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## SOCIO-ECONOMIC VALUES OF THE ALBORAN MARINE PROTECTED AREA IN THE MOROCCAN MEDITERRANEAN: REFERENCE STATE FOR MONITORING THE IMPACT OF THE MPA PERFORMANCE

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### ABSTRACT

In Morocco, the establishment of Marine Protected Areas (MPAs) is a new management approach used for strengthening traditional fisheries' management measures. This approach was proposed in the Mediterranean due to the decline of the main fisheries' resources, both small pelagic and demersal species. This paper discusses the presentation and analysis of the reference state of the Alboran MPA, located to the west of the Moroccan Mediterranean coast since 2013, in relation to socioeconomic aspects. The analysis revealed indicators allowing regular monitoring of the impact of the performance of the MPA. These include sociodemographic indicators and economic indicators, including household income sources and fishermen's incomes, which remain very positive compared to other artisanal fishers in the region and governance-related indicators such as the acceptability of the MPA and conflicts over resources. Other socioeconomic indicators were also analyzed, concerning the ones used for the choice of the area to be protected and those related to the perception of fishermen. These include the acceptability of the marine population, the importance of fishing activity and fishery resources, income-generating activities and accessibility. All these indicators were very favourable to the implementation of the MPA. Social and economic considerations and socioeconomic analysis are essential for the successful implementation of MPAs. Poor assessment of these aspects may lead to the failure of the implementation of the MPA, which may also be due to difficulties of its acceptability by local communities. These considerations should be introduced in the implementation of MPAs, from planning, through the choice of the area, the implementation of the MPA to its management. At the global level, it is becoming increasingly rare to create MPAs without incorporating these considerations.

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## INTRODUCTION

The Moroccan Mediterranean coast has rich and diversified fisheries resources. Around 50 species of high commercial value are exploited (Greenpeace, 2003). Fishing activity ensures direct employment of more than 18,000 people.

The current challenge is to find a compromise for the sustainable management of these resources whose stocks are generally fully exploited to overexploited (GFCM, 2013). Fisheries management in the Moroccan Mediterranean coast has been based for several years on the control of the fishing effort and catches. An investment freeze in the fisheries sector

has been in place since 1992. However, these measures have shown some limitations, owing to the technological development and increased capacity of the vessels, which has led to an indirect increase of the fishing effort. The other form of management and conservation of marine ecosystems, which is considered effective by several countries and international organizations such as the Commission for Biological Diversity (CBD), is the establishment of Marine Protected Areas (MPAs) (CDB-Convention sur la Diversité Biologique, 2007 ; OCEANA, 2011; SCDB-Secrétariat de la CDB, 2004 ; SCDB-Secrétariat de la Convention sur la Diversité Biologique, 2004). Indeed, MPAs have become, at the global level, one of the main components of policies for restoring and preserving marine and coastal ecosystems degraded by fishing activities (Agardy, 1994; Gubbay, 1995; Jones, 2002; Kelleher, 1998; Omar, 2005 Féral, 2017; Weigel, 2002). In this context, Morocco has adopted this approach and has initiated in recent years a national policy for the establishment of MPAs for fishing purposes (Day et al. 2012; Kelleher Kenchington, 1991; Kelleher, 1999), aiming to develop artisanal fisheries. This policy has been implemented since 2013 along the Moroccan Mediterranean and Atlantic coasts. Three MPAs for fishing purposes were created, namely: Mogador and Massa in the Atlantic and Alboran in the Mediterranean. These MPAs were identified according to a set of bio-ecological and socioeconomic indicators (Kelleher, 1991 and Richardson, 2006). The adoption of the participatory approach, with the involvement of artisanal fishermen and fishery operators in this choice, is one of the strengths of this project. One of the main objectives of this study is to prepare an operational framework for assessing and monitoring the impact of the MPA (Halpern, 2003; Roberts, 2001; UNEP-MAP RAC/SPA, 2010), in order to assess objectively the effectiveness of MPAs and to adapt their management, it is necessary to design an integrated system of indicators on biological, socio-economic and governance aspects (Alban, 2003 ; Beattie, 2002 ; Grafton, 2005 ; IUCN, 1994 ; Pitchford, 2007; Richardson, 2006; Sanchirico, 2001 and Tupper, 2007).

