BEACH SEINING IN MOZAMBIQUE - BANE OR BENEFIT?

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ABSTRACT

Manual beach seining is a widespread and popular fishing gear in Mozambique, targeting small pelagics and demersals and supplying exclusively national markets. The fishery provides employment for half of all marine artisanal fishermen in the country, and lands a significant proportion of total catch from the artisanal sector. The fishery shares the Sofala Bank fishing grounds with the industrial shallow water trawl fishery targeting penaeid shrimps, and management measures to protect shrimp stocks from the capture of juveniles in the beach seine fishery have been notably unsuccessful. The paper presents the results of primary research in beach seine fishing communities, quantifying their dependence on the fishing method. Analysis is made of issues surrounding compliance in the fishery with closed seasons, including estimates of the costs and benefits both for the dependent communities and industrial shrimp fishery. The paper concludes that the closed season results in an unfavourable redistribution of rent in favour of the industrial fishery, but with significant economic losses. Policy guidelines are proposed for the development of management mechanisms in the fishery, based on consultative principles.

INTRODUCTION & PROBLEMATIC

Beach seines have been in use in Mozambique since the 1940s, and were introduced by fishers probably coming from Portugal and then copied and developed by immigrants of Chinese origin. Technical development of the gear over the past 50 years has been particularly dynamic and construction has evolved from the use of sisal and cotton natural fibres, through to synthetic ropes and net panels, and finally the use of mechanised hauling and steel cables. The use of mechanised beach seines was limited to Inhambane province and the fishery had all but collapsed by the end of the century due to high operating costs and dwindling returns. Today manual beach seines are in widespread use in four of Mozambique’s coastal provinces and, on a national level, they employ more artisanal fishers than all other gears put together. The fishery targets small fish species (pelagics and demersals) as well as penaeid shrimps, and it is the latter that continues to be the focus of the attention of both fisheries managers and the operators of industrial shrimp trawlers on the Sofala Bank. The capture of shrimps by artisanal beach seines is considered by the industrial fishery to be prejudicial, resulting in reduced profits in the industry as well as reduced economic benefits due to lower export earnings. Fisheries managers have extended the closed season in the industrial fishery to include the artisanal beach seine fishery on the Sofala Bank – a measure that has proven to be very difficult to implement.

This paper examines the dependence of artisanal fisheries on manual beach seines, their contribution to national fish consumption and the wider implications of compliance with the closed season management measure. Estimates are presented of the costs and benefits of compliance with the closed season and policy implications drawn from the combined analysis.

METHODOLOGY

This paper is based on primary research carried out for FAO in 2007 (Wilson J.D.K et al, 2007) as part of a global study of beach seines in artisanal fisheries (FAO, 2011). The field research covered two case
study fishing communities where beach seines are in common use but in different contexts and targeting different resources. Primary data were collected through a series of interviews with gear owners and crew based on participatory techniques, extensive household benefit surveys in the communities and direct observation of fishing activity.

Further investigation into the biological and economic aspects is based upon unpublished desk studies commissioned by the Government of Mozambique as part of the continuing development of management measures.

NATIONAL CONTEXT

Gear Characteristics
There are two basic designs of the manual beach seines in use in Mozambique: In the provinces adjoining the Sofala Bank beach seines may have a head rope of 125-225m, are often mounted without a cod end, and will be hauled by teams of up to 14 fishers. In the more southern province of Inhambane nets invariably have a cod end, are significantly smaller with a head rope of around 100m, hauled by around 10 crew. Mesh sizes range from 63mm in the wings to 12mm in the centre panels or cod-end. In certain areas the use of mosquito netting in the centre panel can be commonplace. Nets are deployed by paddled canoe and hauling ropes seldom exceed 400m. In the south a more specialised form of mini-beach seine has recently emerged, about half the size of the standard net, with a smaller crew and launched from a paddled raft. The gear has the advantage of being very much faster to deploy and haul, as well as being significantly less expensive.

