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The Pelagic Artisanal Fishing of Mangapwani, Northern Unguja

Shavonne Stanek
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The Pelagic Artisanal Fishing of Mangapwani, Northern Unguja

Shavonne Stanek
Oberlin College 2016
SIT Spring 2015
Advisor: Dr. Narriman Jiddawi
Academic Advisor: Helen Peeks
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Abstract:

A total of 99 interviews were conducted. Over a period of 28 days from April 5- May 2, 2015, a total of 75 interviews were conducted with 72 fishermen, 2 drying processors and 1 Bwana Diko. During a 5 day preliminary period from March 12-16, 2015, a total of 24 interviews were conducted with 7 fishermen and 14 drying processors. The interviews focused on their work in the local fishing industry, the amount of fish caught and dried, and their opinions on the sustainability of their industry. The interviews were conducted using a translator who relayed the responses in English to the interviewer who then recorded the responses.

The interviews and study were conducted in the small fishing village of Mangapwani. This location on the Tanzanian island of Unguja was chosen due to Mangapwani’s relatively high level of drying activity and its’ status as an official landing site.

The Survey indicated that the dagaa dryers and local fishermen were aware of some environmental impact resulting from the fishing industry. But, the dryers were more concerned with producing a marketable product and earning a daily wage, and the fishermen were more concerned about bringing as much fish home as possible. Both the dryers and the fishermen appeared to be more concerned with their current economic status than about the future ecological implications of their involvement in the industry. During the survey, an overuse of natural resources such as the surrounding wood and land, a scarcity of clean water, and overfishing of the natural fish stock in the area was observed. These impacts if left unchecked will eventually lead to the collapse of the fishing industry in Mangapwani and other such small villages if not better regulated.
Introduction:

While the economy of Zanzibar is dominated by the tourism industry, Zanzibar is still an agriculture-based economy with agriculture being the second dominant sector followed by the fishery sector which accounts for about 7.1% of the GDP of 2012 (Smart Fish, 2014). Zanzibar’s fisheries are vitally important to the coastal communities and have a large social and economic impact on the locals. In the Western Indian Ocean region (Comoros, Kenya, Madagascar, Mauritius, Mozambique, Réunion, Seychelles, Somalia, South Africa and Tanzania) fisheries play an important role in supporting national economies, providing from 5.0% to 99.1% of national agricultural exports as well as sources of employment, income and animal protein (Walmsley, et al., 2006).

The fishing industry in Zanzibar in particular has seen enormous growth. Since 1990, when there were only approximately 8,365 fishermen, the number has grown to the current estimate of over 34,000 artisanal fishermen alone (Phelan and Stewart, 2008). An additional several thousand should be added to those involved in the fishing industry to account for occasional fishers, and people who are indirectly employed in fishing and related activities such as boat construction, fish processing and marketing. Total fishing production in Zanzibar was estimated at 29,000 tons in 2012, excluding self-consumption of fish by fishing communities. Official data has shown a steady increase of total fish production for the last 12 years with an estimated Tanzanian Shilling 103.1 billion (about $64 million) in 2012 (Smart Fish 2014).
The need to manage resources such as fisheries, which are currently open to exploitation by all users as in a traditional “commons,” is a pressing environmental problem that needs to be resolved to sustain the use of renewable resources and to preserve biological diversity (Mcclanahan, Glaesel, Rubens 1997). In general, fisheries in Zanzibar are diverse, e.g. type of gear, fishing techniques, and habitat use (De la Torre-Castro, 2006). Subsistence and artisanal fisheries catches in Zanzibar are mainly comprised of four family groups, namely parrot fish, rabbitfish, sardines, and mackerels, which together account for over 50% of the total catch (Francis et al., 2001), but over 500 species of the 1,000 species found are commercially important (Jiddawi, 2002).

Coastal and marine resources in developing countries are under increased threats due to the ever growing numbers of resource users with common interests (Mangora et al, 2014). In many tropical developing countries, poverty is believed to be the main driving force behind the degradation of marine and coastal environment (Silva, 2006). The damage to these natural assets diminishes livelihood opportunities and therefore aggravates poverty. The livelihoods of the poor, living in remote rural areas where the basic social services are persistently inadequate, remain at stake with the decrease of fish stocks (Silva, 2006). Fishing is an attractive activity for the poor in particular as it does not necessarily require the ownership of any assets and has very low startup costs. Fishing generates food and income on a daily basis (Silva, 2006).