The other objective is to participate positively in the choice of the MPAs in Morocco. Empirically, the choice of an MPA has always been based on biological and ecological aspects (Day, 2012; IUCN, 1994; Kelleher, 1991; Kelleher, 1999; PNUE, 2013 and Wells, 2004). This vision begins to open to the socioeconomic aspects (Alban, 2003), because of the importance of the direct impact of the MPA on the local population and in particular on fishermen (Pitchford et al., 2007) who want to see their sacrifices validated through the increase of fish prices, incomes and improvement in working conditions. On the basis of the elaborated objectives this will lead to the establishment of a monitoring and evaluation framework for the impact and effectiveness of the Alboran MPA on the fishing community based on socioeconomic indicators. The expected goal is the establishment of a socioeconomic baseline for this MPA (Alban, 2003; Beattie, 2002; Grafton, 2005 and Richardson, 2006). In order to ensure regular assessment and monitoring of the effectiveness of MPA management and also the impact of the MPA on the fishing community, it is necessary to establish a baseline (Alban, 2003; Beattie, 2002; Grafton, 2005 and Richardson, 2006). The results of this study will later serve as a basis for a process of monitoring and evaluating the effectiveness of MPAs in Morocco, taking into account multiple factors but also local realities. The analysis and characterization of the socioeconomic status of the Alboran MPA made it possible to

describe, in a summary and fixed form, the initial situation of the MPA before its establishment.

### Alboran Marine Protected Area

The area of the Alboran MPA is located on the Mediterranean coast of Morocco. It extends between Tamrabet (35° 32.2 N; 05° 11.7 W) and Amtter sites (35° 14.6 N; 04° 47.4 W). The area is part of two maritime districts, M'diq and Jebha, with a coastline stretching for about 45 km. It is bounded by the province of Tetouan in the west and the province of Al Hoceima in the east (Figure 1). This area is mainly characterized by fishery resources of high commercial value, a significant part of which is destined for export. It is part of the Alboran Sea in the western Mediterranean, forming a transition zone between the Atlantic and Mediterranean waters across the Strait of Gibraltar. The Atlantic water penetrates from the surface up to the interior of the Alboran Sea at a flow of 38,000 km<sup>3</sup> / year. This mixing allows the formation of plankton and a great wealth of fish resources, cetaceans and sea turtles (Harzallah, 1993 and Harzallah, 2014). The study area has a high ecological value. It is known for the presence of several macrophytes and invertebrates as international priorities for conservation and sustainable use, as well as some highly threatened species of turtles and marine mammals (IUCN-WCPA, 2008). Biodiversity and marine ecosystems in the study area are confronted with numerous natural threats, likely related to climate change and other human-induced threats such as over-exploitation of fisheries resources and illegal fishing, but also the impact of economic development in the region in recent years. Adding to this is the weakness of the networks of sanitation and wastewater treatment.

### Choice of the Alboran MPA

The creation of a MPA implies the management of a maritime area that would lead sometimes to conflicts of interest between the different users of the MPA, so it will be essential to involve the marine populations in the choice of this MPA. This choice should be based on bio-ecological and socioeconomic aspects, after consensus among different stakeholders, in order to guarantee an easy social acceptability (Sarah, 2015), of this choice. The selection criteria for the choice of the Alboran MPA were based on the ecological importance (presence of species of great ecological interest and threatened species) and fisheries (overexploitation of the main species stocks) in the proposed area. Socioeconomic criteria are complicated to assess; they were analyzed with caution.

**Due to the lack of information, only 4 socioeconomic criteria were analyzed (McNeil, 1994 and Ban, 2009).**

- **Acceptability of the marine population** it presents their level of reception and support to the creation of the MPA.
- **Importance of fishing activity and exploited fishery** resources are estimated by the number of fishermen working within the MPA boundaries, the production of high commercial value species and turnover.
- **Income-generating activities** are opportunities for developing other economic activities than fishing. These activities may also present a source of funding for the MPA and an opportunity for fishermen to improve their income.
- **Accessibility** presents the level of ease and difficulty of access to the MPA.

