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Total admissible catches and experimental fishing quotas in the pink lobster (*Palinurus mauritanicus*, Gruvel 1911): A new opportunity for economic development in West Africa?

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Abstract

Over the last thirty years, the poor state of certain fish stocks in the Large Marine Ecosystem of the Canary Current gradually revealed the limits of the West African fisheries management. The Ecosystem Approach advocated in Mauritania, calls to change the perception of fisheries management to incorporate participatory management considerations total admissible catches (TACs) and fishing quotas. An experiment around, a total allowable capture of 800 tons of pink lobster (*Palinurus mauritanicus*) is at the heart of this approach using methodological tools of analysis / assessment of the economic performance of crawfish exploratory fishery. Survey results show that during the period from February 2015 to January 2016, the fishery was based on a total of 23 vessels. 52% is held by Mauritanian and the rest is chartered with European (EU) ship owners. The capture of the Mauritanian fishery is significantly higher than that of the European Union, respectively 393 tons against 390 tons. 98% of the overall production volume is in live lobsters, mainly for the European market. This production generated sales of 4.26 billion MRO Affairs. Overall, experimental rock lobster industry is an important macroeconomic activity. The Turnover (CA) represents approximately 5% of revenue from exports of the Mauritanian Fish Marketing Company in 2015 (US \$ 268 million) and 13% of fishing GDP in 2014 (33.47 billion MRO, BCM 2015). Over two thirds of this amount (3.62 billion MRO) is generated by the (VA) Added Value 85% of turnover. The VA created by Mauritanian operators is 10% more than the VA created by European operators. The Fixed Annual Costs and the Estimated Gross Excess (FACEGE) represents 1.3 MRO billion or 32% of sales. More than half (MRO 896.6 million) in FACEGE is generated by Mauritanian. Experimental lobster industry creates 557 direct and indirect jobs. These jobs represent 10% of the industrial fishing jobs, globally estimated at 3764 Live 2014. It is estimated that the Mauritanian segment creates 25% more jobs than the European segment. This assessment of socio-economic performance of the exploratory fishery in Mauritania lobster is a first step towards a deeper understanding of its cost structure and its dynamics, necessary for the management of TACs and fishing quotas.

Keywords: *Palinurus mauritanicus*, Economic performance, European fleet, turnover, added value, Mauritania, West Africa.

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Introduction

The northwestern coast of Africa, which occupies the entire Mauritanian Atlantic Sahara, between the peninsula of the White Cape and the Senegalese border, has a large continental shelf hosting of a variety of fishery resources (Boitard, 1981; IMROP, 2006). Benthic stocks, particularly lobsters, *Panulirus regius* and *Palinurus mauritanicus*, are mainly found on the continental shelf pits between 50 to 600 m depth (Maigret, 1978). Lobster fishing for *P. mauritanicus*, which started in 1950, has long been the main target species in the French, Spanish and Portuguese industrial fisheries (Diop and Kojemiane, 1990; CNROP, 1993). Trap fishing, particularly active from the French ports (*e.g.* Camaret and Douarnenez), essentially target the pink lobster of the Mauritanian coasts, was in its heyday in the French Brittany ports, which were at that time (until the 1970s/1980) the first European lobster ports. The highest production in Mauritanian waters was recorded by Bretons in 1961 with 3,600 tons of pink lobster (IMROP, 2016).

The price of pink spiny lobster caught in the waters of the Atlantic Sahara peaked in the European markets, which meant that its exploitation had rapidly intensified to the point of overexploitation in two decades (Diop and Kojemiane, 1990). As a result, by the end of the 1990s, there was a near-total withdrawal of all European Union vessels targeting pink lobster. Since 2006, several recent surveys and studies by the Mauritanian Institute of Oceanographic Research and Fisheries

have concluded that the abundance indices of the spiny lobster *P. mauritanicus* are improving (Dia *et al.*, 2015; IMROP, 2014). At the same time, the demand for the exploitation of the pink lobster is increasing. This situation has led the Ministry of Fisheries and Maritime Economy (MPEM) and the profession to call for research on the exploitable potential and therefore from this total allowable catch of the lobster evaluate the opportunities for recovery of lobster fishing in Mauritania which had once flourished for Europeans.

In this context that an "Ecosystem Approach to Managing a Total Allowable Capture of Pink Spiny Lobster" program has been implemented (MPEM, 2015). Circular 007 of 06 February 2015 defines the conditions for carrying out fishing, among other things, by determining a Total Allowable Catch of 1020 tons of lobsters (including 800 tons of pink lobster) with 30 vessels authorized [(each vessel unloads all its production in Mauritania including all by-catches)]. Planned for a period of one year from 06 February 2015, the experiment consists in carrying out, in partnership with the professionals of the sector, a fisheries research program aimed at collecting up-to-date information on lobster fishing. The efforts undertaken will, among other subjects, complement and consolidate the scientific results on the lobster stock assessments, obtained during the last IMROP working group, December 2014. The objective of this study is to make an economic approach of the experimental lobster fishing through the

comparative analysis of different indicators of economic performance.