Distribution
Beach seines comprise 19% of the 32,500 fishing gears in use on the coast of Mozambique (IDPPE, 2007) and may be found throughout the country, wherever the coastal geography is suitable and sea conditions (especially long-shore currents) are not severe. The gear is particularly commonplace in the provinces adjoining the Sofala Bank, namely Nampula, Zambézia and Sofala, and is also widely used in the northern part of Inhambane province, as illustrated in Figure 1.

Employment
The significance of the gear becomes more apparent when examining employment. The last national census of artisanal fisheries estimates that there are 100,000 full time marine fishers in the country (IDPPE, 2007), around half of whom, 50,000, are directly employed in beach seine fishery. Total employment will be significantly more than this, considering those involved in the value chain, including net makers, boat builders, fish processors and traders, and the number of people dependant on the fishery even higher still.

Production
Production estimates, based on the national stratified catch and effort sampling system (IIP, 2010), indicate that beach seines currently produce around 41% (43,000 tonnes) of total annual catch from the marine fishery.
Although this is significant, it is also considered to be an underestimate principally due to the fact that there is incomplete coverage of catches by the sampling system, part of which is not successfully accounted for during the extrapolation process.

On the Sofala Bank the target species for beach seines are small pelagics (*Thryssa spp*, *Rastrelliger spp* and *Trichiurus*) as well as penaeid shrimps. The latter are especially sought after in peri-urban fisheries (such as around Beira) where adequate processing and conservation facilities exist. To the north of the Sofala Bank, beach seine catches are dominated by fusiliers, surgeon fish, tangs and tuna, whilst to the south, in Inhambane province, the target species are pelagic and some demersals, namely: *Clupeidae spp* (Sardinela), *Gerreidae spp* (Silva-biddy), *Sphyraenidae spp* (barracuda), emperor fish, Squids, and rabbit fish.

Production from beach seines is invariably destined for national markets, either fresh or salted / sundried. In areas where there is better access to markets and infrastructure (roads and electricity in particular), shrimp from beach seine catches will enter into a completely different value chain, ending up in national hotels, tourist resorts and even exported onto regional markets. Where no such access exists, even shrimp will be dried or smoked and end up in traditional, lower value, markets.

**LOCAL CASE STUDIES**

Field work to examine the extent of dependency on beach seines at community level was carried out in two sample fishing centres, one in Mponha in Nampula province on the northern part of the important Sofala Bank and the other in Petane, Inhambane province, south of the Sofala Bank ecosystem. Although the use of beach seines was commonplace at both sites, there were several important differences both in the fishery and the economic context, as summarised in Table 1 below.

**Table 1 - Characteristics of field sites**

<table>
<thead>
<tr>
<th></th>
<th>Mponha</th>
<th>Petane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beach seines</strong></td>
<td>Predominant gear, little diversity</td>
<td>Commonplace but hand lines also widely used. Diversity in beach seine size &amp; design.</td>
</tr>
<tr>
<td><strong>Target species</strong></td>
<td>Small pelagics, shrimp</td>
<td>Small pelagics, small demersals, squid</td>
</tr>
<tr>
<td><strong>Market</strong></td>
<td>Extensive national markets; export &amp; urban markets (shrimp)</td>
<td>National markets</td>
</tr>
<tr>
<td><strong>Economic activities</strong></td>
<td>Fishing, Agriculture,</td>
<td>Fishing, Agriculture, Remittances, Trade, Tourism</td>
</tr>
<tr>
<td><strong>Local management measures</strong></td>
<td>None</td>
<td>Self imposed closed season (effective)</td>
</tr>
<tr>
<td><strong>National management measures</strong></td>
<td>Minimum mesh size, Closed season (ineffective)</td>
<td>Minimum mesh size</td>
</tr>
</tbody>
</table>
The objective of the fieldwork was to provide illustrative data that could shed some light on the importance of beach seining, rather than provide statically significant results that could be extrapolated to a national level.

