M. Beger. 2000. A study of the key anthropological and physical impacts that occur on the reefs of Danjungan Island, Negros Occidental. *Danjungan Island Survey Summary report 1, PRRCFI*. Bacolod, Philippines.

The Planning Commission. 1997. *Tanga Region Socio-Economic Profile*. Dar es Salaam and Regional Commissioner's Office Tanga, The United Republic of Tanzania.

Talbot, F. 1960. Notes on the biology of the Lutjanidae (Pisces) of the East african coast, with special reference to *L. bohar*. *Annals of the South African Museum* 45: 549-573.

Verheij E., Makoloweka S. and H. Kalombo. 2004. Collaborative coastal management improves coral reefs and fisheries in Tanga, Tanzania. *Ocean and Coastal Management* 47: 309-320.

Vincent A.C.J. 2006. Reconciling fisheries with conservation on coral reefs: the world as an onion. *In: J. Nielson. (ed.). Proceedings of the 4th World Fisheries Congress, Vancouver, 3-6 May 2004. American Fisheries Society Symposium 49:587-620.*

Wells S., Makoloweka S. and M. Samoilys (eds.) 2007a. *Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Tanzania.* IUCN-EARO.

Wells S., Samoilys M.A., Anderson J, Kalombo H, and S. Makoloweka 2007b. Collaborative Fisheries Management in Tanga, Northern Tanzania. *In: McClanahan TR and J.C. Castilla (eds) Fisheries Management: Progress towards sustainability.* Blackwell. pp. 139-165.

Wells S., Horill C., Kalombo H., Kabamba J., and E. Verheij. 2007c. Collaborative Management Area Planning. *In: Wells S., Makoloweka S. and Samoilys M. (eds.) Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Tanzania.* IUCN-EARO, Nairobi. pp. 22-45.

Wells S., Samoilys M. and S. Makoloweka. 2007d. Conclusions and lessons learnt. *In: Wells S., Makoloweka S. and Samoilys M. (eds.) Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Tanzania.* IUCN-EARO, Nairobi. pp. 170-185.

Woodman G. H., Wilson S. C., Li V.Y.F. and R. Renneberg. 2004. A direction-sensitive underwater blast detector and its applications for managing blast fishing. *Marine Pollution Bulletin 49, 964-973.* Correction in the text--Woodman et. al....

Yussuf, I. 2007. Dynamite fishing writer provokes furore in Z'bar <<http://ippmedia.com/ipp/guardian/2006/11/20/78754.html>>

Zuberi L., Urio F., van Ingen T. and S. Wells. 2007. Enhancing livelihoods. *In: Wells S., Makoloweka S. and Samoilys M. (eds.) Putting Adaptive Management into Practice: Collaborative Coastal Management in Tanga, Northern Kenya.* IUCN-EARO, Nairobi. pp. 103-123.