Closely coupled to the fishing industry are the activities involving the preservation of dagaa. Along the coast of Tanzania the term dagaa usually refers to any small fish caught by various gear such as beach seine, ring net, purse seine, lift net, dip net, scoop net, cast net and
even trawl net and stake trap (Nhwani 1981). In this paper, the term *dagaa* will refer to the sardine, (*Rastrineobola argentea*), a small fish with the life span of 1.5 to 2 years (Nsina, et al., 2013).

Salting and drying are the most common methods of fish preservation in Tanzania. Besides being extremely valuable economically, fish are a valuable source of nutrients such as proteins (15-27% wet basis), lipids and poly-saturated fatty acids. However, *dagaa* contain up to 80% water. Thus, *dagaa* are highly perishable products; especially in hot countries were cold preservation techniques are often lacking (Djendoubi, et al., 2009). In many developing countries, dried salted fish are one of the principal sources of low-cost dietary protein.

Salting techniques are simple to implement, and involve the use of salt crystals or brine. Salting can be accomplished three ways: dry salting, wet salting and a combination of the two methods. Drying is widely accomplished the traditional way: sun drying. However, this success of this drying technique is directly related to the weather conditions and thus makes the results uncertain (Bellagha et al., 2007).

In small coastal rural villages pressure on the ecosystems threatens the long-term livelihoods of the 8 million people that inhabit the country’s coastal district (National Environment Management Council, 2009). The fishing industry affects the whole village, not only the fishermen affected by the increase or decrease of fish stock. The fishing industry impacts the dryers, the fishmongers (middlemen), and anyone else who profits from the fishing industry. Statistical data on all landing sites must become a higher priority in order to determine what can be done to best improve these areas (National Environment Management Council, 2009). Additional information is needed to make better decisions.
Zanzibar does employ beach recorders “Bwana Dikos” at several landing sites. Their job is to collect data on catch sizes, types of catches, number of boats and fishermen, etc. (De la Torre-Castro, 2006). However, gathering information takes time during which further degradation can occur. There is a risk that by the time the decision to protect an area has been made, it may no longer be worth protecting. Thus, information is the key for progress and this study is a small accumulation of some of the data a Bwana Diko could collect.
Study Area:

The fishing village selected for this study was Mangapwani. It is located on the Tanzanian island of Unguja. It is situated on the northwest coast, 25 kilometers north of the Unguja capital of Stone Town. There used to be over 254 official landing sites for Zanzibar (123 on Unguja and 131 on Pemba). But, due to lack of time, money, and employees, the government has reduced the number of landing site to 30 official sites, 18 on Unguja and 12 on Pemba. Mangapwani’s landing site is part of the North B section of the Island and is called Kwabwandau (Kitengo Cha Takwimu Za Uvuvi, 2010). However, most landing sites that are used by fishing boats are natural sandy harbors. At the landing sites where tidal differences are large (about 4 m) fishing boats are forced to moor several hundred meters away from the storage site and access to the boats is difficult during high hides (National Environment Management Council, 2009).

Mangapwani was selected because it is an official landing site and it is one of the three major locations for dagaa processing on the island of Unguja. While most fishing households in coastal areas are also engaged in some sort of agriculture, there is less dependence on agriculture on the coast due to the lack of suitable soil for farming. Less fertile soil is characteristic of certain areas where coral rag soil dominates the terrain (Silva, P. (2006).
Methodology:

A total of 99 interviews were conducted. Over a period of 28 days from April 5- May 2, 2015, a total of 75 interviews were conducted with 72 fishermen, 2 drying processors and 1 Bwana Diko. During a 5 day preliminary period from March 12-16, 2015, a total of 24 interviews were conducted with 7 fishermen and 14 drying processors. Interviews ranged in length from fifteen minutes to over an hour. The interview sessions were conducted during the morning hours when the fishermen had returned to the landing site and the dagaa drying was just beginning. Fishermen and Dryers were selected at random. There might have been some bias due to the translator’s status in the fishing village. Questions were asked in Kiswahili using the translator. Responses were relayed back in English and recorded. The list of the questions asked can be found in the Appendix (page 35). Any relevant first hand observations were recorded including the number of boats present every morning on the beach and in the water, an approximate count of people present, as well as conversations and details of the practices of the dryers and the fisherman.
Results:

1. Biographic Information

   a. Of the 99 people interviewed, only six were female.

      i. It was observed that there were no female fishermen present during either
         the preliminary study or the main study time frame.

   b. Of the 99 people interviewed, 19 were dagaa dryers, 79 were fishermen and
      1 was a Bwana Diko (beach recording official).

   c. The average age of all participants was 49.46 years

   d. The fishermen had an average experience of 16.28 years

      i. The maximum being 45 years

      ii. The minimum being just 1 year

      iii. The most frequent response was 10 years

Figure 2. Participant Demographic Breakdown
e. The estimated number of people directly involved in the fishing industry in Mangapwani can be broken into 3 categories (Interviews, 2015):

i. 1500 fishermen and fishmongers who actually live within 4 Kilometers of the landing site;

ii. 1200 *dagaa* dryers who camp at the landing site during the period surrounding the new moon when *dagaa* fish are most readily caught (around 20 days a month), but actually are from other villages; and

iii. an unknown number from out of town who come into the area, especially fishermen, due to the fish catch of the rainy season, or are from areas where their fish stock has been exhausted and must search other places to find a new stock.

2. **Tools Used in Trade**

   a. **Dagaa Industry**

      i. 83% of the dryers added additional salt to the salt water used for boiling;

      ii. 84% of the dryers used a tarp on the ground to dry the *dagaa* after the *dagaa* were boiled;

      iii. 16% of the dryers dried the *dagaa* by laying the *dagaa* on top of a raised table made of wooden sticks and a sheer mesh. Most dryers who did not use the drying rack said they would switch if they could afford to do so.
b. Fishing Industry

i. Fish Catching Gear

1. Of the 72 interviewed during the main study,
   a. 15 Fishermen were using just *mshipi wa chubwi* (hand lines)
   b. 32 Fishermen were using just nets including: Mtando (purse-seine), Senga (snoop net), and Nyavu (ring nets).

Juya (Beach-seine nets), which are illegal in Zanzibar, were also seen on the beach. It is unknown if they had been used recently. Mesh sizes as small as 2 mm were found on site, while the recommended size for *dagaa* mesh nets on the basis of harmonization of adult to juvenile catches is 8 mm (Manyala, 2005).

i. Fishermen were asked whether they caught any by-catch (unwanted fish stock that was not the initial aim). Only 17 fishermen said they did.

1. The by-catch fish stock fishermen said that what they had caught included (1) White-Spotted Pufferfish (*Arothron hispidus* L.), (2) Bottlenose Dolphin (*Tursiops truncates*), and (3) Indian Mackerel (*Bastrelliger kanagurta*)
2. All by-catch was said to be eaten.

c. 25 Fishermen were using both hand lines and some type of net.

![Types of Gear Used](image)

Figure 3. The distribution of gear used by the Fishermen

ii. Lights Used By *Dagaa* Fishermen

   When using light to attract the fish on moonless nights, the fish will swim towards these nets and be caught. The catch rate is 500-3000 kg per net (Jiddawi et al., 2002).

1. Of the 79 fishermen, 58 fishermen caught *Dagaa*

   a. Of those 58 Fishermen

      i. 35 used only Kerosene Lights

      ii. 5 used only Solar Lamps

      iii. 3 used only Pressure Lamps

      iv. 15 used a combination of one or two different lights
v. Future studies could expand by asking why they preferred each type of lamp.