**Dependency for household benefits**

The proportion of households that supplied temporary or part time *labour* to the beach seine fishery was significantly different between the two study villages: in Petane, outside the Sofala Bank, only 27% of households were directly involved in the fishery, whereas in Mponha the figure was 62%. Bearing in mind the relative diversity of economic opportunities, this difference may not be that surprising. The dependency relationship on the fishery for labour is however somewhat more surprising when examined from the perspective of the fishery’s ability to absorb labour. In Mponha should all the beach seines in the fishing centre fish simultaneously they would require more that the total male labour force available in the village. In reality this would never happen, and either nets may be absent (following migratory patterns) or the community’s resident labour force would be reinforced by incoming migrant fishermen. In spite of the apparent danger of a labour shortage, owners reported very little down time (an average of 4.5 days per year) due to lack of crew. In Petane, with the plethora of other activities and a less remote location, labour related down time was reported to be ten times this figure.

The relationship between the fishing and livelihoods in the case study communities was further analysed through an investigation into the sources of net *household benefit* using a participatory qualitative valuation technique, which permitted interviewees to place relative value on the sources of household benefit (whether in cash or kind). The nature of this technique allowed interviewees to place importance not only on the value of benefits, but also how important they were considered to be. For example a household may occasionally gain substantial and unplanned earnings from selling labour on a short term construction project, but in the evaluation process this would be scored as less important than consistent (but much smaller) income / produce from fisheries or agriculture that assured basic subsistence needs.

![Figure 2a. Petane](image1.png)  ![Figure 2b. Mponha](image2.png)

**Figure 2 - Sources of household benefit**

Figure 2 presents the summary data for household benefit sources. Of note is that in both cases communities depend on both agriculture and fishing (especially for subsistence needs), these were found to be of comparable importance. The two activities combined provided more than 90% of benefit in Mponha on the Sofala Bank and 70% in Petane.
Analysis in further detail of the origin of fisheries related benefit reveals that in Petane only 22% is derived directly from beach seining (through wages and auto-consumption) whereas in Mponha the figure is significantly higher at 76%, including benefits from processing and trading production from the fishery.

In Petane households were found to derive a similar amount of benefit from the *collection of discarded fish* on the beach as they derived from direct employment. The collection of discards is a particularly common occurrence in Inhassoro district where fishing areas are often over sea grass beds and each haul may bring in significant quantities of dead sea grass. The sorting of the catch is both laborious and time consuming resulting in appreciable quantities of lower value or smaller sized fish being left on the beach in the sea grass whilst the crew proceeds with additional sets. No charge is made by the owner of the net for the collection of discarded fish and in many cases this is the only way that poorer households (especially those with no male labour) may get access to fish. Other secondary benefits from beach seining accrue to local communities through the sale of refreshments, snacks and alcohol to beach seine crews during the working day.

Such a high degree of dependency raises some very serious issues regarding the management of the fishery on the Sofala Bank, and the securing of livelihoods should there be any form of access restriction, either short or long term. The analysis of dependency on the beach seine fishery in communities on the Sofala Bank was further extended by looking at the *seasonality of fishing and agriculture*, and the implications for the securing of livelihoods in the short term.

![Photo 1 - Women searching for discarded fish, Petane](image)

**Figure 3 - Seasonal benefit from agriculture and beach seining, Mponha**

Figure 3 above presents the monthly variation of a qualitative benefit index, derived from opinions in households on the degree and timing of benefits from agriculture and fishing. The agricultural cycle...
shows two distinct peaks, associated with the cassava harvest in October-November and the beans in May-June. Fisheries production also has a peak in October-December, making the final quarter of the year a time of plenty. The low in the fisheries cycle in April-May coincides with the harvest of beans and hence some degree of household food security is maintained. During the periods of low agricultural production, January-March and July-September, households will depend on income from fishing to meet subsistence requirements, including the purchase of dried staples from the interior.

MANAGEMENT AND COMPLIANCE

Management measures
The management measures in place in the beach seine fishery are established either at a central or local level.