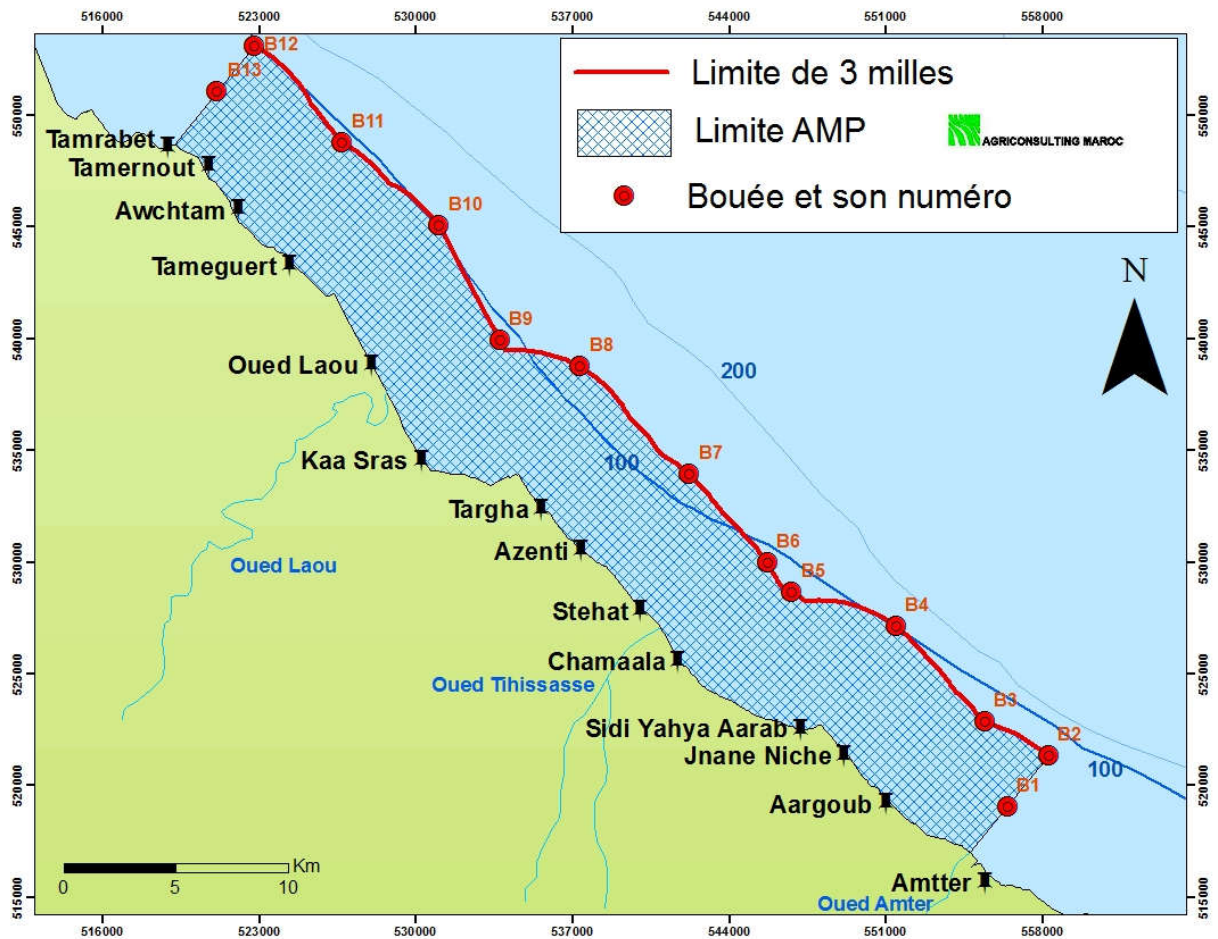
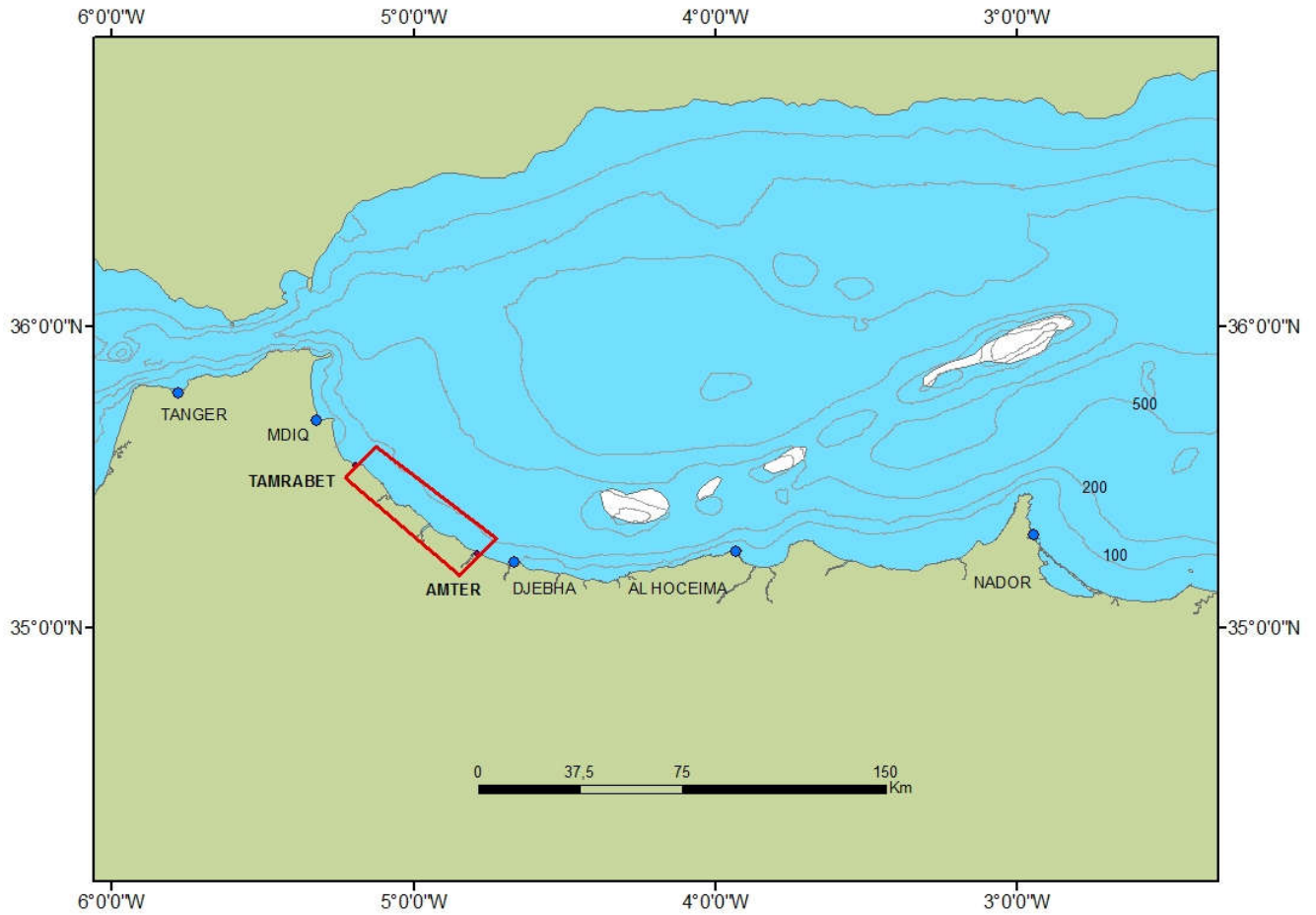


