

# How Partnerships and Adaptive Management can contribute to Ecosystem Approaches to Fisheries: The Case of the Red Sea fishery in Sudan

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## Abstract

The paper discusses how partnerships and adaptive management can contribute to ecosystem approaches to fisheries (EAF). This is illustrated in the Red Sea State of Sudan where the active participation and engagement of fishers, traders and the government in EAF has led to the establishment of co-management groups and an agreement on a fishery management plan for seacucumber and demersal reef fish. The approach has enabled the sector to test and collect data on the fisheries and fishing communities that is improving governance through greater participation in stock assessment, capacity building and fishery management.

The paper also uses social capital to assess the characteristics of the co-management arrangements and reveals a complex network of ties between fishers, traders and government institutions. The analysis illustrates the significance of context in building partnerships and the importance of engaging actors such as the security agencies that can determine the effectiveness of EAF approaches.

## Key words

Coastal fisheries; co-management; social capital; governance

## INTRODUCTION

An Ecosystem Approach to Fisheries (EAF) has been applied to the Red Sea (RS) fishery in Sudan with the support of the European Union (EU)<sup>2</sup>. EAF embraces both the human and ecological elements of a marine environment and is an approach that favours the active participation and sharing of fishery management responsibility between the State, private sector and fishing communities (Staples, 2009).

The aim of the EU intervention is to improve fishery management and the livelihoods of its mainly artisanal fishing community. EAF has been used to help establish several co-management partnerships representing fishers, traders and the State that are addressing fishery management for the key fisheries of seacucumber, coral trout, shark and shellfish. With limited knowledge of these fisheries, the partnerships are employing adaptive management to build better understanding of the fishery and users. Adaptive management is based on experimentation and appreciating that the uncertainties of any ecosystem requires an iterative and integrated process of learning by doing (Holling, 1978). The approach advocated in Sudan requires fishers, traders and the State to share data collected during experimental harvesting and to address fishery management from its socio-economic, ecological and

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governance contexts. This is contributing to stock and fishery user assessments and helping to build trust through greater collaboration and transparency in decision-making, allowing different harvesting regimes to be developed and agreed by all participants.

The active participation of stakeholders in EAF is creating mutually beneficial relations and ties between the State, private sector and fishing community. These relationships influence the behaviour of a partnership and can be assessed using social capital (SC) analysis. SC refers to the networks, norms and sanctions that connect different people and institutions, and can have a positive and negative impact on people's behaviour. SC examined in the Sudanese case is seen to have both positive and negative influences on fishery management and observed to exclude and include fishers, traders and government departments in decision-making and benefit sharing.

### *Sudanese marine environment*

The least known and arguably least understood of Sudan's diverse ecosystems is the marine tropical ecosystem represented by the Red Sea. The RS is shared by ten coastal States including Sudan and is recognised as a Global 200 eco-region. It contains geographically distinct assemblages of natural communities and species, which provide important livelihood opportunities for coastal populations from fishery resources, tourism, transportation and petroleum.



**Figure 1. Map of Sudan and Red Sea**

Sudan has jurisdiction over 750 km of the coastline from Egypt in the north to Eritrea in the south and has an Exclusive Economic Zone (EEZ) that covers an area of 91,600 Km<sup>2</sup> including a shelf area of 22,300 Km<sup>2</sup>. Its pristine coastline shows high diversity in habitat and complexity that is characterised in its lagoons several of which are fringed by mangroves and enclose seagrass beds. Its coral reefs are

regarded as the most diverse in the RS and include fringing and outer barrier reefs as well as atolls. The RS is shaped by small tidal variations (0.5m), weak currents, low nutrient upwellings, high water temperatures (20-33°C), high salinity (39-56 percent) and no permanent freshwater runoff. Although such factors can limit fish and organic production the Sudanese RS supports high biodiversity including an estimated 200 species of soft and hard coral, 300 bony fish species, over 50 species of sharks and rays and 1,000 species of invertebrate. The coast also functions as an important feeding and breeding ground for the endangered dugong and sea turtle as well as for migratory and residential birdlife.