The only management measure that applies universally to all manual beach seines in the country is the minimum mesh size of 38mm, set at a central level by national regulation. Beach seine units operating on the Sofala Bank may also be subject to a closed season, the aim of which is to increase recruitment into the shallow water shrimp stock, primarily in the interest of the industrial fishery. The closed season for both the industrial shrimp fishery and the beach seines is set annually by ministerial diploma in accordance with research recommendations and other current priorities. This has resulted in some years where the beach seine fishery has been exempted from the closed season and others where the suspension has lasted from one to four and a half months (mid November to end of February). At the time of the field studies the fishery was subject to the full four and a half months. Outside of the shrimp producing areas of the Sofala Bank and Maputo Bay there are no the mandatory closed seasons.

At the local level there are beach seine fisheries that have developed and successfully apply local management measures, including Inhassoro district where Petane is situated. A voluntary closed season was first implemented in the 1980s, and almost certainly instigated by the few (relatively powerful) mechanised beach seine owners operating in the area. Initially the closure covered June to August (inclusive), and was increased to include May in 1994. In 2004 fishing was permitted in May, thereby shortening the closure back to 3 months and it has been the same ever since. In the same year, fishers banned the use of beach seines at night and on Sundays - measures which continued in force at the time of the field study.

There were no locally conceived management measures in practise in the fishery at Mponha.

Compliance
Compliance with management measures is assured through a co-management mechanism involving the State on the one hand (through the Ministry of Fisheries’ National Directorate for Fisheries Administration, as well as provincial and district government) and community fisheries councils (CCPs) on the other. In theory local government legislation empowers the district authorities with fisheries management but in practise there are few which have the inclination, technical knowledge or human resources to make an significant inroads, and much support continues to come from provincial and central levels. The CCPs are composed of fishers and community leaders and are the first line in assuring compliance with both national fisheries legislation and any local measures.

Compliance with the centrally determined measures including the minimum mesh size and closed season on the Sofala Bank is extremely low, and during the field studies fewer than 10% of the nets inspected complied with the mesh size regulations. Non-compliance with the closed season was particularly
widespread and none of the owners contacted under the field study stated that he had either stopped fishing or reduced fishing effort due to the measure, citing subsistence priorities.

The community fisheries councils (CCPs) on the Sofala Bank are yet to take a proactive role in the enforcement of the closed season partially due to the fact that many of the fishers who make up the CCP do not themselves agree with the measure! The compliance context therefore is extremely poor: Fishers perceive the risk of being caught as extremely low; the penalties are unknown (or if known considered ‘negotiable’); the domestic costs of compliance are high and the benefits of non-compliance very significant. The net result of the closed season measure is well illustrated in Photo 2 below.

![Photo 2 - Closed season fishing, February 2007](image)

In considering subsistence as a compliance motivator, Figure 3, which shows the timing of fisheries and agricultural cycles, confirms that during the first quarter of the year agricultural stocks would be dwindling and fisheries must therefore play a fundamental role in securing livelihoods, especially in areas in the Sofala Bank with few alternative economic activities. If fishing ceased mid November, households would have very little food security by March. On top of this, there are one-off payments that have to be made in the same period, notably school costs, and fishing would be the only way to earn the necessary cash.

Compliance with the mesh size regulations in the fishery was not as low as that for the closed season. Although the CCPs did not manage to enforce the national legislation, in Mponha they did manage to enforce a total ban on the use of mosquito netting in the bunt of the seine. They were notably successful in ensuring this measure not only amongst local fishers but also migrants from further afield. Older fishers were quick to point out why the use of mosquito nets might damage the resource, clearly illustrating the potential effectiveness of the co-management structure should the community level organisations perceive that the management measure is in their interest.

**COSTS AND BENEFITS OF COMPLIANCE WITH THE CLOSED SEASON**

The issue of inclusion of the beach seine fishery in the closed season on the Sofala Bank has been subject to further analysis, focussing on both economic and biological aspects.
Costs of compliance in the beach seine fishery

Data from the national catch and effort statistical monitoring system for the last five years indicates that average catches in the beach seine fishery on the Sofala Bank during the current closed season (January – March) are in the order of 6,300 tonnes per year. The data shows high catch variability with the catch of one year (2009) double that of any other year. This was confirmed during the field study and is in line with what might be expected in a tropical fishery, whose catch is primarily made up of small pelagics. The data set indicates that in the same period an average of 320 tonnes of shrimp is caught. Although a small portion of the shrimp will be caught using set nets and trammel nets, for the purpose of this analysis it is assumed that all of this is caught by beach seines, as part of the 6300 tonne average catch.

