

TOPIC AREA

QUALITY SEEDSTOCK DEVELOPMENT



SPAT COLLECTION AND NURSERY METHODS FOR SHELLFISH CULTURE BY WOMEN

Quality Seedstock Development/Experiment/13QSD01PU

Collaborating Institutions and Lead Investigators

University of Hawaii at Hilo (USA)

Maria Haws

University of Dar es Salaam (Tanzania)

Narriman Jiddawi

Western Indian Ocean Marine Sciences Association (WIOMSA) (Tanzania)

Julius Francis

Objectives

This work builds on eight years of efforts to develop a small-scale bivalve shellfish culture industry in Zanzibar to increase food security and family income with women being the primary participants. Specifically, this work will address one of the primary obstacles to further development of the small shellfish farms-how to obtain stock in a sustainable manner for the farms. Spat collection is one of the most sustainable and cost-effective methods to obtain stock for shellfish farms, hence methods will be tested to determine the best materials and timing for spat collectors, and test nursery methods to rear the collected spat. Women will also be provided training in other shellfish farming methods beyond the nursery stage.

Introduction

Zanzibar has recently been the site for innovative work that combines development of aquaculture with integrated coastal management and fisheries management to implement alternative livelihoods. Zanzibar consists of two main islands and a number of small islands in the East Coast of Africa. The total area of both islands is 2,643 km² (Unguja 1658 km² and Pemba 985 km²). The population is estimated to be around 1,300,000 people, growing at 3.1 % annually. Fishing is the most common coastal activity and is 95% artisanal, mostly operating in shallow water using traditional vessels and gear. However, the artisanal fisheries are now considered to be overfished (Jiddawi, 2012) which has stressed local villages and the economy. Alternative to fishing are a high priority of the national and local governments.

The residents of Zanzibar suffer from multiple nutrition and health issues related to poverty and marginalization. Of children under five years of age, 35% are stunted, 25% are underweight and 6% are wasted, resulting in approximately 130 child deaths per day (ZPRP 2002). This is one of the highest rates amongst areas in Tanzania. Nutritional problems include protein/energy, iodine and Vitamin A. Bivalve shellfish are good sources of protein, vitamins (C, B1, B2, B3, D) and nutrients such as calcium, iron, copper, iodine, magnesium, zinc, manganese and phosphorus. Hence farming of bivalve shellfish represents a direct means of improving nutrition through local consumption, as well as an indirect means since women also sell bivalve products to support basic family needs.

The proposed work builds on eight years of efforts to develop a small-scale bivalve shellfish industry led by women stakeholders in East Africa. These efforts have had successful results in that over seven coastal villages now engage in some form of bivalve shellfish farming.

Coastal women have traditionally utilized reef-gleaning of bivalves, other invertebrates and small fish as one of their livelihoods, and as the principal source of high protein food. This traditional livelihood is threatened by: 1) increasing populations; 2) migration of inland populations to the coast; 3) development for tourism which excludes villagers; and 4) over-fishing. Climate change may also affect women's

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livelihoods. For example, seaweed farming has been a mainstay for coastal women for over twenty years but recent disease outbreaks have lowered production (Msuya et al. 2007) and may be linked to increased sea surface temperatures. Since 1998, a team of partners including the Institute for Marine Sciences (IMS), Tanzania Coastal Management Partnership (TCMP) and the Western Indian Ocean Marine Sciences Association (WIOMSA) have led efforts to improve marine resource management, improve coastal management, build awareness for ICM and conservation, provide alternative livelihoods and conduct relevant research. These partners were supported by the national and local governments, and a wide array of universities and international donors.

Most recently, the partners were supported by the Coastal Resources Center of the University of Rhode Island (CRC/URI) and the Pacific Aquaculture and Coastal Resources Center at the University of Rhode Island (PACRC/UHH) to focus on protecting and sustainably utilizing the coastal shellfish resource. This work was supported by USAID through the Sustainable Coastal Communities and Ecosystems (SUCCESS) Program, along with other donors such as the MacKnight Foundation and the European Union ReCoMap (Regional Coastal Management Programme). Successful efforts previously supported by USAID include:

- Establishment and community-based monitoring of Marine Protected Areas (MPAs) to protect cockle (*Anadara* spp.) populations, a mainstay of the coastal diet;
- Development of bivalve shellfish farming led by women farmers;
- Piloting of pearl production and production of half-pearl jewelry by women;
- Initial testing of spat collection methods for a variety of bivalve species; and
- Development of a cottage industry utilizing discarded mollusk shells to make jewelry.

This work has been modeled on the successful efforts to develop seaweed farming by women along the East African coast which is now a major coastal industry. Many of the women shellfish farmers have also engaged in seaweed farming, hence they have a basic knowledge of aquaculture. Shellfish farming has equal potential if technical support is provided so that existing methods can be refined.

Despite the success of the initiatives listed above, these are still new economic activities which continue to need technical support and further applied research to make more profitable, scale up and become more sustainable. These efforts support food security both directly and indirectly. Bivalve shellfish are an important source of protein and micronutrients for women and children. They are commonly the only source of protein that this group can access on a daily basis. Shellfish are also one of the main sources of income for coastal women, and the new cottage industries of producing shell jewelry and half pearls has significantly increased women's incomes. It has been documented that Zanzibar women use income from these activities for children's school fees, food, and clothing and to improve their housing (Crawford et al. 2010; Haws et al. 2010). Hence stabilizing and scaling up bivalve culture offers a feasible approach to improving food security and income for coastal women and children.

