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Les enjeux informationnels de la planification spatiale marine. Les leçons tirées du cas des petites pêches artisanales au Sénégal

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Chapter 10. The information challenges of marine spatial planning

Lessons learned from small-scale fisheries in Senegal

Brice Trouillet, Ndickou Gaye, Aïchetou Seck, Michel Desse, Awa Niang, Alexis Fossi, Thierry Guineberteau, Alioune Kane and Laurent Pourinet

Introduction

- 1 Marine spatial planning (MSP) requires the ability to “objectify” the distribution of activities at sea, which in turn requires information on multiple aspects. Geographic information is one of the central of these. However, from the construction of information to its dissemination (types, metrics, collection and processing methods, modes of representation, quality and reliability, tools and forms of dissemination, etc.), data is far from “objective” or neutral, and thus nor is the series of following choices (D'AQUINO *et al.*, 2002; ILIADIS and RUSSO, 2016; KITCHIN and LAURIAULT, 2018; NOUCHER *et al.*, 2019). BOWKER (2005) stated this in his assertion, later taken up by GITELMAN and JACKSON (2013), that “‘Raw data’ is both an oxymoron and a bad idea.” Geographic information is no exception to this (BOUCQUEY *et al.*, 2019; CAMPBELL *et al.*, 2020; TROUILLET, 2019). This leads to an information issue that is little discussed, but lies at the heart of several problems raised by the scientific literature on MSP. Among these are the unequal distribution of the benefits of MSP, the predominance of the rationalist approach, the absence of real theoretical foundations, and the dominance of certain interests to the detriment of others (FLANNERY and ELLIS, 2016; FLANNERY *et al.*, 2018; JENTOFT, 2017; KIDD and ELLIS, 2012; TAFON, 2019; TROUILLET, 2018).
- 2 Two elements may further accentuate this information issue. Firstly, this problem is particularly acute when seeking to characterise spatially dispersed, mobile and variable activities, which are difficult to describe and represent. This challenge can be even greater in the case of activities at the margins of the market or in the informal sector,

for which observation systems may be inoperative. This is linked to another limitation of MSP that tacitly makes it an exercise of rationalising the use of space in a quest to maximise economic gains while taking into account marine ecosystems, but leaving aside other aspects associated with its use (cultural, social, identity, religious, territorial). In short, MSP is not only a question of defining what to observe, but knowing how to do so, i.e. with what variables. Fisheries, in particular small-scale, artisanal, subsistence fisheries, are often off the radar of observation systems (AGAPITO *et al.*, 2019; TROUILLET *et al.*, 2019), and therefore marginalised (PAULY, 2006). At best, they are summarised by reductionist bioeconomic metrics unable to capture their complexity and diversity (TOLVANEN *et al.*, 2019; SAID and TROUILLET, 2020), and as such can be at risk.

- 3 The second element that makes information an issue in MSP particularly affects developing countries and involves the greater scarcity of data (MILLS *et al.*, 2011) and informational dependence on foreign actors (e.g. foreign aid agencies, large international non-governmental organisations) (AVGEROU, 2008; WALSHAM and SAHAY, 2006). As a result, to date, very few marine plans have been developed in emerging countries (FRAZÃO SANTOS *et al.*, 2020; TROUILLET, 2020), with the exception of a few island micro-states and other sub-national approaches sometimes related to MSP, such as certain marine protected areas (MPAs)¹. Yet this situation is starting to change as new uses of the sea arise and major projects become more numerous, in developing countries as elsewhere. This is the case in Senegal, where the evolving blue economy may lead the Senegalese authorities to embark on MSP in the near future, following in the footsteps of a growing number of countries around the world (ZAUCHA and GEE, 2019). A project promoting MSP in all the signatory countries of the Abidjan Convention (including Senegal) is currently underway².
- 4 This chapter aims to draw attention to the information challenges of MSP by exploiting the heuristic potential of the case of small-scale artisanal fisheries in Senegal. In particular, the chapter examines the role of geographic information and associated geo-technologies used in MSP to identify the main points of vigilance to be considered (see Box 1 on the risk of ocean grabbing, for example). An empirical approach was used, based on fieldwork, interviews with stakeholders in maritime and coastal development, and the analysis of a body of literature including reports and websites of the various stakeholders. The first part describes the changes taking place in Senegal's maritime space that may justify the implementation of MSP in the near future, and the importance of taking into account information issues in an MSP approach. This information issue is highlighted in our case study at two levels: fisheries at the national level and three more localised cases in Senegal. The chapter then discusses lessons to be learned regarding geographic information in the context of MSP in developing and emerging countries in the tropics.

Box 1. The threat of ocean grabbing

Alexis FOSSI

The term “ocean grabbing” originated in a 2012 report on fisheries by Olivier DE SCHUTTER (UN Special Rapporteur on the right to food) for the UN General Assembly. The report raised the alarm on the growing constraints faced by coastal communities and artisanal fishermen linked to the non-respect of “human rights” or “rights of access to resources”. It stressed the importance of involving fishing

communities at all stages when developing projects in coastal areas, as well as in the development and implementation of fisheries policy. Many of the report's recommendations were incorporated into the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries (FAO, 2015), supported by the work of organisations such as the World Forum of Fisher Peoples (WFFP) and the International Collective in Support of Fishworkers (ICSF) in negotiations with the Committee on Fisheries of the Food and Agriculture Organisation of the United Nations (COFI).

In 2014, the issue of ocean grabbing was analysed in a study carried out jointly by three fisherfolk and farmer support organisations (TNI *et al.*, 2014) with the WFFP. The causes identified for this phenomenon are very diverse, but one of the most important is the complex process involved in defining fisheries policy and access rights in the form of quotas, from which artisanal fishing is often excluded. Other factors are the increasing number of projects linked to aquaculture or energy production (e.g. offshore wind farms), the creation of large marine protected areas associated with ecotourism projects, the expansion of the oil and gas extraction industry and the development of port infrastructure. These activities, grouped under the concept of the “blue economy”, very often involve a form of privatisation or restrictions on access to marine or coastal spaces and/or resources. Fishing communities, which depend on these areas and resources for their livelihoods, are typically not involved in the discussions and decision-making processes, which tend to be mainly oriented towards short-term economic benefits.

The Transnational Institute (TNI), a non-profit research and advocacy think tank, brought up this issue in a critical analysis of blue growth in 2018, in which it presented MSP as a tool for the privatisation of maritime space for the benefit of the most “profitable” industries, such as fossil fuel extraction and maritime transport.

For more information

BRENT Z., BARBESGAARD M., PEDERSEN C., 2018

The Blue Fix: unmasking the politics behind the promise of blue growth. Amsterdam, TNI, 24 p. <https://www.tni.org/en/bluegrowth>

FAO, 2015

Voluntary Guidelines for Sustainable Small-scale Fisheries. Rome, FAO, 39 p. <https://www.fao.org/documents/card/en/c/14356F>

SCHUTTER O., 2012

Interim report of the Special Rapporteur on the right to food. General Assembly, Sixty-seventh session, A/67/268, New York, United Nations, 28 pp.