Figure 1. Geographical location and delimitation of the Alboran MPA

After several workshops and awareness sessions with the artisanal fishermen of the Alboran MPA, at almost all-artisanal fishing site the results relating to these criteria are summarized as follows:

### Results of the selection criteria to establish the Alboran MPA

Acceptability of the marine population	Importance of artisanal fishing activity	IGA, proposals	Accessibility
Fishermen have shown great interest in establishing MPAs and artificial reefs as new management tools for the preservation of marine resources and biodiversity and for the development of artisanal fisheries.	- 13 artisanal fishing sites - 1 fishing village in "Chmaala": a small port with fishing facilities - 413 active boats, of which 58 are of larger size targeting small pelagic ("Chebbak"). This fleet provides direct employment for some 1700 fishermen - The species caught are of high commercial value.	-Pleasant landscape to develop ecotourism activities -Organization of underwater activities (hunting and diving) - Some craft trades are ancestral and can be the subject of study visits and sightseeing tours.	Medium to easy, for certain areas and sites, especially after the construction of the Mediterranean ring road; - Difficult for other areas and sites.

Two main constraints were observed when choosing the Alboran MPA, which may cause some difficulties for the management of the MPA:

- Dispersion of artisanal fishing sites;
- The area of the MPA is quite large, therefore the tools for its management should be important.

After the analysis of all the proposed criteria, it was found that the Tamrabet to Amttter area located to the west of the Moroccan Mediterranean coast is very well placed to have the status of a MPA.

## MATERIALS AND METHODS

### Data Collection

The data used in this work comes from two main sources: 1) data available from administrations and reports and 2) data collected through field surveys and interviews with different users of the MPA.

### Conduction of surveys with stakeholders at the Alboran MPA

Before carrying out any field work, all existing information was analyzed. Consultation of secondary data was necessary, mainly that available from rural communes, under the territory of the MPA and the monographs produced by the High Commission for Planning (HCP) and other data sources. Data were collected between 2012 and 2014 (Féral et Cazalet, 2007). In order to collect the data necessary for socioeconomic analysis, three types of surveys were conducted with the stakeholders and users of the MPA. Depending on the nature of the indicator sought, these include:

- **Individual surveys:** An individual interview is conducted with the fisherman or another, on the basis of a strategic questionnaire that was already pre-established.
- **Group interviews:** This is an interview with a small group of 3 to 6 people. This technique allowed surveyors to receive as much information as possible, through the confrontation of ideas.
- **Focus group:** These consist of collecting qualitative information and evaluating the quality of the data collected during the individual surveys. The focus group is used to confirm hypotheses and to open up the debate around indicators that may have discrepancies between populations. The number of participants in the focus group never exceeded 20 people.

Socioeconomic surveys were carried out in collaboration with artisanal fishers, professional organizations active in the sites located inside the MPA, as well as those in close collaboration with the rural towns.

The survey touched around 800 people including fishermen, fishmongers (small and big fish traders) and fishermen's families (their wives and children). Age (young or old) and gender (women and men) factors were taken into consideration when carrying out the surveys. In order to have a correct reading of the MPA's baseline and its socioeconomic impact, surveys reached almost 300 fishermen in the target population, representing more than 35% of all fishers (Table 1).