![Types of Lights Used By Dagaa Fishermen](image)

Figure 4. Distribution of lights used to catch *Dagaa*

iii. Boat use by the 72 fishermen

1. 34 Fishermen used small boats that would hold up to 4 people including *Ngalawa* (Outrigger canoe), *Boti* (Wooden planked boat), and *Hori* (Dingy)

   a. It was observed that one small *Boti*, roughly 10 feet long that held 4 people took 24 days to build by 5 people and cost over 1 million Tsh.
2. 38 fishermen used large boats holding up to 25 people including *Mashua* (Wooden planked boat with a sail) and *Boti Kubwa* (Wood planked Boat)

3. The average boat used carried 9.78 people

4. It was observed that all of the large boats had engines that were removed after every day of work

5. The largest number of boats counted on a given day at the landing site was 50 boats on April 14 2015 when there were 17 boats in the water and 33 boats on the beach.

3. **Fish Stock**

   a. The 72 fishermen interviewed caught roughly 11,619 Kilograms total during 28 day period. This number was calculated using the amount each fishermen reported he caught that day. To find out how much was caught for the entire 28 day period all fishermen would have to be interviewed every day or it could be estimated by taking the amount caught by each fisherman multiplied by 28. This would assume that the fishermen caught the same amount every day though which is not accurate because the catch depends on weather, and the lunar calendar.

   b. Figure 5 Below. Is a Table including all the fish species caught from this landing site during the 28 day period, the fish with an “*” were fish observed on the beach to have been caught by other fishermen who had not been interviewed. Fish with a + were identified as by-catch fish for some of the fishermen. Fish were
identified using (Kitengo cha takwimu za uvuvi, 2010), (FAO FishFinder, 2010) and (Richmond, 2011).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Swahili Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackspot Emperor*</td>
<td>Lethrinidae harak</td>
<td>Changutewa</td>
</tr>
<tr>
<td>Bluefin Trevally*</td>
<td>Caranx melampygus</td>
<td>Mchakufo</td>
</tr>
<tr>
<td>Bluetai Mullet</td>
<td>Valamugil buchanani</td>
<td>Mkizi</td>
</tr>
<tr>
<td>Bottlenose dolphin+</td>
<td>Tursiops truncates</td>
<td>Pomboo</td>
</tr>
<tr>
<td>Commerson's Anchovy</td>
<td>Stolephorus commersonnii</td>
<td>Dagaa-mcheli</td>
</tr>
<tr>
<td>Common Dolphinfish</td>
<td>Coryphaena hippurus L.</td>
<td>Fulusi</td>
</tr>
<tr>
<td>Cowtail Stingray*</td>
<td>Pastinachus sephen</td>
<td>Taa usinga</td>
</tr>
<tr>
<td>Dogtooth Tuna</td>
<td>Gymnosardia unicolor</td>
<td>Jodari</td>
</tr>
<tr>
<td>Giant Catfish*</td>
<td>Netuma thalassina</td>
<td>Hongwe</td>
</tr>
<tr>
<td>Indian Anchovy</td>
<td>Stolephorus indicus</td>
<td>Dagaa-mcheli</td>
</tr>
<tr>
<td>Indian Lionfish*</td>
<td>Pterois miles</td>
<td>Mbevu</td>
</tr>
<tr>
<td>Indian Mackerel+</td>
<td>Rastrelliger kanagurta</td>
<td>Vibua</td>
</tr>
<tr>
<td>Indian Squid*</td>
<td>Uroteuthis duvaucellii</td>
<td>Ngisi</td>
</tr>
<tr>
<td>Kanadi Kingfish</td>
<td>Scomberomorus plurilineatus</td>
<td>Nuguru-kanadi</td>
</tr>
<tr>
<td>Pickhandle Barracuda</td>
<td>Sphyraena jello</td>
<td>Mzira</td>
</tr>
<tr>
<td>Red Mullet Fish*</td>
<td>Mullus barbatus</td>
<td>Mkundaji</td>
</tr>
<tr>
<td>Spangled Emperor</td>
<td>Lehrinidae nebulosus</td>
<td>Changutewa</td>
</tr>
<tr>
<td>Striped Bonito</td>
<td>Sarda orientalis</td>
<td>Jodari</td>
</tr>
<tr>
<td>Sweetlips</td>
<td>Diagramma pictum</td>
<td>Komba</td>
</tr>
<tr>
<td>Thumbprint Emperor</td>
<td>Lethrinus harak</td>
<td>Changu</td>
</tr>
<tr>
<td>Tille Trevally*</td>
<td>Caranx tille</td>
<td>kambambizi</td>
</tr>
<tr>
<td>White Sardine</td>
<td>Sardinella albella</td>
<td>Dagaa</td>
</tr>
<tr>
<td>White-Spotted Puffer Fish+</td>
<td>Arothron hispidus L.</td>
<td>Bunju</td>
</tr>
<tr>
<td>Whitebait</td>
<td>Hypoatherina temminchii</td>
<td>Dagaa</td>
</tr>
<tr>
<td>Whitetip Reef Shark</td>
<td>Triaenodon obesus</td>
<td>Papa</td>
</tr>
<tr>
<td>Yellow Fin Tuna</td>
<td>Thunnus albacares</td>
<td>Jodari</td>
</tr>
</tbody>
</table>