The coastal plain, which is bordered by the RS Hills, is home to a complex blend of indigenous people known collectively as the Beja. The Beja are considered an ancient nomadic tribe of Hamitic descent that have occupied the eastern desert region of Sudan, Eritrea and Egypt for over four thousand years. Fishing does not have a long tradition in the Beja culture, which is seen as a seasonal subsistence activity, contributing to a livelihood based on pastoral and agricultural activities.

Fishing operations are conducted mainly in the near shore inlets and inshore fringing reef using traditional gear, craft and fishing methods. The main gears are handlines and gill nets that target reef associated fish species that account for 80 percent of the 1,500 tonne annual catch. The locally constructed wooden and fibreglass open boats are powered by sail or outboard motor with the majority of the approximate 600 vessels 5-7m in length and used by an estimated 2,000 fishers.



**Figure 2: Beja fishermen from Akayai and Suakin, Red Sea State, Sudan**

The domestic demand for fish products is weak and the market small, which constrains the growth of fishery business. Sudan has one of the lowest annual per capita consumptions of fishery produce in the region at 1.4 kg per person compared to 14.2 kg in Israel, 9.9 kg in Saudi Arabia and 25.1 kg in Yemen. Coral reef associated finfish account for over 80% of the landings with the rest composed of

prawn<sup>3</sup>, Pearl Oysters (*Pinctada margaritifera*), Spider Conch (*Trochus dentatus*) and Strombus as well as seacucumber<sup>4</sup> and shark. The cost and limited supply of ice outside of main market of Port Sudan results in significant post harvest losses estimated at 30% with increased pressure on fishery resources that can be marketed without cold storage such as trochus, pearl shell and seacucumber.

Despite fishing being an important livelihood to coastal communities its contribution to GNP is small estimated at less than 3% with the main RS State economy coming from marine transport and petroleum.

### *Policy and governance*

The RS fishery sector has experienced limited investment over the last 20 years, which has resulted in a contracted public service and budget, loss of experienced staff, poor physical infrastructure and weak institutional capacity. Fishing is conducted by artisanal fishers whose level of income, production, fishing range, political influence, market outlets, employment and financial dependence keeps them subservient to the economic decisions and operating constraints placed upon them by those who buy their production.

The policy framework is established under the 2002 Comprehensive Peace Agreement (CPA) and Interim National Constitution (INC) which adopts a system of federalisation. Responsibility for fishery policy and governance lies principally with the RS State although there are several national institutions with jurisdiction over marine resources such as the Federal Ministry of Agriculture as well as national policy frameworks such as the National Agriculture Revival Programme. As a consequence there are often tensions between Federal and State institutions and programmes leading to ad hoc policy arrangements. In addition, the legal framework is weak, established under the 1937 national fishery law (amended 1975), which does not reflect modern management principles such as those outlined in the Code of Conduct for Responsible Fishing or recognises Sudan's commitment to international agreements<sup>5</sup>.

To help develop fishery policy and improve governance the EU intervention has focussed on building a consensus on the key management objectives for fisheries and creating an advisory forum representing government institutions responsible for fishery resources. The RS Fishery Coordination Group (RSFCG) has been established under the State Ministry of Agriculture with representation from the RS University, Fishery Administration (FA), Fishery Research Institute, Ministry of Planning and Finance, Humanitarian Aid Coordination (HAC) and security agencies. The RSFCG has identified the main fishery management areas (FMAs), agreed on the key fisheries and management objectives and set up several co-management groups. These groups have broadened consultation requiring the State, private sector and fishing community to share responsibility for fishery management. To

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<sup>3</sup> *Penaeus monodon*, *P. indicus*, *P. semisulcatus*, *P. latisulcatus*, *P. japonicus*, *Metapenaeus monocerus*, *M. stebbingi*, and *Tracypenaeus curvirostris* represent the shrimp species found in Sudanese water

<sup>4</sup> *Holothuria Scabra*, *H. arta*, *Microthela fuscogilva*, *Actinopyga miliaris*, *A. mauritiana* and *A. fusca*

<sup>5</sup> 1982 United Nations Convention on Law of Sea (UNCLOS); 1995 UN Fish Stocks Agreement; FAO Compliance Agreement; FAO Code of Conduct for Responsible Fisheries

date the groups have identified and agreed on management measures for the seacucumber and finfish fisheries and have drafted a fishery management plan.