**Table 1. Number of surveys carried out by type of indicators**

Indicators / type of survey	Individual survey (x1)	Group survey (x4)	Focus Group (x15)	Total
Number of fishmongers			2	30
Sources of Household Income	60	20	2	170
Income of MPA fishermen	60	20	2	170
Availability of seafood	60	20	2	170
Acceptability of the MPA	80	40	2	270
Conflicts of use	80	40	2	270

### Indicators used in the reference MPA

After the analysis of the types of indicators and their relevance to better diagnose the reference state of the Alboran MPA (Alban, 2003 ; Grafton, et al., 2005; Halpern, 2003; Leeworthy, 2005; Pitchford, 2007; Richardson, et al., 2006) on one hand, and in order to understand the perception of the impact and performance of the newly established MPA on the other, the number of indicators to be analysed was limited mainly owing to technical reasons and the lack of data for certain aspects. Three types of indicators were analysed:

### Sociodemographic indicators

These indicators are of great social importance because they provide general information about the population that may be potentially affected by the establishment of the MPA at or near their agglomerations. Three indicators were examined:

- **Population of the MPA:** This information was collected from the HCP ([www.hcp.ma](http://www.hcp.ma)).
- **Number of fishers in the MPA:** This information was collected per artisanal fishing site. In addition to artisanal fishermen, numbers of fishermen related to coastal fleet operating in the MPA whose home port is outside it were also counted. The data were collected from the Delegations of Maritime Fisheries at Jebha and M'diq and completed by field surveys.

- **Merchant population:** Information on this aspect was collected through field surveys with fishermen and fishmongers at all the sites of the MPA.

### **Economic indicators**

The economic indicators are the most important ones in the analysis of the reference state of the MPA, as well as to evaluate its effectiveness. These indicators are related to economic activities, income, availability of fishery products and others. The examined indicators are:

**Sources of household income:** It is interesting to know whether fishing activity is the only source of life for fishermen or if there are other alternatives in case the proposals for management measures affect the fishing activity. The data related to this indicator were collected from rural towns and completed by field surveys data with fishermen and the MPA inhabitants.

**Income of the MPA fishermen:** The objective is to estimate the income of MPA users, in particular income derived from fishing activity, and to see its contribution to the total income of the fisherman. When calculating this indicator, it was distinguished between fishermen and boat owners. Information on this indicator was collected from field surveys.

### **Indicators related to governance:**

It is difficult to envisage indicators related to governance, since the MPA has been newly established. Nevertheless, surveys were carried out with users of the MPA on their perception of the new situation. Two governance indicators were examined:

- **The acceptability of the proposed measures for the MPA:** This indicator is at the same time qualitative and quantitative. From the surveys with fishermen and inhabitants of the MPA, it was asked how the MPA users perceive the implementation of a MPA in their fishing area. The survey was pushed to estimate the percentage of fishers who are in favour of the MPA and those who are against it.
- **Conflicts over resources at the level of the MPA:** The implementation of the MPA may lead to conflicts of various kinds between users of the MPA, especially between artisanal fishermen for the use of different types of gear, eg. the use of nets and hooks.

For these two indicators, the most appropriate method to receive the maximum amount of information and to confront all divergences was focus group surveys. Five sessions were held.

## **RESULTS**

### **Socioeconomic status of the Alboran MPA**

#### **Population of the Alboran MPA**

The population size of the Alboran MPA is about 79,000 inhabitants (www.hcp.ma) with a density of 112 hab./km<sup>2</sup>. Half are women. This situation is very important compared to other reserves in the Moroccan Mediterranean, particularly the protected park of Al Hoceima and the area of the "Trois

Fourches" Cape. Furthermore, the MPA area becomes overcrowded during the summer, because of the splendid beaches it offers. This situation presents a major handicap for the application of management measures.

About 90% of the population of the MPA is rural, this is similar to the whole population living along the Moroccan Mediterranean coast. This situation is a constraint for the development of awareness-raising and skill-enhancement programs due to the relatively high rate of illiteracy and the socio-cultural peculiarities not yet open to the outside world.

### **Economic activities at the level of the Alboran MPA**

Fishing activity is the main economic activity of the majority of the population living within the MPA. It is generally supplemented by agriculture.

### **Fishing sector in the Alboran MPA**

#### **Marine employment**

The fishing activity in the region ensures direct employment of about 1,700 people, a young community, exclusively male, that originates from agglomerations near the fishing sites. After the implementation of the MPA and due to continuous regression of the resources stocks exploited in the area, the marine population has shown a downward trend. Additionally, fisher's sons do not want to take again the job of their parents and seek other work in urban areas. On the other hand, fishermen's wives usually take care of home and the education of their children. In recent years, they have begun to engage in income-generating activities to help improve household income.

#### **Professional organization**

The level of fisher's organization of the Alboran MPA is relatively high compared to other regions in the Mediterranean. There are 18 cooperatives and associations based at all fishing sites. These organizations are expected to play a key role in the management of the MPA, and they are part of its local governance committee. The success of the MPA depends partly on the involvement of fishermen in their organizations. Therefore, it would be necessary and urgent for the fisheries administration to provide them with specialized training to accompany them in their projects and in the development of activities related to the MPA.