TNI, MASIFUNDISE DEVELOPMENT TRUST, AFRIKA KONTAKT, WFFP, 2014

The global sea grab. A booklet. 57 p. http://worldfishers.org/wp-content/uploads/2014/08/The_Global_Ocean_Grab-FR.pdf

Marine spatial planning and geographic information

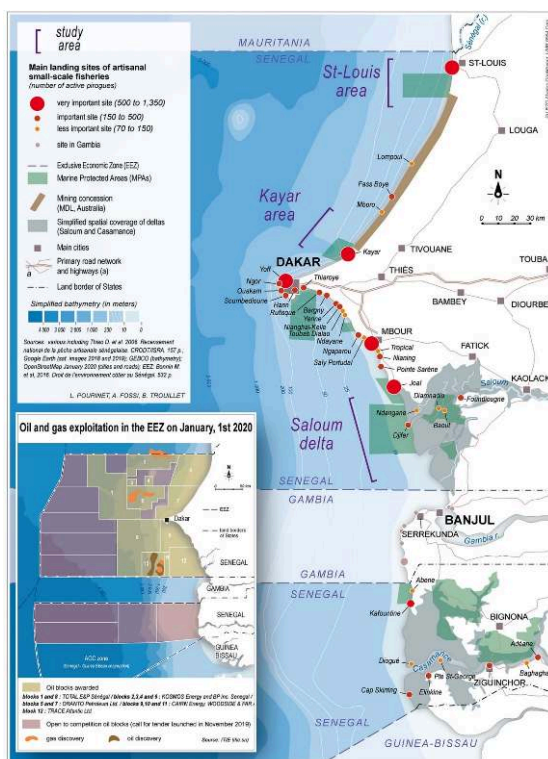
- 5 In this section, the emerging issues around sharing maritime and coastal space in Senegal are highlighted, with a focus on challenges around the information issue in the field of fisheries.

Changes in Senegal's maritime and coastal space

- 6 There have been multiple changes in Senegal's maritime space in recent years. These affect all coastal and maritime sectors in the country to varying degrees, and are often linked to global changes (climate, energy transition, etc.).
- 7 Following several initiatives to promote growth in different sectors, the Plan for an Emerging Senegal³ (PSE) (REPUBLIC OF SENEGAL, 2014) puts forward an overall development strategy for 2035, focusing in particular on the diversification of activities. This has resulted in an ambitious Strategic Plan for the Development of Aquaculture (PSDA) adopted in December 2016. Its objective is to increase aquaculture production to 40,000 or 50,000 t in 2023 (BONNIN *et al.*, 2016), a 40- or 50-fold increase, in certain identified geographical areas, notably Casamance (Sédhiou department upstream from Adéane; fig. 1). Another priority in the PSE is tourism, which has been the subject of various previous initiatives: the National Agency for the Promotion of Tourism in 2004, the Society for the Development and Promotion of Senegal Coasts and Tourist Zones (SAPCO) in 1975, whose scope of action was extended beyond the Petite Côte from 2004, and a tourism development strategy defined in 2005. Although the development of tourism is aimed at the whole of Senegal, the expected effect will be particularly strong in the coastal areas, which include five of the six "integrated tourist areas"⁴ of the PSE. The energy sector is a further priority, with the PSE expanding the orientations in the 2012 policy letter on the development of the energy sector. With regard to hydrocarbons, after the first discovery of deposits in 2014 in the current Block 10 (fig. 1), almost all of Senegal's maritime space has been opened up to offshore oil and gas exploration permits. In terms of mining activities, a sand extraction zone (rich in zircon and ilmenite) corresponding to a 4.5 km strip extending over 107 km was granted in 2007 until 2032 to the Australian company Mineral Deposits Limited (MDL) (BONNIN *et al.*, 2016) (fig. 1). Lastly, there is a development strategy for infrastructure, which is reflected in several projects to create new commercial ports. This includes a multifunctional port project at Ndayane on the Petite Côte (fig. 1), built by the UAE company Dubai Ports World. This would be one of the links in a large logistics hub integrating several port projects, including the bulk and mineral port currently under construction in Bargny, interconnected by planned road, motorway and rail networks. In Ndiago in Mauritania, just on the other side of the border with Senegal (15 km north of Saint-Louis, where a river-sea port project is in the works under the aegis of the city and the Organisation for the Development of the Senegal River), the multifunctional port of Ndiago is being constructed by the Chinese company Poly Technologies and is due to be completed soon. The Ndiago port is designed both to take advantage of the exploitation of the offshore deposit of Grand Tortue Ahmeyim on the Mauritania-Senegal border (partially in Block 2; fig. 1), and to land fish from Senegalese fishermen working in this area.

- 8 Despite the fact that they are spread along the Senegalese coastline, these rapid changes, which are sometimes profound, are having an impact on fishing activities, (fig. 1), which form the backbone of Senegal's coastal economy and on which many coastal communities depend. After several years of growth, fishing landings in Senegal are slowing, or even decreasing, depending on the species (MINISTRY OF FISHERIES AND MARITIME ECONOMY, 2016). This is due to a complex mix of fishing overcapacity, habitat degradation (MBAYE *et al.*, 2018) and the effects of climate change, which are redrawing the distribution patterns of species of interest. Moreover, these changes are taking place against a backdrop of geopolitical issues linked to fishing agreements with neighbouring countries (particularly Mauritania⁵) or regions further afield (Asia, Europe), or issues linked to illegal, unreported and unregulated (IUU) fishing, which represents an estimated loss of income of nearly US\$300 million per year in Senegal (BELHABIB *et al.*, 2014).
- 9 Two other elements add to an already complex fisheries situation. Firstly, following sub-regional initiatives such as the Regional Partnership for Coastal and Marine Conservation (PRCM), the Regional Network of Marine Protected Areas in West Africa (RAMPAO), etc., Senegal has recently developed a national MPA strategy in line with international commitments (MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, 2013). To date, Senegal has about 15 MPAs, four of which are relatively large (fig. 1). Secondly, strong urban pressure on the sea front (construction of hotels, urban port projects, etc.), combined with sometimes very rapid coastal erosion problems (Guet Ndar, Dakar, etc.), exposes fishing communities to the risk of exclusion and forced relocation.

Figure 1. Study areas and general context



Source: L. Pourinet, A. Fossi, B. Trouillet
High resolution map: Figure 01 HD

- 10 All of these changes are taking place at a time when the legislative foundations for coastal and maritime planning to regulate their effects are still unclear, both in land planning (problems of defining the public maritime domain) and in marine planning (absence of agreements on maritime borders with Cabo Verde, an unclear zone between Gambia and Cabo Verde, and a joint management zone between Senegal and Guinea-Bissau) (BONNIN *et al.*, 2016).