Figure 5: Types of Fish Caught

c. The amount consumed by the fishermen interviewed was roughly 434 kilograms.
4. Fishing Industry Employment

a. Distribution of Fish Landed

1. Out of the 72 fishermen interviewed, 37 fishermen sold to just fishmongers or middlemen located on the beach. Some of the fishermen and fishmongers were observed to have agreements where the fishermen would sell all the fish caught to a particular fish monger;

2. 27 fishermen sold directly to the Dagaa dryers. Again some dryers were observed to have agreements with particular fishermen where the dryers would collect all the Dagaa caught

3. 8 fishermen sold to both

4. Of the 6,328 kilograms of dagaa purchased by the dryers
   a. 74% of this will be sold to the Congo;
   b. 26% of this will be sold to locals of Mangapwani or in Stone Town.

b. Daily Income For the 72 Fishermen in April 2015:

   i. Average Tsh 41,110 ($22.83 in 2015)
   ii. Max Tsh 167,000 ($92.78 in 2015)
   iii. Min Tsh 950 ($0.53 in 2015)

c. Number of Days Fishermen Worked:

   i. Average Days Per Month Worked was 19.97 Days per Month
   ii. Average Number of Hours Per Day was 10.74 Hours per Day
1. It takes the fishermen an average of 2 hours and 22.8 minutes to reach his fishing location.

5. **Fishing Industry Sustainability**
   
   a. **Drying Industry Sustainability**
      
      i. The amount of wood used per person per day on average was 1.31 carts full, which is roughly 655 kilograms of wood (Development Technology Unit 1994). There was no favored tree species used. Dryers would just use whichever trees were readily available.

      ii. As seen in Figure 6, when the *dagaa* dryers were asked whether the local drying industry was sustainable, 87% responded that there were no significant environmental problems, the traditional drying process was environmentally friendly and the environment was okay. However, all 24 people interviewed during the preliminary study, did say they had noticed an increase in fishermen and dryers in the area in comparison to prior years.
Figure 6. Survey results: “Is dagaa drying environmentally okay?”

b. Fishing Industry Sustainability

i. Of the 99 people interviewed, 97 people said they had noticed an increase in the number of fishermen in the area;

ii. As seen in Figure 7, there is a trend showing an increasing number of large boats in the Mangapwani landing site area. The graph reflects the increase of big boat types such as Boti and Mashua. Future studies could include the decrease of the boat type Ngalawa, which was observed but not studied.
iii. When asked: “do you have to fish harder to catch the same amount of fish as last year?” 43 fishermen responded that the catch has decreased, 15 fishermen said the catch is high right now and 6 fishermen said that the catch for dagaa was high right now but the catch for big fish has decreased. Several people also mentioned that in the last five years, there had been a large decrease due to an increase in fishermen.

iv. When asked: “do you think fishing affects the environment?” 57 fishermen said no it did not and 17 fishermen said yes it did.

v. For those fishermen who said the fishing affects the environment, their responses included: (1) small-mesh nets affect the environment, (2) the smell affects the environment, (3) particular fishing methods such as
dynamite fishing and using beach-seine nets effects the environment and (4) if the fisher has by-catch that affects the environment.