### **Fisher's organizations take part in two main aspects, necessary for the management of the MPA**

- Participation in the proposal and application of management measures and participation in the monitoring of these measures.
- Participation in the valorisation and commercialization of fish, in order to improve their price and consequently the fishermen's incomes. This will facilitate the management of the MPA.

#### **Fleet**

The fishing activity in the Tamrabet to Amtter area is ensured by about 350 active boats, whose sizes are no longer than 7 m. In the MPA region, there are also 51 boats of larger size (up to

12 m), commonly called "Chebbak". This fleet is based at 13 artisanal fishing sites and the fishing village of Chmaala. According to the domestic regulation, this fleet is not likely to be larger in the coming years, and even its fishing capacity would be limited with restrictive measures on fishing gear both in number and size. In addition to professional fishing, around 300 underwater fishing and other fishing type licenses were distributed in 2014. With the establishment of the MPA, these licenses would be more restrictive.

### Infrastructure and equipment

In recent years, the region has undergone considerable economic development with the installation of several infrastructures, the main ones being:

- Construction of 3 landing points and a fishing village. These infrastructures have improved the working and commercialization conditions of fishermen, led to a fish of better quality and increased income for fishermen.
- The construction of the Mediterranean ring road enabled the marine population to be opened up and fisheries products to be valued. It has also enabled tourist and industrial development.

This economic development has both positive and negative effects on the MPA. The working conditions, the commercialization, and fishermen's incomes have improved. However, negative effects are expected on the marine ecosystem and consequently on fishery resources stocks, due to uncontrolled pollution, continuously increasing fishing effort and fragility of coastal ecosystem. Strict management measures are required.

### Production means

#### Level of fishing equipment

Artisanal fishermen of the Alboran MPA practice several types of fishing and use a variety of gears, including hook gear, nets and dredges for collecting bivalves (Table 2). For "Chebbak", this artisanal fleet uses purse seine to target small pelagic. For standard boats, the average number of gears per boat varies from 4 to 8. The most common gear used are the surface net, bottom net, hand line and jig. The use of a specific gear depends on the fishing season.

**Table 2. Main artisanal fishing gear used in the Alboran MPA**

Gear name	Number of gears / boat	Unit Price (Dhs)
Jig	15	20
Dredge	4	2.250
Bottom gillnet	1	3.000
Trammel	1	2.000
Long-hook Longline	1	2.000
Longline with small hooks	1	1.000
Hand Line	15	50
Beach seine		5.000
Purse seine	1	50.000

This situation is relatively similar to the whole of the Moroccan Mediterranean, where artisanal fishers use between 3 and 8 gears per boat. Each boat has fishing equipment that costs on average about 20 000 Moroccan dirhams (MAD). For the "Chebbak", the price of the equipment varies between 30 000 and 60 000 MAD, with an average of 50 000 MAD. The use of several fishing gears and their seasonality at the level of the Alboran MPA makes it easier to accept and apply new management measures.

### Fish production

In the MPA area, fishery production has experienced a remarkable drop over the past five years (DPM, 2015), as it is the case in all other regions of the Moroccan Mediterranean. Current production was estimated to be about 2600 tons, of which 900 tons of demersal species and 1700 tons of small pelagic. This fall in fishery production is mainly due to overexploitation of the main target species stocks. To overcome this crisis, the proposed management measures should be applied in a very strict manner.

### Economic and financial aspects

#### Capital invested

The capital invested expresses the current value of the means of production consisting of the boat, the engine and the fishing gear. This parameter provides information on the investment effort made by the fishing community. The capital invested per boat varies between 90 000 and 120 000 MAD. The difference is mainly due to the nature of the equipment used by the fisherman and to costs associated with administrative papers necessary to accomplish the act of boat appropriation. For the "Chebbak" boat, the investment is more important because the owner uses, in addition to the main vessel, two other small boats: one used to provide light during fishing operations locally called "Lamparo" and the other used to recover the captured fish. The average investment per boat was estimated to be about 240 000 MAD. The total capital invested by the artisanal fishing fleet at the Alboran MPA was estimated to be about 52,900,000 million MAD, a very significant investment compared to the geographical extension of the region and other protected areas, especially the Al Hoceima Park, with 20 million MAD and the Trois fourches Cape, with only 8.4 million MAD. It is likely to increase, due to the dilapidated state of the fleet and fishing gear. Over-investment is totally inconsistent with the over-exploitation status of resources, which would probably conduct to a crisis situation in the coming years. It should be noted that in almost all cases the financing of production means is secured by the own savings of boat owners. Bank credits are not appreciated by artisanal fishermen because of the risks and instability of the activity but also because of the socio-cultural traditions that accept, with difficulty, the use of credits.