Geographic information: key to marine spatial planning

- 11 While MSP has its roots in experiments carried out as early as the 1960s and 1970s, it only really began to take hold in the mid-2000s. Of the many existing definitions, the most common is: “The public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process” (EHLER and DOUVERE, 2009). It can be tempting to adopt a unifying and universalist definition, but in reality practices encompass diverse rationales and pursue diverse goals (JONES *et al.*, 2016; TROUILLET, 2020), tipping the balance either to the side of systematic conservation planning (AGARDY *et al.*, 2011; KIRKMAN *et al.*, 2019) or to spatial planning in the broadest sense of the term (JAY, 2010a; OLSEN *et al.*, 2016).
- 12 Nonetheless, three constants can be identified, regardless of the position between the two typical cases mentioned above. Firstly, **geographic information is omnipresent throughout the MSP process**. It is used to describe the existing situation, to construct and represent different scenarios, and finally to translate these into spatial management measures. Geographic information technologies – in particular geographic information systems (GIS) – are thus enlisted to carry out multi-criteria spatial analyses that shed light on “(in)compatibilities” between uses, regulations, natural habitats, species and the physical environment (CALDOW *et al.*, 2015; PINARBAŞI *et al.*, 2017; STELZENMÜLLER *et al.*, 2013). In this, the input data (from which information is extracted) is fundamental, as to a large extent the final result and the very way of rendering it depends on this: “What data go into the data portals has profound impacts on what kinds of decision-making are possible and how the environment and communities are formatted” (CAMPBELL *et al.*, 2020).
- 13 This information issue is central to MSP, even more than in land-based planning, for two main reasons. One is that for most maritime stakeholders, and especially decision-makers, maritime space is an abstract space disconnected from experience (STEINBERG and PETERS, 2015). This means that there are fewer alternatives to qualitative – even sensitive – data on maritime space, and less critical distance from the data itself. The other is the multiple levels at which “what data goes into the data portals” plays out: the presence or absence of information, the context of information production, the metrics used, the types of processing carried out, the cartographic representations produced, the portal or dissemination infrastructure, and the nature and status of the information producers (BOUCQUEY *et al.*, 2019; ST. MARTIN and HALL-ARBER, 2008; STAMOULIS and DELEVAUX, 2015; TROUILLET, 2019; SAID and TROUILLET, 2020). At each of these levels, choices are made, whether conscious or unconscious, explicit or implicit, and none can be considered neutral. As MSP is now leaning towards a quantitative and rationalist model, unlike land-based planning (JAY, 2010b; KIDD and ELLIS, 2012), the information

issue is exacerbated and, paradoxically, remains little studied. The consideration of this is in line with the perspective of “a partial renewal of the methodological frameworks of critical cartography (...) [which] must allow for a deeper description of new ways of making maps, of the stages of their making (...) and of the power relations that accompany this making both in design and in use” (JOLIVEAU *et al.*, 2013).

- 14 The rationalist anchoring of MSP, confining itself to “evidence-based” or “data-driven” planning, seems to be linked to the dual aims of MSP of systematic conservation planning and spatial planning (understood here in the broad sense). So the second constant is that **the information issue delineates an epistemological fault line between conservation science and spatial planning science**. In the absence of the clarification and substantive theoretical debates taking place for over a century in land-based planning, this fault line raises the question of positivism in the field of MSP (TROUILLET, 2019). In land-based planning, DAVOUDI (2006) reminds us that facts and information are not in themselves evidence (it is more a matter of combinatorics), and that any evidence must include multiple forms of knowledge. It is therefore necessary to place this information issue, which is currently only indirectly addressed in the already limited theoretical debates regarding MSP, at the centre of our concerns. Failing this, and given a certain revival of (neo)positivism in the field, there will be an overinvestment in “how” to the detriment of “why”, returning to the tired but endless debate between spatial and strategic planning.
- 15 The third constant is that **the question of information is also one of situated and relational power**. Information is strongly dependent on the socio-technical organisation – or network – of actors, as well as objects such as information, technology, discourse, etc., within which it is gathered and disseminated (AKRICH, 1989; CALLON, 1986; 2006; LATOUR, 2005). Each point in the network influences the others and thus contributes to shaping the power relationships between actors. To take an extreme example, a situation of data deluge, in which there is an abundance of data, differs from that of a lack of data, even if the abundance of data has no bearing on its quality and vice versa. In some ways, the situated and relational power in the information issue echoes the shift from an interest in maps as objects to maps as practices (CRAMPTON, 2009) or, by extension, geographic information as object to geographic information as practice. The capacity of geographic information to exert power over the dominated has long been pointed out (PICKLES, 1995; CHAMBERS, 2006; DUNN, 2007), but vigilance is particularly necessary in the West African context, as standards and references are usually defined exogenously (as is often the case with aid and data production), overlooking pluralism, local specificities and so-called “non-scientific” knowledge (D’AQUINO *et al.*, 2002). This observation has been at the origin of the development of participatory geographic information systems (CRAMPTON, 2010), and the emergence of certain currents of critical cartography, critical GIS, counter-mapping and even data activism. It is linked to questions of invisible power (LUKES, 2015), referring in part to what YOUNG (1990) defines as cultural imperialism, i.e. a process leading to the unconscious acceptance of the norms and references of the dominant power. In tropical maritime contexts, where geographic information is scarce, attention must be paid to intertwining top-down and bottom-up (especially participatory) approaches to information production, and the associated information issues, including the analysis of formal and informal information networks, powers and modalities of collection, and tools for knowledge integration (POMEROY *et al.*, 2014).

- 16 With these three constants in mind, it is of interest to apply a methodological framework explicitly attentive to power issues to the question of information and MSP in the case of small-scale fisheries in Senegal.

The information issue in Senegal's fisheries

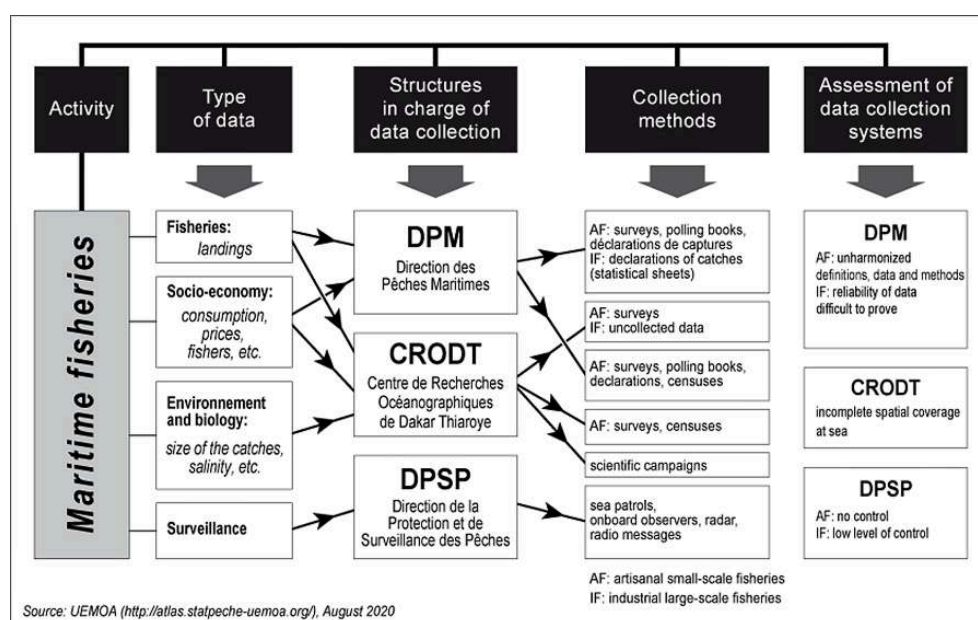
- 17 This section gives a brief overview of Senegal's fisheries at a national level and the information systems related to this, and then looks at three case studies in the regions of Saint-Louis, Kayar and the Saloum delta.