1. Figure 8. Is a pie chart of the responses to this question showing the percentage of each response.

Figure 8. Results asking the question “Does fishing effect the environment?”
Discussion:

1. Fishing Industry
   
a. Fishing Gear

   The fishermen in the Mangapwani use nets including: *Mtando* (purse-seine), *Senga* (snoop net), *Nyauv* (ring nets) and *Mshipi wa chubwi* (hand lines). There was no clear tool preferred. It seemed that many of the fishermen would use whichever tool was most readily available. Many people shared boats, were able to invest together and purchase larger nets to catch more fish. While there were beach-seine nets found on the beach there was no evidence showing that they had been used recently. Beach-seine nets have become illegal to help eliminate the amount of by-catch associated with those nets.

   However, in Zanzibar, there is a general concept that there is no such thing as by-catch. When asked if the fishermen ever caught by-catch only 17 said they had by-catch. They reported by-catch as (1) white-spotted puffer fish, (2) bottlenose dolphin, or (3) Indian mackerel. Some fishermen who said they never had by-catch, clarified that they did not think of it as by-catch because they would eat everything they would catch. This concept that there is no by-catch could be one reason why the beach-seine net is still used. The fishermen may not understand why it was banned. To them it is just the net with the highest catch rate.

   There was an extreme variation in the number of boats in the area through the main study period. During the new moon period boats from different villages
and even people from the mainland could be found in the area. During the full moon, the number of boats dropped almost in half due to the increased difficulty to fish *dagaa* with an excess of natural moonlight.

Most of the boats in the area were larger boats. Very few *ngalawas*, the small artisanal boats, were seen in the area. It could be said that with the increase in fishermen in the area and the increase of larger fishing boats, the *ngalawas* cannot compete with the larger boats. The fishermen banning together to buy engines to allow for farther travel could have resulted in the decrease of *ngalawas* seen. If the trend of larger boats continues at the Mangapwani landing site there will soon not be enough of space to dock all the boats.

b. **Fish Stock**

The fish stock collected for the area, only 11,619 kilograms, may not seem like much. But, if the increase of the number of fishermen continues for the next ten years, Mangapwani will see an increased amount of fish collected. While most of the fish caught in this area are smaller fish, these small fish are necessary for the larger fish to feed on. Without *dagaa*, the larger fish used for sport fishing and to feed tourists, such as the Kanadi Kingfish (*Scomberomorus plurilineatus*) and the Pickhandle Barracuda (*Sphyraena jello*) will slowly diminish.

The fish stock collected at the study site does not mainly stay in the community. Approximately 74% of the *dagaa* that will be caught at this landing site will be shipped off to the Congo and resold there to consumers. The dryers do not
make a large profit because they have to keep the price low so that the men from the Congo can justify buying the *dagaa* given the shipping costs in the final price.

The average daily income of the fishermen during April 2015 was Tsh 41,110 ($22.83 in 2015). This is higher than other months because April is the beginning of the rainy season when there is a larger abundance of fish, especially *dagaa*, because the rainy season coincides with the breeding season (Kiwale 2003).

c. **Drying Process**

Traditionally, *dagaa* was dried in the sun., (Bellagha et al., 2007), However, currently most dryers interviewed are salting and boiling the dagaa due to consumer preference. All of the dryers surveyed boil the *dagaa* first in a large metal pot using salty ocean water. The dryers then add additional salt at an additional cost if they think necessary. The dryers feel compelled to absorb this additional cost in order to satisfy consumer preference. The dryers who chose not to add additional salt usually did so because they could not afford the salt.

When asked why they boil the fish first before drying, the most common reason was that the consumers preferred that the *dagaa* be cooked first. Others felt that the boiling improved the taste. Studies show that boiling the fish does preserve the fish for longer periods of time, resulting in less spoiled products (Walmsley et al., 2006). Fortunately if the *dagaa* spoils, it can be used as animal feed. However, the average price is significantly reduced (average 900 Tanzanian Shillings compared to 4,000 tshs)
Tanzanian dyers use either a tarp on the ground to hold the drying fish, or a raised slatted platform. Of all the dryers who used the tarp method, 84% of them would switch to a raised platform, if they had funds available to do so. The raised platform dryers are becoming increasingly more popular due to the preference of consumers for this method. The average consumer views the raised platform method as more hygienic, with less potential for contamination from microbacteria in the dirt. The drawbacks to the raised dryer are that (1) they are more expensive to maintain and build in the first place, (2) less fish can be dried in the same area, and (3) many people think that raised dryers dry slower because the dagaa do not also have the heat radiating from the ground to decrease moisture faster.