**Table 3. Simplified Annual Operating Account of a Boat (Estimated)**

Item	Dhs
INVESTMENTS	115 400
Small boat	80 000
Engine	18 000
Fishing equipment	17 400
TURNOVER	144 000
VARIABLE COSTS (CV)	38 000
GROSS INCOME (RB = CA-CV)	106 000
Fisherman's share	17 667
FIXED COSTS (CF)	4 180
NET INCOME (RN = RB-CF)	101 820
Non-Marine Owner Income	48 800
marine owner Income	66 490

#### Production costs

The costs associated with artisanal fishing activities are divided into two types: fixed costs, which are annual expenses, and variable costs, which vary according to the fishing effort.

**Fixed costs** consist of the maintenance costs of the production means. They were estimated, on average at 2000 MAD / year. The expenses associated with the fishing rights are identical for all the boats, with an average cost of about 180 MAD per boat.

**Variable costs** are common expenses, assumed both by the boat owner and fishermen. These are the costs incurred during a fishing trip. They consist of fuel costs, bait, change of small fishing gear, food and sometimes ice. These costs vary according to the type of fishing, between 150 and 300 MAD per boat, with an average of 200 MAD. Fuel is the main component of these costs. For the "Chebbak" boat, the average cost of a fishing trip was estimated to be around 550 MAD.

### Annual Turnover

The average annual turnover of the fishermen was estimated at 120 000 MAD per boat, whereas the total average annual turnover was approximately of 51 300 000 MAD. This figure is highly influenced by production level, which fluctuated considerably over the last five years. Nevertheless, the average price of the main species caught hasn't fluctuated significantly. With the MPA, it is expected that the price of fish would increase, as it will be more valued. Fishermen, through their organizations, are highly motivated and have already started with small actions, such as widespread use of ice and selling with fewer intermediaries.

**Table 4. Resource Conflicts**

Relation of artisanal fishers with	Good	Neutral	Conflictual
Other artisanal fishermen	96,4%	3,6%	0,0%
Trawlers	0%	25,3%	74,7%
Underwater fishing	100%	0%	0%
Recreational fishing	90,6%	5,3%	4,1%

### Estimated Income and Operating Account

The income of a fishing unit is the remuneration of its owner. This indicator was calculated from the deduction of the total expenses of the turnover. The boat owner's participation in fishing operations improves their income by about 36%. The results recorded by the boats of the Alboran MPA are positive, compared to boats from other artisanal fishing sites in the Moroccan Mediterranean Sea and particularly those active in the protected areas. These results are far more important because of the quality and commercial value of the species caught in the area. This is in favour of the application of restrictive management measures at the level of the MPA.

### Commercialization of fishery products

Production flows are handled by about 30 traders. Some of them are collectors or commissionaires from processing or export companies. The majority of traders come from the region and frequent fishing sites on a daily basis. Small pelagic are sold in local markets and cities close to fishing sites, while demersal species are partly destined for the Spanish market. No specific strategy is adopted for the disposal of these catches. But, the distribution chain varies according to species. Fishers consider that the prices offered are lower compared to the real value of the fish because intermediaries benefit from the remoteness of the fishing sites in order to set low prices. In addition, some fishermen establish relationships of mutual interest with the fishmongers, which sometimes turn into a

verbal commitment between the two partners, which ends with the exclusive sale of the catch.

### Other economic activities in the Alboran MPA

In addition to fishing activity which is the main economic activity in the Alboran MPA, the population of the region practices other income-generating activities, mainly agriculture and petty trade. These activities are generally for self-subsistence, with low profitability. The income structure of fishers' households is almost identical, and is similar to that of all artisanal fishers in the Moroccan Mediterranean coast. Fishing activity is the main source of income, representing on average 80% of the total income, and it is complemented by low agricultural productivity. The production of this activity is mainly used for household consumption. The fishermen's wives and their children are involved in the agriculture. The high dependence on fishing activity and the lack of significant income-generating activities pose a serious danger to the population, especially as it is a sector at risk and has experienced great difficulties in recent years. The success of the MPA is very much linked to the search for new sources of income other than fisheries, such as the case for other MPAs in the Mediterranean. The Alboran MPA has great natural assets (beaches, mountains, magnificent marine ecosystem, etc.), which can help to develop a tourism activity generating labour and income for fishermen, using their fishing facilities and infrastructures. Additionally, this can relieve pressure on resources.

### Conflict over resources

Due to the stocks status of the species targeted by artisanal fishers of the Alboran MPA, which are mainly over-exploited, there is some conflict between the MPA users in accessing fishery resources, especially for demersal species. The status of this conflict is plotted in Table 4. The results concerning the conflicts between the different users of the Alboran MPA on resources show that artisanal fishermen have great difficulty with trawlers. This is an expected finding, since the two fishing segments target almost the same species. It should also be pointed out that trawlers do not comply with zoning regulation.