Overview of Senegal's fisheries

- 18 While there has long been pirogue fishing activity on the Senegal coast, at the turn of the 20th century, the French colonial power began to develop Senegalese maritime resources (CHAUVEAU and SAMBA, 1990). The initial colonial objective "was to supply food products to France at war and to the local European population cut off from exports"; over the subsequent decades, Senegal's fisheries would undergo many changes (CHAUVEAU and SAMBA, 1990).
- 19 Today, maritime fishing in Senegal is made up of two sectors with often competing rationales, with a marked dichotomy between industrial and artisanal fishing. Industrial fishing, based in Dakar, is mainly characterised by vessels equipped with inboard engines. The national fleet consists of an estimated 104 trawlers and eight tuna boats⁶, not counting the presence of a foreign fleet. Landings are destined for export and, unlike artisanal fishing, industrial fishing plays a small role in the national economy. Artisanal or traditional fishing is often defined by (1) a household-based production unit, (2) the acquisition of knowledge and skills adapted to the local environment, based on local or traditional transmission, and (3) the use of relatively simple technologies (JENTOFT, 2006; WORLD BANK, 2008; 2012). In an attempt to capture the diversity and complexity of artisanal fisheries, various criteria are combined: technological (size of boat and type of fishing gear), spatial (area of exploitation, area of catch) and socio-economic (capital, labour, integration into local and national markets) (CHUENPAGDEE *et al.*, 2006; GARCIA *et al.*, 2010). In Senegal, artisanal fishing is increasing due to its flexible nature, which allows new actors to take up the activity or develop related industries and trade networks, but also because it is being promoted as a lever for development. The artisanal fleet is estimated at 19,000 pirogues, of which more than 90% are motorised⁷. These two different types of fishing pose challenges in terms of fisheries monitoring: the industrial fishing fleet is concentrated in the port of Dakar and consists of a small number of boats, while the artisanal fishing fleet is scattered along the coast, is very diversified and has a much larger number of boats.
- 20 It is important to note that fishing activity should not be reduced to its bioeconomic dimension alone: it constitutes the most visible form of maritimisation of coastal societies. Senegal's fishing area presents forms of exploitation and appropriation that policies have long sought to structure and organise. The Senegalese government's initiatives and strategies in terms of information collection in this sphere are essentially based on two objectives: the development of the fisheries sector and the management of the fisheries resource (FAO, 2008). The latter provides an overview of the existing information on fisheries throughout Senegal's maritime space. To ensure

the sustainability of its marine resources, Senegal has relied heavily on the institutional framework, particularly by strengthening the capacity and means of action of the fisheries agencies. At the national level, the collection and management of this information is the responsibility of the Directorate of Maritime Fisheries (DPM), the Directorate of Fisheries Protection and Monitoring (DPSP) and the Oceanographic Research Centre of Dakar Thiaroye (CRODT) (fig. 2). These institutions are supported by decentralised regional and departmental agencies, and locally by monitoring stations. An example of a classic monitoring system, this institutional framework aims to provide information for discussions on sectoral policies, particularly those aimed at fisheries management, regulatory and environmental frameworks, and the implementation of monitoring programmes for certain overexploited species (e.g. sharks and shrimp).

Figure 2. Collection and management of marine fisheries information at a national level



Source: WAEMU (<http://atlas.statpeche-uemoa.org/>)

- 21 Information collection relating to the fisheries sector thus relies heavily on both central and decentralised agencies, as well as on national research institutes (notably CRODT). These structures are mainly oriented towards collecting information on resources (landings, size/weight, quality, origin, etc.), and the sprawling development of small-scale fishing poses a problem for monitoring. Fisheries agencies are understaffed, and cooperation at a local level with management agencies (particularly for checks at sea) is not operational. These rely on a small number of volunteers who lack official status and very often encounter resistance from small-scale fishermen. There is also an issue of the reliability of the collected data, which is often biased or even the result of extrapolations.
- 22 The system for monitoring foreign fishing vessels is also problematic. Satellite monitoring by a vessel monitoring system (VMS) was made compulsory by Ministerial Decree No. 009757 of 5 December 2005, theoretically making it possible to receive data on the position of vessels operating in Senegal's national waters and to verify their activities. In practice, surveillance is far from regular. Aerial patrols (flyovers,

photography and identification of vessels) are subject to the availability of the French armed forces in Senegal (EFS) (DIAGNE, 2014), while maritime patrols (especially on the high seas) require significant financial resources. These constraints prevent regular monitoring and leave an open door to illegal, unreported and unregulated (IUU) fishing.

- 23 Other entities are also involved in the collection/production of data alongside Senegal's fisheries agencies: other ministries (in particular the Ministry of the Environment via the Directorate of Community Marine Protected Areas), national organisations and federations (Association of Shipowners and Fishing Industrials in Senegal, Employers' Union of Wholesalers and Exporters of Senegal, Local Artisanal Fisheries Councils), foreign or regional supranational organisations (European Union, Sub-Regional Fisheries Commission), scientific institutes and non-governmental organisations (NGOs) through research programmes, etc. These various forms of cooperation provide more or less one-off additional information, either for routine monitoring or in areas not covered by observation systems.
- 24 The collection of data on the fisheries sector thus faces a variety of shortcomings (reliability, availability of human, technical and financial resources, etc.). Once collected, the information is processed by Senegalese authorities and disseminated through statistical reports that are sometimes accessible online. There is little or no geographic processing of the data collected, except through landing points. To date, there is no fisheries data infrastructure in Senegal (in open access).