The co-management arrangement for the seacucumber fishery is currently providing the model for the development of management systems for the other fisheries. Commercial fishing for seacucumber was closed in 2009 based on evidence provided to all RS coastal States from the regional conservation organisation PERSGA (Regional Inter-government Organisation for the Conservation of the Environment of the Red Sea and Gulf of Eden). The decision to close the fishery based on regional concerns rather than data specific to Sudan created tensions from fishing communities and traders benefiting from the seacucumber fishery. This led to a workshop where broad management objectives were identified and a 'Roadmap' that set out how to improve seacucumber management tabled. The roadmap presented a 10-point plan in which the ban on harvesting seacucumber would be lifted if there was an agreement between traders, fishers and the State to set fishing effort limits, reduce the harvesting period and number of harvesting areas, and to share data collected during an experimental one-year harvest.

The seacucumber fishery is the first co-management arrangement in the Sudanese fisheries and uses adaptive management through experimental harvesting that requires fishers and traders to provide data on their harvesting activities. The first step involved legalising the fishery so that the boats involved in harvesting were registered and marked accordingly, and all fishers were licensed. Traders are supporting the initiative by funding the costs of government observers to remain in each of the camps to gather data. This is helping to monitor the fishery and has led to improvements in processing such as a ban on the use of mangrove wood and limiting the size of species harvested. The State is now collecting catch data as well as gaining a better understanding of the operational costs and benefits of the fishery. This is helping to develop management measures that address marketing, production and equity concerns. Where infractions have occurred particularly in the supply of poor quality SCUBA diving equipment such traders are required to cover inspection costs as an initial penalty. This arrangement currently means that the management costs and benefits are shared by the partnership and is not reliant on licensing or State revenues.

#### *Stock assessment and capacity building*

The Fishery Administration (FA) is responsible for fishery management despite its limited physical, financial and human capacity to monitor and manage commercial fish stocks. Data collection is poorly organized and there is no applied research conducted. Similarly there are no surveillance activities and the fishery legislation is poorly enforced.

Mechanisms to involve fishers and communities in the fishery management process have not been exercised since cooperatives were set up in the early 1980's to assist fishery development projects supported by the UN Food and Agriculture Organization (FAO) and the UK's Overseas Development Institute (ODI). Both these projects worked through the FA to increase production and functioned by subsidising the supply of new equipment and ice for fishers, and by guaranteeing the purchase of fish through rotation funds for low cost sale and distribution. Privatisation has

meant that many of these activities are now managed by companies or individuals that have not re-invested in the sector. Fishers have become dependent on local traders for all inputs (ice, food, fuel, loans) with repayments schemes that keep them in debt. The sector depression has constrained the market with no investment to improve storage or processing facilities, few quality controls and standards, and administrative delays before transport of fish is approved for market. The constraints have limited the ability for the sector to modernise and supply quality products to domestic and international markets.

To help build the capacity to monitor fish stocks and improve fishery management the EU intervention has supported the setting up of three technical working groups representing key technicians from the government's FA, Fishery Research Centre and Red Sea University. Each technical working group is tasked with a particular aspect of EAF: (1) ecological and biological factors; (2) socio-economic issues; and (3) governance concerns. The technicians from these institutions have collaborated for the first time, developing their understanding of EAF and designing practical interventions that can collect essential data on the fishery and fishing communities. This has led to a programme of experimental fishing based on adaptive management principles that is testing new fishing technologies and techniques and gathering data on the fishery and users.

Capacity building has aimed to strengthen the institutional capacity of government institutions so they can develop better extension services and build capacity within fishing communities. The approach has been used to introduce new fishing techniques and technologies such as bottom-set long-lines, fish traps, handreels, circle hooks, Global Positioning Systems (GPS) and fish-finders. The capacity building has functioned as an important catalyst that has brought together State institutions responsible for fishery management with the fishers and traders. Engaging fishers has been tackled through traditional institutional structures that involve key fishers from the main fishing centres that have shared knowledge with the technical working groups. This has been mutually beneficial and provided an opportunity to discuss management issues in particular the management of reef associated finfish such as the coral groupers. A co-management group representing key fishers, traders, scientists and managers has been set up to identify the most appropriate management measures to sustain this fishery with the group favouring limits to be placed on the market during the spawning season aggregations as a mechanism to reduce fishing effort.