### Acceptability of proposed management measures

The Department of Marine Fisheries (DPM) has proposed a number of management measures for the conservation of resources at the MPA level. These include closure of specific areas, zoning, regulation of fishing gear and the market size of target species. The implementation process of these management measures has involved fishermen in the proposals in order to ensure their applicability. It is a participatory approach that has produced very positive results. The process of accepting management measures by the Alboran MPA users was simpler and easier than in the case of the Al Hoceima National Park because of the level of fishermen's supervision through their cooperatives and the role of fisheries administrations, which has made considerable effort through the high number of awareness and sharing meetings.

## DISCUSSION

Undoubtedly, Morocco is facing a great challenge to succeed in its policy of setting up marine protected areas. This study is the first to highlight a socioeconomic status of the Alboran

MPA. The reference state indicates that it is a relatively more populated area compared to other marine reserves of the Moroccan Mediterranean, namely the protected park of Al Hoceima and the area of the Trois fourches Cape. In addition, the MPA becomes overcrowded during the summer period. This will make its management difficult and complicated. On the other hand, 90% of the population of the MPA is rural. This situation is similar to the whole maritime population of the Moroccan Mediterranean living on the coastal strip. This presents a serious constraint for the development of awareness and skills upgrading programs, due to the relatively high illiteracy rate and the socio-cultural peculiarities not yet open to the outside world. In addition, infrastructure is needed for the development of this MPA. The human factor is very important to ensure the success of the MPA (Robert et al., 2006; Robert and Pomeroy, 2010) through the strong involvement of fishermen (Russi et al., 2016) by means of their organizations. The state of reference shows that fishermen are favourable to participating through the mode of co-management of the MPA (ICSF, 2006) especially when fishermen's cooperatives are present in all the fishing sites. To better manage this situation and ensure its success in a sustainable manner, the fisheries administration should urgently provide specialized training to support them in their projects and in the development of activities related to the MPA. Fishing is the main economic activity of the MPA users. They put a lot of pressure on the resources and the marine ecosystem of the MPA, with more than 300 boats active all year round and the use of fishing gear sometimes harmful to the marine ecosystem, such as dredging. In relation to the stock status of the majority of the fishery resources of the Moroccan Mediterranean, which are overexploited, the investment can be considered excessive, since incomes from fishing are unsatisfactory. Therefore, a crisis is expected in the coming years if strict management measures are not taken and implemented. Compared to other artisanal fishing sites in the Mediterranean, fishermen earn relatively higher incomes that remain insufficient. It is expected that the fishermen's income will improve in the near future (Marta et al., 2016; Russi et al., 2016) due to the expected improvement in fish prices for two main reasons: (1) the MPA fish should have a relatively higher price for its ecological quality and its label of the MPA (2) the development of the region (construction of the Mediterranean ring road, improvement of infrastructure, especially touristic ones, etc.), will lead to a significant increase in demand and consequently to an improvement in fish prices.

Conflicts between artisanal fleet and trawlers are likely to be reduced with the implementation of new management measures at the Alboran MPA, especially as it is expected an improvement of the state of the MPA ecosystem (Agardy, 1994; Allison, et al., 1998; Graham and Neville, 1999). There would be an improvement in biomass for several species (Malouli, 2004; Mesnildrey et al., 2013), an increase in large predator populations (Friedlander and De Martini, 2002), and the size of fish of commercial interest (Gell and Callum, 2003). Within the managed MPAs, overexploited stocks can also be found to be biologically stable (Harmelin-Vivien et al., 2008). The success of the MPA is closely related to the search for new sources of income other than fisheries, like the other Mediterranean MPAs. The Alboran MPA has great natural assets (splendid beaches, mountains, magnificent marine ecosystem, etc.), which can help to develop tourism activities generating labour and income for fishermen, using fishing

facilities and infrastructure. In addition, this can alleviate the pressure on marine resources. The social acceptability of the Alboran MPA is a key factor in ensuring the success of the MPA (Aurelie Thomassin et al., 2010; Robert et al., 2006; Sarah et al., 2015). A questionnaire on this issue involved 170 users of the MPA, representing all artisanal fishing sites. Although the majority of fishermen are in favour of the implementation of this MPA, some fishermen are opposed, thinking that restrictions on fishing activity may negatively affect their incomes.

## Conclusion

The success of the Alboran MPA is not yet guaranteed, due to the lack of visibility for its management. The "zero" state or the reference state of the MPA, shows that this region has several assets, especially in terms of importance of fishery resources and tourism. Analysis of the baseline of socioeconomic indicators shows that the MPA fishing community is large (about 2000). It is highly dependent on fishing activity and fishermen earn a higher income compared to the average income earned in the Moroccan Mediterranean. These results are taken into account in the implementation of the management measures specific to the MPA. On the other hand, interviews with fishermen revealed that more than 90% of them accept this MPA and predict that it will be very beneficial for the preservation of fishery resources as well as for the improvement of incomes and conditions of work. Finally, this baseline will provide a reference tool for scientific monitoring of socioeconomic indicators at the level of the Alboran MPA and other MPAs in Morocco.

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