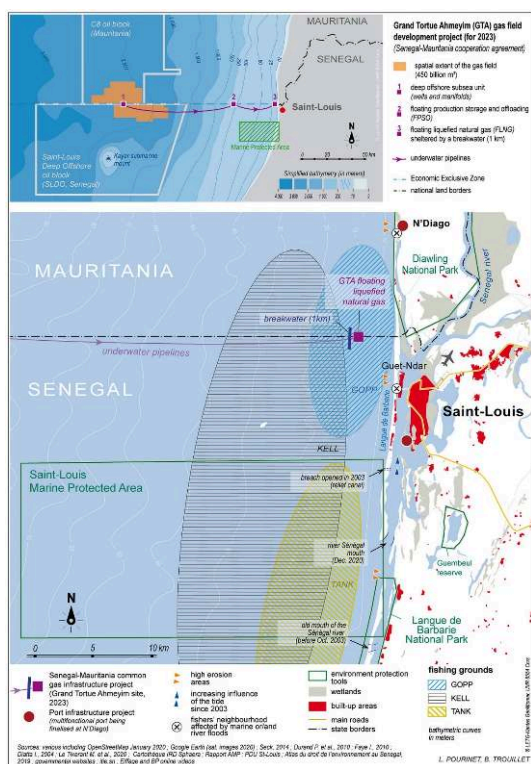
The Saint-Louis region: multiuse and multiscale

- 25 The Saint-Louis region (fig. 1) is one of the most active and long-standing artisanal fishing areas in the country. Artisanal fishing is mainly carried out by the migrant fishermen of Guet Ndar, a coastal community that has participated in turning West African fishing into a market economy (SECK, 2014). Through its dynamism and by taking advantage of technological advances, the Guet Ndar community has extended its fishing area along the West African coastline to preferred zones such as Mauritania and Guinea-Bissau (DÈME *et al.*, 2012). The mobility of the production unit (the pirogue), its specialisation in relation to the resource, and the investment made for long migrations give the Guet Ndar of Saint-Louis a succession of fragmented fishing areas that extend beyond Senegal's national jurisdiction.
- 26 In the Saint-Louis region, the specific characteristics of fishing, in addition to the appearance of new maritime activities (MPAs, blocks for gas and oil extraction and future ports) have resulted in real MSP issues that involve methods of sharing maritime space, integrated management of the coastline and its resources, and environmental protection. These issues must be addressed on an appropriate scale, taking into account the functional borders which, in the case of the northern region, transcend the Mauritania-Senegal border, or even take shape on a sub-regional scale. The Saint-Louis fishing area is undergoing rapid and profound changes that require a reexamination of the dynamics of the activities involved. As early as 2004, the creation of an MPA covering an area of 496 km² upset the spatial perception of artisanal fishermen and raised the question of the capacity of local agencies to regulate, manage and monitor the marine area. When the Saint-Louis MPA, located between the relief canal opened on

the Langue de Barbarie in 2003 and the original river mouth (fig. 3) was defined, three considerations were taken into account to ensure that the MPA:

- encompasses an important spawning area for shrimp – resources necessary for the presence of demersal species (fishermen participated in its definition)
 - avoids proximity to the fishermen’s settlements and is therefore far from the Guet Ndar district, while not encroaching on the Louga area located further south
 - covers a large area – an asset for artisanal fishermen to stop repeated incursions by trawlers into their fishing space (arbitrarily set by the government at 6 miles offshore).
- 27 However, the participatory process to delimit the MPA was quickly unanimously opposed by the community, which feared restrictions on the resource and sanctions. This led to numerous demands and even a denial of the conservation area by certain categories of users (those fishing with passive nets and purse seines). In addition, the lack of monitoring resources (equipment and personnel), the absence of markers, and the conflicts of authority between the Ministry of Maritime Fisheries and the Ministry of the Environment have all created obstacles to the proper functioning of the MPA. Today, the Saint-Louis MPA is recognised as a conservation area by fishermen; however, updating its perimeter will rely on the availability of information to enable managers to establish clear planning and mapping, which is currently lacking (fig. 3).

Figure 3. Spatial planning issues in the Saint-Louis region



Source: L. Pourinet, B. Trouillet
High resolution map: Figure 03 HD

- 28 In this already complex context, new challenges are emerging on the Saint-Louis coastline with the discovery of gas leading to exploration/extraction blocks and a renewal of river and maritime transports through port projects (the “Polish” port of Saint-Louis and the port of Ndiago). The potential for a hydrocarbon industry has been

discussed and researched since the 1990s, and in the 2000s the Senegalese government initiated exploration contracts with oil companies. Hydrocarbon exploration and production activities carried out in Senegal's sedimentary basin between 2014 and 2016 confirmed the presence of significant oil and gas reserves along the coastline, with the prospect of effective exploitation by 2022 (fig. 1).

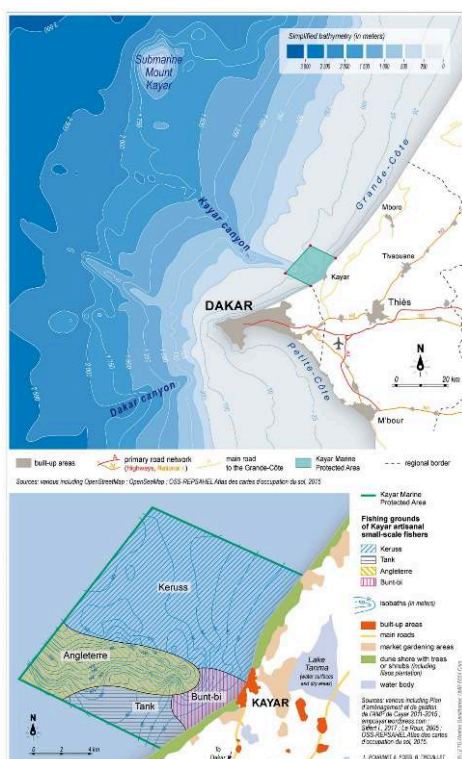
- 29 In this context, the Grand Tortue Ahmeyim gas field on the Mauritania–Senegal border in the Saint-Louis area presents great opportunities (fig. 3). With reserves estimated at 450 billion m³ according to British Petroleum⁸, the gas field is located in rock formations under the seabed 125 km from the coast and covers a total area of 9463 km². A framework agreement was signed on 14 January 2016 between Société des Pétroles du Sénégal (Petrosen), Société Mauritanienne des Hydrocarbures et du Patrimoine Minier (SMHPM) and Kosmos Energy Ltd.⁹ This agreement covers the delineation, evaluation, development and exploitation of the common hydrocarbon resources of the area. The area of activity is specified as:
- an offshore area approximately 125 km from the coast and at a water depth of 2700 m. It includes the gas field as well as the subsea wells and manifolds.
 - a pipeline area linking the offshore and nearshore infrastructure. It will house a floating production, storage and offloading facility (FPSO) and a platform about 35–40 km offshore for gas pre-processing and liquid disposal.
 - a nearshore area where a breakwater will protect the planned floating gas liquefaction plant. The breakwater is 1-km long and will be approximately 3–5 km from the coast where the depth is approximately 16–20 m.
- 30 There are high economic expectations for the Grand Tortue Ahmeyim project, with production intended for export as well as for the domestic market, but the project also raises questions about its potential impacts. A public consultation was conducted in 2017 between project stakeholders and local stakeholders in Saint-Louis (fishermen's organisations, women's groups involved in fish processing, fishmongers, Saint-Louis citizens, local authorities, NGOs, academics, etc.), but information that would allow the environmental and social impacts of gas exploitation to be identified is sorely lacking.
- 31 The fishermen of Guet Ndar fear that the future construction of the gas terminal will lead to a reduction in their fishing territory in an already tense context. They are concerned that a loss of territory would lead to a drop in landings and revenue, not to mention the risk of accidents, safety problems and pollution caused by the operation. For their part, conservation stakeholders (managers of the MPA and the Langue de Barbarie National Park) are very uncertain about the future of migration corridors for certain species (avifauna, marine turtles and cetaceans) due to the noise caused by seismic activities. The decentralised government services are powerless to anticipate the risks of pollution and degradation of the marine environment related to the project. The local authorities also have an urgent need for information to deal with issues linked to coastal erosion, a major problem on the north coast, an area in which two major port projects are underway. With the retreat of the coastline particularly marked on the Langue de Barbarie and the relocation of Guet Ndar populations to the interior (which is not always successful, especially when fishing communities are very resistant to these measures), risk management for vulnerable coastal communities will require planning that takes greater account of the need for observation data on coastal dynamics¹⁰. In this context, updating development and management plans on the basis of documented information is imperative in order to reassess the human and financial