d. Drying Process Sustainability

While many of the people interviewed said that they have indeed noticed an increase in the number of boats, fishermen, and dryers in the last few years, 87% said there was no environmental or sustainability problem with the drying process. The fishermen and the dryers interviewed seemed more concerned with their income than with the environment. They often shared that they were struggling financially, that they needed help from the government, and they had applied for loans to help meet their obligations. Dagaa are by far the cheapest fish to purchase in the area and profits are small (Geheb et al., 2008).

For the 13% who said they thought there were some environmental problems because of the local fishing industry, the main problem reported was the increasing
population of the fishermen and the dryers. With an increase in population of both the fishermen and dryers, there is a corresponding increase in land use. Dryers typically set up camp close to the landing sites. With additional fishermen using additional land, dryers have to start moving farther away from the landing site adding the cost of environmental transportation. Additional fishermen and dryers put a strain on available clean water for cooking and cleaning, for the dagaa processing, and for general home use. There is also a corresponding increase in the demand for trees used in the local area. The types of trees used for the firewood, and the ones which are typically in abundance, are coconut trees and mango trees. Several people surveyed mentioned how the area around the site had become scarce of trees, and how they noticed an increase in soil erosion. However, no one takes the time to plant more trees. The use of trees could be eliminated if the dryers returned to the traditional method of drying using just the sun instead of using the firewood to boil the dagaa first. But, then they would risk losing customers. All of these increasing long-term environmental problems that some of the dryers saw were either deliberately ignored by the majority, or simply went unnoticed.

e. Fishing Industry Sustainability

Of the total 99 people interviewed, 97 people said they had noticed an increase in the number of fishermen in the area. The increase in the number of fishermen could be the reason 43 fishermen responded that the catch has decreased. A continual increase in fishermen will eventually lead to the overfishing of Mangapwani if it has
not already reached this point. Fishermen will soon have to start traveling further and further out to sea to catch the same amount of fish that they used to be able to catch.

Zanzibar waters also are now attracting fishers from other areas (migrating fishers, locally known as *Dago*) because many local stocks in their areas have been over exploited. In Mangapwani when the moon is new, fishermen come all the way from Stone Town to fish in an area where they might be able to catch more than home.

The 15 who said that the catch is high right now and the 6 who said the *Dagaa* catch is high were probably only looking at the current catch and not thinking about the big picture. Because this study was conducted during the high season for *dagaa*, which coincides with the rainy season, the catch is high currently. If this study was conducted again during the dry season, there probably would have been a higher number of fishermen reporting a decreased catch.
Conclusion:

The long-term sustainability of the fishing industry and *dagaa* drying industry around Mangapwani is in question. With no formal regulation of the number of fish taken, or number of businesses operating locally, and an increase in the number of people involved, there has been a corresponding increase in local resource use. The increasing number of fishermen will lead to a gradual depletion of fish stocks, the local fisherman working longer hours for the same monthly quotas, and an increase in the number of days fishermen need to work per month. Currently, they are traveling as far as 6 hours, with an average of 2 hours and 22.8 minutes to reach areas where they know they can catch fish.

Left unchecked, the fishermen will not be able to catch ample amounts of fish without the use of engines and extended travel hours. Eventually, the fishermen will reach a point where they cannot make a profit due to the costs of boat maintenance, gasoline for the engines and time. Further research is needed to evaluate whether fishing for a living, be it in commercial or artisanal fisheries, can provide a sustainable source of income. Currently, there is a conflict between environmental concerns, and the livelihood of the local residents.