The highly participatory approach to training has combined the introduction of new fishing technologies and techniques of fishing communities with the gathering of essential data on each local fishery. The data generated are shared and analysed so all stakeholders are engaged in decision-making and this is enhancing the transparency in the fishery management process. The approach has helped to identify seven fishery management areas (FMAs) and has also involved undertaking participatory stock assessment using ParFish (Walmsley *et al*, 2005). ParFish is based on depletion tests and the approach has been effective in raising awareness and facilitating discussions on fishery management within fishing communities.

## *Social capital - conceptual framework and analysis*

Applying SC analysis to the Sudanese case study can assist fishery managers and practitioners better understand how co-management partnerships are functioning and supporting the process of fishery management. SC refers to the social networks, and the norms and sanctions that govern their character (Halpern, 2005). In its broadest sense SC is the connections made between people and the networks, norms and relations of common values in whose membership constitute a resource, forming a kind of capital (Field, 2003). The best-known protagonist of social capital is Robert Putnam who defines social capital as:

*“Features of social life – networks, norms, and trust – that enable participants to act together more effectively to pursue shared objectives”* (Putnam, 1995)

The concept of social capital can be approached from a number of perspectives but of particular interest for understanding the effectiveness of the co-management partnerships and their contribution to fishery management are the theoretical constructs of Pierre Bourdieu (1992), James Coleman (1988), and Robert Putnam (1993). These approaches are not mutually exclusive but emphasise social capital's influence from the position of the individual, the community, and at societal level. This is a useful theoretical framework in which to assess how fishers, traders and the State are contributing to sustaining fisheries as it parallels similar deductive approaches in fishery management (private, communal and State), and also the human interaction with the environment (rationality, cooperative behaviour and historical sociology).

The analytical approach uses SC as a heuristic tool to explore social process, and considers that social relations and alliances that enable fishers and other stakeholders to participate in fishery management are dependent on social, political and ecological context. SC in this sense is used as analytical device that helps to identify and explain the influence of context, such as power and history and their influences on fishery governance. This can be considered as the “lens” of social capital in fishery governance analysis. The approach also uses SC as an important variable and subject of analysis, with a particularly focus on the way linkages are made between different stakeholders within the partnerships. This is a unique use of SC and has importance in fishery governance and developing fishery policy.

The issue of context and how it influences the participation of fishers, traders and the State in fishery management is addressed by focussing on the positive and negative characteristics of two types of social capital. These occur in: (1) the cross-sector linkages between sectors; and (2) SC within “political society” (Harriss and Renzio, 1997). These two types of linking social capital are facilitated through cognitive elements of social process that predispose people towards collective action, and also structural elements that facilitate such action (Grootaert and Bastelaer, 2002). Cross-sectoral linkages are the structural elements of SC, determining what people “do”, whilst political alliances are the cognitive or embedded elements of SC referring to how people “feel” (Jones, 2005; Harriss and Renzio, 1997; Evans, 1996). Structural SC is considered rational and independent of context, history and politics, whilst cognitive social capital is seen as interdependent on context (Harriss and Renzio, 1997; Evans, 1996). The social networks, norms and sanctions that create

the linkages between the different stakeholders in a fisher co-management partnership can result in positive cooperation, and can also be used to exclude and reinforce differences. Therefore SC operates in both positive and negative directions and this is critical to understanding the attributes of the social networks that help establish partnerships and the norms that govern their character.

To analyse SC in the case study, proxy indicators are used (See Table 1 below). The indicators assess the interactions between the different stakeholders that can facilitate cooperation, compliance, bargaining, benefit distribution and compensation, which can help fishery managers understand the extent and effectiveness of participation in the fishery management process (Johnstone, 2009).