resources necessary in this new context, including for various monitoring activities – a question that currently remains without a clear answer.

Kayar MPA: mapping fishing grounds

- 32 The fishing areas of Senegal's artisanal fleets have expanded considerably over the last few decades. Although economically very important for the country, artisanal fishing is not yet officially and systematically geo-referenced, although a great deal of data exists. The example of the trollers of Kayar, a dynamic fishing centre, illustrates the potential that exists at a national level.
- 33 Located about 60 km north of Dakar (fig. 1), Kayar has long been considered one of the two main landing centres for artisanal fisheries on the north Senegalese coast along with Saint-Louis (CURY and ROY, 1987). The particular topography of the coast as well as the presence of a submarine canyon that cuts deeply into the continental shelf creates a discontinuity in the environment that strongly influences the distribution of fish in this area (CURY and ROY, 1987) (fig. 4). As early as the 1950s, artisanal fishing developed here with the construction of a paved road following the recommendations of the 1948 Dakar Maritime Fisheries Conference (CHABOU and KEBE, 1989). Subsequently, various projects have contributed to the development of the site: the Senegalese Cooperative for the Supply and Distribution of Seafood Products (Coopmer) with an industrial complex in 1950, followed by the Senegalese Artisanal Fishing Support Centres (Capas) and the Pirogue Motorisation Support Centres (Camp) in the 1970s¹¹. In the early 2000s, with the support of Japanese cooperation, major developments took place to improve the marketing and processing of fishery products. In this context, the artisanal fishermen of Kayar developed an awareness early on of the uniqueness of their marine environment, which became their "fishing territory" (CHARLES-DOMINIQUE and MBAYE, 2000).

Figure 4. Kayar MPA: geographical context and fishing areas of Kayar artisanal fishermen



Source: L. Pourinet, A. Fossi, B. Trouillet
High resolution map: Figure 04 HD

- 34 This attachment to a “fishing territory” and the desire to preserve it, combined with strong local cohesion, have generated repeated and sometimes violent conflicts (1953, 1985, 2001, 2005) between the trollers of Kayar and the driftnetters of Guet Ndar and Fassboye (LE ROUX and NOËL, 2007; SIFFERT, 2017). The Kayar fishermen wanted to ban fishing with set nets, arguing, quite rightly, that the nets lost on the shelf edge “destroy” the trollers’ fishing grounds. However, according to some analyses, this “technical argument” was merely a catalyst for tensions between communities that existed for different reasons (CRODT, 1985). Thus, in the 1980s, the Kayar fishermen participated in the first structuring of the profession within the National Committee of Senegalese Fishermen (CNPS) and created a local Fisheries Committee. This level of organisation enabled, in 1994, a set of “management rules” to be accepted by the two main fishing communities present: the Kayar and the Guet Ndar of Saint-Louis. These “rules” made it possible to regulate the daily supply of fish in order to raise prices and compensate for the economic loss linked to the devaluation of the CFA franc (CHARLES-DOMINIQUE and MBAYE, 2000; DÈME, 2014).
- 35 From the end of the 1990s onwards, the possibility of acquiring a portable GPS – which can therefore be used onboard a pirogue – has had a major impact on the evolution of fishing strategies. It is interesting to note that the appropriation of GPS by Senegalese artisanal fishermen was very rapid and was not supported by any project. This new tool was an immediate success among the artisanal fleets, as in Kayar (fig. 5), facilitating the precision of the positioning of anchorage, which largely determines fishing success, particularly in the vicinity of the canyon.

Figure 5. Kayar troller looking for a position on his portable GPS



© A. Fossi, 2002

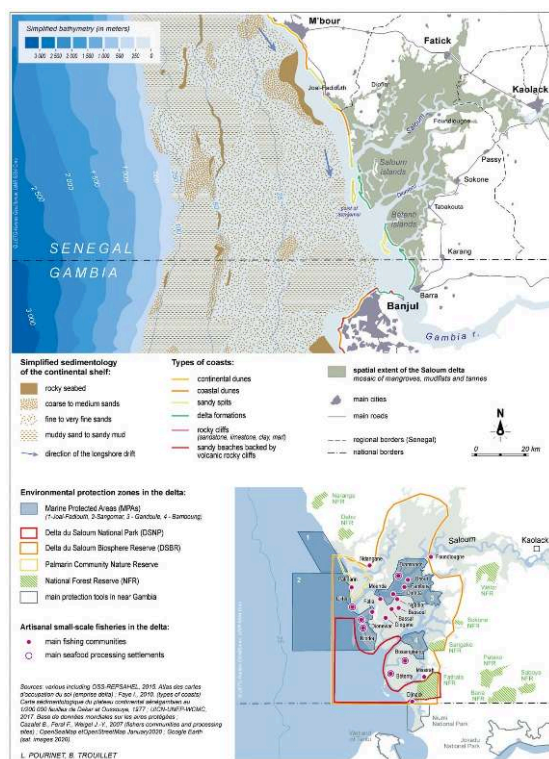
- 36 In 2004, the Senegalese government created four MPAs along the coast ex nihilo under pressure from a conservation NGO, without taking into account the knowledge of artisanal fishing communities. Only the Community Marine Protected Area of Bamboung was the subject of consultation with local communities before it was set up under another programme. In Kayar, it was not until the establishment of the MPA development and management plan in 2007 that community knowledge was taken into consideration (DÈME, 2014). The resulting MPA zoning map (fig. 4), based on toponymy and the knowledge of artisanal fishermen, shows precise zones determined by bathymetry, the different areas and uses, making it possible to precisely define fishing zones. The community mapping of fishing zones is very different from the arbitrary and rectangular delimitation of the MPA, but is limited to the perimeter of the MPA up to about 7 miles offshore. Thus, it does not cover all the fishing zones of the Kayar fleet, whose range has been estimated at between 10 miles and several dozen kilometres (CURY and ROY, 1987; CHARLES-DOMINIQUE and MBAYE, 2000). It is highly likely that the small-scale fishermen of Kayar have a vision of their “fishing territory” and the toponymy associated with fishing zones that extends well beyond the boundaries of the MPA towards the north, west and open sea.
- 37 Within Senegal’s artisanal fishing communities, there is now very detailed geographical knowledge of the zones and of artisanal fishing practices. Following the example of the work carried out in Kayar, capitalising on the knowledge of artisanal fishing communities, at least in the major fishing centres, would make it possible to draw up dynamic “maps based on the words of fishermen”¹², produced by and for artisanal fishermen, and to understand the occupation of maritime space by the artisanal fisheries sector in its entirety. Given the numerous issues that weigh on fishing in

Senegal today, producing geographic information by artisanal fishermen would contribute to envisaging a more just consideration of the fisheries sector in the framework of future MSP in Senegal.