Data analysing the division of revenues and other work examining the value chain of fisheries products on the Sofala Bank (Kusi Lda, 2010) can be used to estimate the added value derived from beach seine catches during the closed season, be it at producer level, or further up the marketing network. The value added figures in Table 3 below have been calculated assuming that all of the shrimp caught are smaller calibre penaeus indicus but still big enough to make it into the frozen chain, for sale in urban markets. The remainder of the catch is assumed to be the lowest value thrissa anchovies, salted, dried and sold onto provincial markets.

<table>
<thead>
<tr>
<th>Year</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1,700</td>
<td>2,000</td>
<td>2,000</td>
<td>5,800</td>
</tr>
<tr>
<td>2008</td>
<td>1,500</td>
<td>1,600</td>
<td>1,300</td>
<td>4,300</td>
</tr>
<tr>
<td>2009</td>
<td>3,400</td>
<td>3,800</td>
<td>4,400</td>
<td>11,600</td>
</tr>
<tr>
<td>2010</td>
<td>2,300</td>
<td>1,700</td>
<td>1,700</td>
<td>5,600</td>
</tr>
<tr>
<td>2011</td>
<td>1,000</td>
<td>1,200</td>
<td>2,000</td>
<td>4,200</td>
</tr>
</tbody>
</table>

5 year average 2,000 2,000 2,300 6,300

Table 3 - Attribution of Added Value from beach seine catches

<table>
<thead>
<tr>
<th>Participant</th>
<th>Value added per tonne Fish</th>
<th>Value added per tonne Shrimp</th>
<th>Total value added during Jan-Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>$105</td>
<td>$920</td>
<td>$921,000</td>
</tr>
<tr>
<td>Crew</td>
<td>$195</td>
<td>$1,031</td>
<td>$1,496,000</td>
</tr>
<tr>
<td>Traders in the value chain</td>
<td>$987</td>
<td>$2,629</td>
<td>$6,743,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$9,160,000</td>
</tr>
</tbody>
</table>

The gear owner will take a share of 50% of the value of the catch at first sale, but be responsible for all maintenance and processing costs as well as the payment of bonuses to the specialised crewmen. The remainder of the catch value is divided up amongst the crewmen, according to experience and specialised function within the team. In spite of the size of the owners share of landed value, the lion’s share of the value added accrues to traders, with those closer to the consumer, selling in smaller quantities, managing to retain the largest net margins.

In addition to the added value detailed in Table 3, the fishery also provides the participating crew with fresh fish for immediate consumption, estimated at 1kg per person per fishing day (Wilson J.D.K 2007), equivalent to around 9% of the total catch. During the closed season, the fish taken for home consumption can therefore be estimated at 570 tonnes per year, with a value of around $390,000

Benefits of compliance

The benefits of compliance with the closed season that accrue to the artisanal beach seine fishery are considered to be small. The nature of the small pelagic fishery and the short range of beach seines indicate that there would be no significant incremental catch of small pelagics during the year due to a January – March closed season. The shrimp caught by beach seines in the period after the closed season...
would however be older and therefore of higher commercial value, but this benefit may be offset by both natural mortality and lifecycle migrations of shrimp to deeper waters, outside of the range of beach seines.