While currently *Bwana Dikos* are attempting to collect data on the types of boats, number of gear,, number of fish, species, monetary value of each species, departure time of fishermen, and arrival time of fishermen, they are understaffed and there are too many locations to be studied (Kitengo cha takwimu za uvuvi 2010). The 254 official landing sites in Unguja and Pemba have been reduced to 30. The *Bwana Dikos* used to monitor the sites every day, but the monitoring has been reduced to 16 days a month and the remaining days are estimated.
The Zanzibar and Tanzanian governments must take control of the fishing industry quickly because many people are relying on the landing site at Mangapwani and other sites similar in nature to it. Of the 1900 people estimated to live in Mangapwani, roughly 1500 people are directly benefiting from the landing site whether they are fishermen or fishmongers selling to the market. The landing sites also support the surrounding communities who are eating the fish, and the dagaa dryers who do not actually come from Mangapwani but camp there during the part of the month when dagaa fishing occurs, and supports the people in the Congo who buy the dried dagaa.
Recommendations:

There are four recommendations that could help improve the sustainability of the area. First, the number of fishermen and dryers in the local area must be limited in order to reduce the environmental impact. This is not an easy thing to accomplish. But, there are several avenues to pursue. Currently, there is talk that the area of Mangapwani might become a conservation area with restricted fishing in the future. However, reducing the number of fishermen because the area has been designated as a conservation area will require an extensive amount of data to convince the government that this particular area needs to be conserved. Reducing the number of fishermen could be possible if an alternative mean of making a living are initiated, and putting in place incentives to switch to these new industries (such as training, small loans, startup support, etc.). Possible alternative livelihoods in the Zanzibar include: (i) seaweed farming, which is usually done by women in intertidal areas for export. It is an important livelihood activity, producing over 7,000 tonnes per year. (ii) Pearl Farming, local communities in the Fumba peninsula farm oysters for pearls. The market for sustainably produced pearls in Zanzibar has high potential due to the high influx of tourism on the island, as long as the oyster population is not depleted, this is currently being done by ensuring all those with pearl farms have no-take zones in their areas. (iii) Sustainable Tourism, the most important creates jobs as wildlife guides, boat captains, park rangers, snorkel guides, hotel staff, and fishing guides (Sustainable East Africa, 2014).

Second, alternative food sources should be introduced to replace the relatively cheap protein source of the fish stock. Third, laws should be created to reduce the catch of rare species that breed slowly (e.g sharks, rays, groupers), reduce the catch of ecologically important species
(e.g. parrotfish, triggerfish, wrasses, and tritons) and would make nets with holes smaller than 10 mm illegal. Such laws would allow for the decrease in by-catch and juvenile fish species to grow in size and population.

Fourth, further research should be conducted to provide accurate tracking of local resources, local fish populations, number of fishermen and dryers, coupled with continuous education of the local population as to the long term consequences of over fishing and resource depletion, on both the general well-being of the local participants as well as the economic health of the fishermen. Studies should also include the ratio of total fish caught to the number of fish processed through the drying. The types of gear used should also be clarified. Estimates should be made of what are thought to be sustainable yearly fish catch numbers, to be used to guide and manage the local resources, and possibly to issue permits for legal fishing.
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Appendix:

Study Questionnaire
1. Name, Age
2. Occupation
3. How many years experience
4. Fish Collected/Dried
5. Do you eat or sell your fish
6. For Dryers
   a. Do you boil your fish before drying
      i. If so why?
      ii. If so for how long?
      iii. Do you add salt?
         1. If yes why?
   b. How many buckets did you dry today?
   c. How much did each bucket cost?
   d. How much will you sell each bucket for?
   e. Do you use a drying table
      i. If so why?
      ii. If no, why not?
   f. Have you noticed an increase in fishermen and dryers in the area?
   g. Is your industry sustainable for the environment?
7. For Fishermen
   a. What kind of gears do you use?
   b. For Dagaa Fishermen, What kind of light do you use?
   c. What kind of boat do you have?
      i. How many people fit on your boat?
   d. How much did you catch?
      i. Which fish did you catch
      ii. Did you have any by-catch
   e. How much did you sell it for?
      i. Who did you sell it to?
   f. Where do you fish?
      i. How many hours does it take for you to get there?
   g. How many hours a day do you work
   h. How many days a month do you work
   i. Have you noticed an increase in fishermen and dryers in the area?
   j. When you started how many boats were present?
   k. Do you have to work harder to catch the same amount of fish that you use to?
   l. Do you think fishing effects the environment?