The Saloum delta: finding a balance between traditional and new activities

- 38 The Saloum delta is located in the Fatick region (fig. 1), where populations living in this estuarine environment have structured the area through the exploitation of a variety of terrestrial and aquatic resources (CORMIER-SALEM, 1997). Although modest on the national scale, fishing activities in the Saloum delta are distinguished by the great diversity of resources due to the biodiversity reservoirs created by the alternation of “bolongs” (inlets colonised by extensive mangrove vegetation) and “tannes” (mangrove swamp interiors). This forms a mosaic of environments (fig. 6) that are favourable to the harvesting of various marine resources (fish, shrimp, shellfish) and other types of activity.

Figure 6. The Saloum delta: geographical context of artisanal fisheries



Source: L. Pourinet, B. Trouillet
High resolution map: Figure 06 HD

- 39 Until the 1970s, the exploitation of these resources was based on a balance between activities and seasons, with agriculture dominant (rice, maize, millet, groundnuts, sorghum, etc.), followed by artisanal fishing, oyster farming, livestock farming and the harvesting of sea products (molluscs, shellfish, etc.). However, a conjunction of factors has led more and more people to turn to fishing activities: the decline in agriculture due to the lack of rainfall since the 1970s, the fall in the price of agricultural raw

materials during the 1980s, free access to fishery resources, and insufficient regulation of the fishing effort. As a result, artisanal fishing has risen sharply in the Saloum delta: the number of pirogues increased by 38% between 2011 and 2014, accompanied by an increase in the size of pirogues and in engine power. In parallel, the number of annual trips to the sea, the technology for locating fish, and the fishing methods used have continued to develop (DÈME, 1991), leading fishermen to explore areas that were previously difficult to access by rowing or sailing over several days at the whim of the tides. These changes in the former ways of doing things have exacerbated the situation, and the increased pressure on fisheries resources is threatening the pre-existing balance to the point of raising doubt about the sustainability of fishing activities, weakening coastal communities (KÉBÉ, 2008).

- 40 In the Saloum delta, women traditionally do most of the fish processing and earn substantial income from this, contributing to the improvement of their families' living conditions. Yet the profound changes taking place mean they are now experiencing difficulties related to the supply of raw materials, as well as to a rise in the purchase price of fish, as they are in competition with fish traders who have much greater financial and material capacity. Despite the fundamental role local women play in the various segments of the sector (micro-trading, artisanal processing, marketing, etc.), they do not always master the methods for better commercialisation of their products. They are also subject to increased competition from foreigners (for example, from Guinea and Burkina Faso) who are increasingly entering the processing business.
- 41 Shellfish harvesting is another exclusively female activity. It has become the main source of local income, contributing significantly to the improvement of women's living conditions. Shellfish provide more than 90% of the animal protein consumed in the delta islands (DIOUF, 1996). Unlike fishing, where the resource is mobile, shellfish gathering is a localised activity that takes place in the mangrove channels and in the mudflats uncovered at low tide. The collection is organised by the women during the *mbissa*, i.e. the period of the month during which the low tides are diurnal. This generally lasts between 15 and 18 days per month (DESCAMPS, 1994) and is punctuated by a cycle of seven days of activity followed by four days of rest (DIOUF and SARR, 2009). Shellfish harvesting takes place during the dry season, from December to June, when it is easier to dry the products collected. Conversely, it is insignificant, or even non-existent, during the rainy season when agricultural activities mobilise almost the entire family.
- 42 Due to the diversity of ecosystems and landscapes as well as a rich cultural heritage, tourism is emerging in the Saloum delta, which is now the fifth largest tourist region in Senegal. There are many protected areas in this zone, but local populations were long excluded from the tourism industry. It was not until the 1990s that local populations became aware of the economic interest of tourism. Several types of tourism are now practised in the Saloum delta: fishing tourism, hunting tourism in leased areas of Niombato, and discovery tourism. Other types of tourism also exist, but are less developed (integrated rural, beach and cultural tourism). The Saloum Delta Biosphere Reserve became a UNESCO World Heritage Site in 2011, and the challenge today is to promote activities that encourage nature conservation. To this end, the policy defined by the Fatick Regional Council highlights the comparative advantages of ecotourism through the development of tourist infrastructure and the promotion of tourist products. The aim is to counter the model of large hotel complexes set up by foreign

companies with an alternative model in which the camps belong to the local population (FALL, 2006). Currently, tourism in the Saloum Delta Biosphere Reserve provides very little employment and income for the local population (DEHEUNYNCK *et al.*, 2004), as:

- almost all the camps and means of transport are owned by external investors
- most guides are not from the area
- local food and craft products are not sufficiently promoted
- the jobs reserved for villagers are often menial.

43 However, the creation of the Community Marine Protected Area of Bamboung in 2004 has been a promising development. Some tourism stakeholders believe that ecotourism is a serious avenue to explore that could have a significant impact on the future of the delta.

Some lessons on information issues in these case studies

44 These three examples highlight a fairly wide range of information issues that could affect MSP. The case of the Saint-Louis region illustrates the chronic lack of geographic information. It also shows the need to consider the spatial logic of various uses – and the interactions between these – on a range of scales (local, regional, or even global, including cross-border issues). In particular, there is a concerning lack of information on the foreseeable impacts of offshore oil and gas activity, which is likely to profoundly change the territory and coastal communities that have long been highly dependent on fishing for food and income.

45 The example of Kayar shows that, while it is necessary to document fishing practices and fleet areas in detail in order to take their specific issues into account, it is important to remember that the ways of documenting the practices (in this case, mapping them) can be diverse. Fishermen and communities can themselves be actors in the construction of information. Moreover, this active participation is probably the best guarantee of the effective appropriation of information by fisheries stakeholders (TROUILLET *et al.*, 2019).