Significance

Women have been leaders in coastal aquaculture in East Africa being the first to culture seaweed, which has become the major type of coastal aquaculture. The shellfish farming development efforts started eight years ago were modeled on the seaweed farming efforts, both of which were supported by the research and extension efforts of IMS and WIOMSA. Shellfish farming was a natural activity for women to adopt since they were already familiar with many bivalve species due to their reef-gleaning activities. Initially women began shellfish farming in a low intensity fashion by placing smaller specimens of the bivalves they collected from reef areas in small, fenced-in enclosures in the intertidal area to allow these to grow to eating size. The purpose of the "fences", made of short stakes, was not primarily to contain the bivalves, but rather to designate the area claimed by the woman farmer and to prevent other intertidal users from treading on the enclosed bivalves. Subsequently they found that the stakes provided good substrates for spat collection, as high numbers of spat naturally attached to the stakes. These specimens were added to

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the “farmed” bivalves in the enclosed area. Women typically gather, consume and sell nearly every bivalve species (*Ostrea spp.*, *Crassostrea spp.*, *Isognomen spp.*, *Donax spp.*, *Anadara spp.*) found on the intertidal flats (~15 common species), including two species of pearl oysters, *Pinctada margaritifera* and *Pteria penguin* (Jiddawi 2008). The latter two species have been utilized for half-pearl production on a limited basis on Zanzibar and Pemba Islands. Hence, unlike single species industries which target specific species for spat collection and hence encounter issues with high rates of collection of undesirable species, shellfish farmers in Zanzibar have the luxury of being able to utilize nearly all bivalve species collected on any spat collector. Of course, developing methods which would optimize collection of the higher value species such as oysters and pearl oysters would be most advantageous.

Collection directly from the reef and intertidal areas and grow-out of small specimens is not necessarily the most sustainable method of obtaining stock for shellfish farms. Moreover, it does not allow for scaling-up farms. The women shellfish farmers in Zanzibar are at the point where scaling up would be possible if greater numbers of juvenile bivalves were available. Previous pilot spat collection studies helped identify several areas where spat fall may be high enough to support shellfish farms. This work will build on the preliminary efforts to conduct a one-year trial to confirm that these locations are adequate in terms of spat settlement rates and to elucidate annual patterns of spat settlement.

Quantified Anticipated Benefits

Quantifiable benefits will include: amount of spat collected, number of students and technicians trained, development of feasible spat collection methods, increased availability of information and increased interest in culture of native species.

Metrics

Number of institutions directly or indirectly benefiting from the training: 6

Number of individual participants in extension and technical training: estimated at 60

Number of communities benefiting from training: 8

Number of private businesses (including cooperatives and women’s groups) benefiting from improved extension services: 10

Students involved: 2

Training modules produced: 1

CRSP newsletter articles: 1

Peer-reviewed journal article: 1

Activity Plan

Pilot studies in 2009-2010 assisted in locating several sites near the villages of Bwelo and Nyamanzi on the Fumba Peninsula of Zanzibar where spat settlement rates on artificial collectors were relatively high. Bwelo and Nyamanzi were among eight villages participating in previous bivalve and pearl culture development work and their residents were among the most active in the participatory research.

Approximately 200 women on the Fumba Peninsula have participated or benefitted from past aquaculture development efforts. Similar experiments were also conducted near Tanga on the Eastern Coast of Tanzania and showed promising results. Improvement of spat collection methods will have regional benefits.

Spat collection experiments will be conducted by establishing submerged long lines in two areas and deploying 50 spat collectors every month over a one year period. Three different spat collection materials will also be tested. This will allow researchers to determine the best time of year to deploy collectors and which material results in the highest level of spat settlement. The latter is more complex than it may appear as results from spat collection for pearl oysters in the Pacific suggest that while many materials appear to be suitable in terms of the initial spat collection rate, some types may result in juveniles detaching themselves or being more vulnerable to predation. Collectors will be inspected two months after deployment to obtain an estimate of the number of juvenile bivalves which have attached and to

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identify these by species. Four months after deployment, the collectors will be removed from the water and all adhering bivalves counted and identified. The juveniles produced in this manner will be used in the nursery experiments. Two types of cages will be tested to determine which results in the highest survival and growth of juvenile bivalves. Data on water quality (temperature, salinity, turbidity) will be collected at each experimental site. Women from the two communities will participate in all aspects of this work and will be trained in the technical details of spat collection and nursery rearing.

Statistical Analysis

Analyses will be performed using the Statistical Package for the Social Sciences Version 10.1 (SPSS 10.1). Data on spat collection rates and survival will be tested by month and by the type of the collection material used. Data from the nursery trial will be tested to determine which cage type may result in higher survival and growth. In all cases, significant results will be followed by a comparison of means using the Least Significant Difference (LSD) Test. Normality and homogeneity of variance tests will be performed on raw data. Sample distributions violating assumptions will be log-transformed before analysis. Data, expressed as percentages, will be arc sine-transformed before analysis. All differences will be regarded as significant at $P < 0.05$.

Schedule

Work will start in July 2013 with establishment of the long-lines and procurement of other materials. Spat collectors will be deployed in August 2013 and continued through July 2014. Nursery trials will begin four months after the first juveniles are removed from the collectors; this is expected to occur in December 2013 or January 2014.