The principal beneficiary of the inclusion of the beach seine fishery in the closed season would be the industrial fishery for shallow water shrimp. Investigation into the impact of the beach seine fishery on the stock accessible to the industrial shrimp fishery (IIP, 2009) concluded that:

- The shrimp caught by beach seine fishery in the closed season is predominately (80-90%) *penaeus indicus*
- In the period 2000 to 2007, between 44%-69% of the shrimp caught by the beach seine fishery were juveniles, but this value fell to 33% in 2008. The incidence of juvenile shrimp in industrial fishery catch was insignificant.
- The fishing of juveniles by the beach seine fishery has an impact on the stock biomass. The model developed by the study indicates that, assuming the industrial fishery observes the closed season, then the inclusion of the artisanal beach seine in the measure would increase industrial fishery catches by up to 262 tonnes, as detailed in Table 4

Of note is that the greatest benefit to the industrial fishery is due to the delay of the opening of the fishing season until the end of March – a measure that the industrial vessel owners have consistently opposed, resulting in the National Directorate for Fisheries Administration fisheries opening the fishery before this date (Yangula, 2011).

The industrial shallow water shrimp fishery is managed through fixed quotas that are invariably fully utilised. Under these conditions, the incremental benefit indicated above will not be manifested in an increase in fleet catches, but would be available to the fleet as an increase in net rent through higher CPUE and reduced total operating costs. Based on a value of the incremental catch of $ 8,000 per tonne, benefits to the fleet would be between $90,000 and $2,100,000 per annum, depending on the length of the closed season.

**Summary of Costs and Benefits**

Combining the costs and benefits outlined above with the issues raised by the field case studies, the costs and benefits of the January-March closed season in the beach seine fishery can be summarised as follows:

**Table 5 - Summary of costs and benefits**

<table>
<thead>
<tr>
<th>Benefits to the industry</th>
<th>Costs to the artisanal beach seine fishery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in profits equivalent to the value of up to 262 tonnes of shrimp</td>
<td>Loss of profits and wages to owner and crew</td>
</tr>
<tr>
<td>$ 2.1 million</td>
<td>-$ 2.4 million</td>
</tr>
<tr>
<td></td>
<td>Loss of profits to processors and traders</td>
</tr>
<tr>
<td></td>
<td>-$ 6.7 million</td>
</tr>
<tr>
<td></td>
<td>Loss of fish for subsistence consumption</td>
</tr>
<tr>
<td></td>
<td>-$ 0.4 million</td>
</tr>
<tr>
<td></td>
<td>Balance: -$7.4 million per year</td>
</tr>
</tbody>
</table>

Table 5 has been developed on the basis of the closed season for beach seines running the full period from January to the end of March. Although this is biologically the preferred option (IIP, 2009), in practise the shrimp fishery is opened during the month of March rather than at the end. Using the same dataset, estimates can be made of the costs and benefits for shorter closed periods:
Table 6 - Balance of benefits by closed season length

<table>
<thead>
<tr>
<th>Closed season period</th>
<th>January</th>
<th>January-February</th>
<th>January-March</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits to Industry</td>
<td>$ 0.1 m</td>
<td>$ 0.8 m</td>
<td>$ 2.1 m</td>
</tr>
<tr>
<td>Costs to artisanal fishery</td>
<td>-$ 3.1 m</td>
<td>-$ 6.2 m</td>
<td>-$ 9.5 m</td>
</tr>
<tr>
<td>Balance</td>
<td>-$ 3.1 m</td>
<td>-$ 5.5 m</td>
<td>-$ 7.4 m</td>
</tr>
</tbody>
</table>

The actual net cost of the closed season is therefore estimated to be between $5.5 million and $7.4 million, depending on the duration of the closure.

In addition to the costs and benefits detailed above, other important consequences of the closed season include:

- Loss of production from the beach seine fishery on to national markets of an average of 6,300 tonnes per year. This is equivalent to the total annual fish consumption of around 1.1 million Mozambicans, or 5% of the population. In practice fish from the beach seine fishery is consumed on rural and poorer urban markets, especially in the northern and central provinces, rather than by the population as a whole. The drop in supply will therefore affect only a subset of the population, but in a more severe way.

- The drop in production during the closed season will have wider food security and nutritional consequences, as a result of short term increases in the price of substitute fish products on national markets, further exacerbating the impact;

- In fishing communities, not only would profits and wages be lost, but also fishers would not have access to fish for home consumption during the period. This is considered to be critical in the context of the timing of the closed season with agricultural production, as discussed above. During the first quarter of the year there is no significant agricultural harvest and normally wages from fishing would be taken to purchase staples and meet other unavoidable seasonal cost (including school materials).