46 Finally, the example of the Saloum delta highlights the importance of reconstructing the dynamics of human activities over a longer period of time to take these into account. There are limitations to seeing traditional activities such as fishing and shellfish harvesting solely as economic activities. Artisanal fisheries can be mainly subsistence activities, with dimensions that virtually always go beyond the framework of the market and touch on identity, culture, etc. This web of relationships is not easy to untangle, and the information that leads to decision-making must reflect this complexity. This requires a close examination of the way in which the diverse and complex reality of fisheries is coded, translated and transcribed into geographic information and not just reduced to simply market interests.

47 Taking a step back, it should be noted that these various information issues concern the entire information chain, from the production to the dissemination of data. In terms of geographic information production, the case studies clearly show that an approach of constructing information project by project, in fits and starts, has limitations, particularly when government information systems are deficient. This type of approach results in gathering information only where the attention of project sponsors

is focused, without necessarily having an overall strategy for producing this information, leading inevitably to data issues (problems of standardisation making comparisons difficult, fragmentation and gaps in data, loss of information, etc.). It is necessary to pay attention to how information is produced, for what purpose and by whom. This has opened up the field of “data sovereignty” at a time when powerful private operators (Tech Giants such as Google, Apple, Meta, etc.) have become leading data producers.

- 48 Gaps in knowledge can also result in the misuse of existing geographic information. Indeed, since information is often not available for MSP purposes, authorities logically resort to the “best available information”, to quote a principle adopted by European authorities for MSP¹³. However, this approach has a downside, since information used for purposes other than those for which it was designed compromises its “external quality” (DEVILLERS and JEANSOULIN, 2006). From this point of view, within the framework of MSP, fisheries are a typical example of a field for which information is constructed (essentially bioeconomic information to characterise fishing effort and the monitoring of fishery dynamics), and then enlisted for want of a better way to illustrate the challenges of the fisheries sector as a whole. Given that this data only concerns the bioeconomic aspect of fisheries, it is erroneous to imagine that such information correctly reflects the issues of the sector as a whole, especially as regards small-scale or subsistence fisheries. However, this is only rarely discussed in the literature on past or current MSP processes (SAID and TROUILLET, 2020). This makes it essential to study more closely how pre-existing information or data created for MSP purposes is used. The same applies to the non-use of data. It is possible that key information exists but is not used, either through disinterest, to serve other interests or simply through ignorance. The example of fishermen’s knowledge in the Kayar MPA provides a good illustration: information on fishing grounds beyond the boundaries of the MPA exists, but only that concerning the MPA is used.
- 49 Another challenge is the dissemination of information. In Senegal, based on the recognition of a threefold problem – the fragmentation of geographic data, the underfunding of the geographic information sector, and inconsistency between existing systems – the National Geomatics Plan (Decree No. 2009-799) has enabled the creation of a geographic data infrastructure called “GéoSénégal”¹⁴. However, the maritime and coastal space remains on the fringe of the priority application areas of this ambitious plan supported by the Canadian International Development Agency, the United States Agency for International Development (USAID) and the European Union (GICC, 2012)¹⁵. In addition to this plan, there are many other initiatives also supported by international agencies: for example, the West Africa Coastal Areas Management Programme (WACA)¹⁶ and one of its offshoots (WACA-F), supported by a French public institution, which has set up a data portal to make available geo-referenced orthophotographs documenting coastal retreat on a regional scale¹⁷. If the information hosted in these portals is enlisted for MSP, it will be important to look closely at the data, as this type of infrastructure in general shapes the representation of issues (BOUCQUEY *et al.*, 2019), sometimes to the point of becoming a mode of governance in itself rather than a simple governance tool (CAMPBELL *et al.*, 2020).
- 50 A further issue concerns the transversal appropriation of information at three major phases: its production, its use and its dissemination. In terms of the appropriation of the construction of information, how can the various stakeholders in MSP contribute to

producing geographic information or alternative data that not only enriches knowledge, but makes the power relationships around geographic information used for spatial planning more explicit? Regarding the use of information, how is it possible to reduce or ideally eliminate the “black box” effect of many information processing tools to allow an understanding of the assumptions underlying data processing? Finally, concerning the appropriation of the tools and methods for disseminating information, how can alternative information that can contribute to a more diverse, complex vision, or a vision out of step with the dominant representations and narratives, be made visible?

- 51 These considerations on the issues around information at stake in MSP will resonate differently depending on the type of planning (spatial, strategic, communicative, prescriptive, integrating land/sea and the different levels of these) and the entity leading the approach (public agencies, NGOs, international institutions and the different combinations of these). Whatever the case, the stakes around geographic information in MSP call for redoubled attention, as this can be instrumentalised by the dominant powers, whether political or economic, particularly when MSP concerns populations that are more vulnerable to this risk of domination, such as coastal communities in developing or emerging countries.

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NOTES

1. In a census by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the Banc d'Arguin National Park (BANP) in Mauritania has oddly recently been listed as an MSP initiative, although the BANP has existed since 1976.
2. Mami Wata Project: <https://mamiwataproject.org> (accessed May 2020)
3. <http://senegal-emergent.com/fr/> (accessed May 2020)
4. Saint-Louis, Dakar, Petite Côte, Fatick, Casamance (Kafountine and Ziguinchor) on the coast, and Tambacounda inland: <http://senegal-emergent.com/fr/zones-touristiques-integrees-zti> (accessed May 2020).
5. In the period between the end of the previous agreement and a new agreement signed in July 2018, the absence of a fisheries agreement for 2.5 years between Senegal and Mauritania was highly detrimental to Senegalese fishermen, particularly those from Saint-Louis. Between 1950 and 2010, 48% of landings in Senegal by Senegalese migrant fishermen came from Mauritanian waters (BELHABIB *et al.*, 2014).
6. www.spcsrp.org (accessed May 2020)
7. www.spcsrp.org (accessed May 2020)
8. <https://www.jeuneafrique.com/742328/economie/senegal-mauritanie-eiffage-et-saipem-construiront-le-terminal-gazier-de-grand-tortue-ahmeyim/> (accessed May 2020)
9. Kosmos Energy Ltd subsequently sold the majority of its shares to British Petroleum, which became a shareholder in both countries.
10. www.international.gc.ca (accessed March 2020)

11. The Capas and Camp initiatives, financed with Canadian cooperation, were part of the first development projects for artisanal fishing in Senegal in the 1980s.
 12. “Fishermen’s maps” based on the toponymy of fishing areas could include “metadata” related to: (1) the determination of these areas (by who? why?), (2) the species present according to season, (3) the fleets and fishing strategies.
 13. Directive 2014/89/EU Art. 10.
 14. <http://www.geosenegal.gouv.sn/> (accessed May 2020)
 15. The plan’s priority application areas are “land registration and the land sector in general, spatial planning in support of local governments, agriculture, water management, transport, democracy support, natural resource management [and] civil protection” (GICC, 2012, p. 34).
 16. <https://www.wacaprogram.org/> (accessed May 2020)
 17. <https://cerema.maps.arcgis.com/apps/MapJournal/index.html?appid=ff30db5d09dd42ec8f4b8145fd346a3c> (accessed May 2020)
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