**Table 1: Social capital indicators of participation in the fishery management process**

<b>Behavioural characteristic</b>	<b>Social Capital Indicators of participation in the fishery management process</b>
<b><i>Cooperation</i></b>	<ul style="list-style-type: none"> <li>• Formal contact arrangements exist between all resource users and the State</li> <li>• Fishery management groups represent all resource users and relevant NGOs, private sector and State governing institutions</li> </ul>
<b><i>Compliance</i></b>	<ul style="list-style-type: none"> <li>• Fishery management rules incorporate traditional knowledge / rules</li> <li>• Fishery management rules are adopted by fishers through traditional institutions</li> <li>• Fishery management regulatory mechanisms include all stakeholders</li> </ul>
<b><i>Bargaining</i></b>	<ul style="list-style-type: none"> <li>• Fishing management rights are secured with political support and maintained through ongoing positive political alliances with the State</li> <li>• Fishing communities recognise fishing management rights of other users</li> </ul>
<b><i>Benefits Distributions</i></b>	<ul style="list-style-type: none"> <li>• Competition between different resource users leads to collaborative actions/ activities with benefits shared</li> <li>• Fishery management benefits are agreed and shared amongst different resource users</li> </ul>
<b><i>Compensation</i></b>	<ul style="list-style-type: none"> <li>• Negotiations on fishing compensation involve the State and all resource users with fishing management rights including migratory fishers</li> </ul>

To date the partnership arrangements in Sudan have helped to build cooperation through the establishment of formal contact arrangements through the co-management groups for seacucumber demersal finfish fisheries. The co-management groups and RSFCG partnership are also helping to improve the negotiating capacity of fishers with the support of the Fishery Administration, which has negotiated guarantees for local employment of fishers in compensation for use and access to the local fishery by the seacucumber harvesters.

Importantly and despite initial reluctance the security agencies are now also engaged in the partnership process. The security agencies are federally managed and controlled and monitor all movement and activities in the RS State. This includes a requirement by all fishers to obtain maritime access licences before going to sea. The partnership approach has engaged the security agencies and encouraged them



to share some management responsibility with other stakeholders including fishing communities. The initial meetings held at the FA were first cancelled by the security agency until the Director General of the Ministry of Agriculture convened a meeting in which the security agency agreed to be involved in the process. The case illustrates both the positively and negatively influence of the security agencies on the co-management process in Sudan, and how they can be moderated by political and institutional interventions. The engagement of the security agencies in the partnership is currently contributing positively to improving compliance particularly as all the stakeholders are involved in the management and regulatory framework including participation in joint surveillance operations.

## **DISCUSSION / CONCLUSIONS**

The EU intervention has applied a highly participatory EAF approach to fishery management in Sudan that has broadened consultation and demanded transparency in decision-making through co-management. Building fishery management capacity around EAF has helped the government work collaboratively with its fishing communities and traders and is contributing to sustainable development by finding a balance between ecological and human well-being.

EAF is particularly effective in the fishery management process when combined with adaptive management as it helps to structure management priorities so that human, ecological and governance issues are addressed, which can be tested. These are now providing the guiding principles for Sudan's fishery management system and helping to define fishery policy.

The experience of the seacucumber fishery is an important example why adaptive management works. Closure of this fishery in 2009 was based on evidence that was not specific to Sudan and encouraged a precautionary approach to management. The decision to close the fishery disenfranchised fishers and traders from benefiting from the fishery. However, negotiating a limited experimental harvest and applying adaptive management principles has meant that the knowledge, risks and responsibility for managing seacucumbers is shared and all stakeholders are partners in its management.

Using SC to assess the extent of participation in the fishery management process is a useful tool for fishery managers. The participation and active engagement of the State and resource-users in the fishery management process are important components of rights-based management. Therefore the ability for participants to cooperate, comply, bargain, distribute benefits and compensate in the fishery management process are essential behavioural characteristics for a sustainable EAF management system.

An important challenge in Sudan is to continue to engage the security agencies as they can undermine the participatory management approaches. The security agencies reluctance to be engaged in the process suggests two issues: first the difficulty of sharing decision-making responsibilities with other stakeholder; and second it indicates the extent of illegal, unregulated and unreported (IUU) fishing facilitated by these agencies. This issue is the most challenging to address as the benefits of IUU fishing often outweigh the costs of compliance.

In conclusion, this paper has discussed the importance of EAF, partnerships and adaptive management in developing policy and governance structures for fishery management in Sudan. The approach is also contributing to stock assessment, strengthening the institutional capacity of the sector and integrating market issues into the fishery management process. Bringing together traders, fishers and the State to form partnerships for fishery management is now ensuring a more comprehensive policy vision for the long-term environmental and economic sustainability of the Sudanese fishery.

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