The overall result of the balance of costs and benefits, the lack of alternative means for securing livelihoods during the period and the lack of engagement of co-management structures in the enforcement of the closed season is, unsurprisingly, almost total non-compliance. This is passively accepted by fisheries administration, in the absence of any feasible way to enforce the measure, and the social tensions that would result were it to be imposed administratively. Although this situation guarantees well-being in the fishing communities, it simultaneously undermines the credibility of both the fisheries administration and the legislative framework.

POLICY IMPLICATIONS

Although the analysis presented in this paper is based on a very limited sample of the activities of a diverse and widespread fishery, there are some important conclusions that can be drawn regarding policy and management strategy. The success of the closed season mechanism outside of the Sofala Bank and the failure of the same measure in another context underlines the importance of integrating management measures with food security and livelihood strategies, especially in poorer communities with undiversified income generation. The importance of the engagement of local co-management structures is self-evident, especially as the government has no other means through which to enforce management measures over such an extensive fishery. The success of CCPs in the enforcement of certain measures (such as the
prohibition of the use of mosquito netting) confirms that, in the correct circumstances, they can be very effective.

Regarding the development of management mechanisms in the artisanal fishery in general:

- If a management measure is to be implemented through community structures, such as CCPs, it must be perceived by the CCP and the wider community as being in their interest;
- There is evidence to suggest that the more diversified the income generation base within a fishing community, the more likely that the introduction of fisheries management measures will be successful;
- Coastal communities are often perceived as fishing communities, and may even identify themselves as such. However in Mozambique, agriculture is as important to meeting the subsistence needs within these communities as fishing and this must be taken into account. Management measures that, due to poor phasing with agricultural cycle, imply an increase in short term food insecurity are unlikely to be successfully implemented through a co-management mechanism;
- The chances of successful implementation of management measures will be enhanced through the adequate involvement of user communities in the development of such mechanisms. This will clearly help to enhance understanding of associated (costs and) benefits as well as to provide a forum where the measure could be adjusted to take into account community priorities. This is a particularly difficult issue where, such as in the case of the beach seine closed season, the real beneficiaries of the measure are outside the community where it should be implemented.

With respect to the management options in the beach seine fishery on the Sofala bank:

- The imposition of a closed season is highly prejudicial to the participants in the fishery, wider consumers and brings net negative benefits to the economy as a whole in the case studied. There are however benefits that accrue to the industrial shallow water shrimp fishery.
- The annual cost of the closed season, estimated at $5.5million to $7.4million is considered to be significant, and does not justify the measure. There may be grounds for justifying the local imposition of a closed season where both artisanal and semi-industrial sectors supply shore based processing facilities. The continuation of artisanal production in these conditions has provided opportunity in the past for other sectors to also continue operating.
- The most important issue relating to policy is that of priorities. The closed season in the beach seine fishery redistributes rent from the artisanal sector to the industrial sector, at net economic loss. In the context of national poverty alleviation priorities, the measure can not be justified, especially as its impacts would not only be confined to the fishing communities but would also be felt by consumers on a national level. It is important to note that the net cost of up to $7.4million implies a cost of $2.8million in poor producer communities and a further cost of $6.7million to a very extensive network of small-scale traders.
- The imposition of a closed season in the beach seine on the Sofala Bank is not considered justified or viable. If the fishery needs to be restricted (in the interest of the industrial sector) then other mechanisms that might limit the capture of juveniles, such as more extensive mesh size controls, should be considered.
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ENDNOTES

i This level of catch implies an average of around 6.7 tonnes per beach seine per year, considerably below the observations and declarations made during the field study, which put catches at between 16-23 tonnes per beach seine per year.

ii Smaller industrial vessels supply fresh shrimp to shore based processing plants would be defined as semi-industrial under Mozambican regulations.