Materials and methods

In Mauritania, the rock lobster, *Palinurus mauritanicus*, is found from 20 ° 40 N to 16 ° 05 N on the bottom near rocky areas between 50 and 600 m with a maximum of abundance at depths from 80 to 200 m.

The statistical data collection system of the experimental lobster fishing is based on the scientific observations of IMROP and the Coast Guard. From February 2015 to January 2016, data on fishing activities (*e.g.* number of days at sea, tide, nets deployed, sailors boarding) and on catches were jointly collected at each landing, by two establishments. A total of 23 active vessels using straight nets for lobster fishing were followed, and 349 tides were observed in 165 fishing days. The fishery operates from the Port of Bay of Repos and the Port of Nouadhibou. 44% of these vessels belong to the European charter concession. A total of 2,976 days at sea has been thus observed throughout the period.

The catch estimate was made independently of logbook reporting, using a specific observation protocol of IMROP but ensuring more reliable estimates of landings by species (including by-catch) and finer identification of species sizes. A total of 783 tons across all species was observed during the period time of February 2015 to January 2016. The production of lobster is approximately 763 tons close to the total catch allowed for the experimental year (TAC=800

tons). Monthly catches have fluctuated around 80 tons on average with a peak level of 111 tons in November and a minimum level of 60 tons in January 2016. In addition to the monitoring of landings, a socio-economic survey has conducted from 25 January to 5 February 2016. The method focused on the analysis of experimental fishing units with cost, employment and system of sharing specific gains. We first divided the experimental fleet into two segment concessions- the national segment and the foreign segment including European charter. The survey has conducted among ship owners and charterers and it was based on a random sampling. A total of 9 vessels were sampled and the sampling rate is a function of the number of vessels within each concession. This allowed us to obtain a sample consisting of 36% for the charter concession and 42% for the national concession. Then the results of the average accounts by concessions are extrapolated to both of the two segments according to the number of days at sea.

The calculation of indicators to describe and quantify the direct and indirect contribution of the integration of the lobster experimental sector to the national economy is based on a cost-benefit analysis method (CEAMP, 1992; Kane, 1998; Lesueur and Boude, 2005). This approach makes it possible to distinguish the creation of the local value added, the Salary Costs (CS), the Variable Expenses (CV) associated with the activity and the Fixed Annual Costs and the Estimated Gross Excess (EBITDA) of this experimentation.

Turnover (CA) is the value of the total production of the fishery:

$$CA = \sum_i P_i Q_i \quad \text{Eq. 1}$$

With P_i : the average unit price of the species i landed and Q_i : the total quantity landed of the species i . It was determined on the basis of the fixed price of 10,000 euros/ton of lobster demanded by the Central Bank of Mauritania in 2015.

For the accessory species, the price per ton is fixed at 150 euros.

Results

Technical characteristics of the experimental lobster fishery

Pink lobster is targeted by 23 vessels experimenting with the gill net or

lobster net. The characteristics of the two segments are presented according to the number of series and the total length of the nets. The results show that during the period time of February 2015 to January 2016, the experimental fleets deployed a total of 3,359 kilometers of nets, *i.e.* approximately 146,739 meters per vessel (Table 1). The chartered European segment holds 62% of the number of series and 63% of the total length of the fishing nets deployed.

Table 1: Number of vessels, number of sets and total net lengths by segments of the experimental lobster fishery, February 2015-January 2016.

	European Charter	National	TOTAL
Active workforce	11	12	23
Tide	116	233	349
Sea days	1218	1758	2 976
Number of series	40 595	24 191	64 786
Series length (meter)	2 091 960	1 267 150	3 359 10

Source: GCM. Document January 2016.

With regard to motor power (horsepower/HP), the results show a very clear difference between the national and European charter vessels (Fig. 1). For Nationals 75% of the vessels are less than 400 HP which represents only about 20% of European chartered vessels. Above 400 HP, chartered European ships have significant advantages over nationals (88% *vs.* 12%), in terms of energy intensity and ability to operate at depths greater than 200 meters.

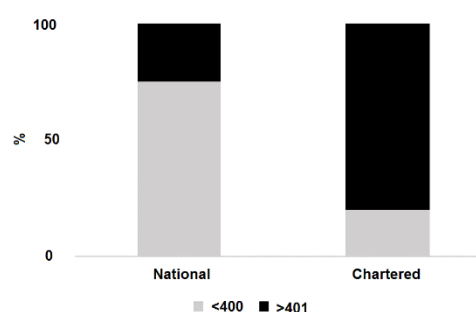


Figure 1: Experimental flotilla of lobster by power class (horsepower/HP), period tie of February 2015 to January 2016 (IMROP, 2015; GCM, 2016).

Initial investment of the experimental lobster fishing

The main investments of the fishery are the boats, the fishponds, the nets and other equipment (GPS, pollsters, etc.). The investments vary according to the type, the dimensions and especially according to the age of the material considered. On average, the life of a new boat is 40 years and fishing equipment can last from 3 to 10 years, sometimes much less. Indeed, it must be recognized that the life of a boat and fishing equipment depends greatly on its use and maintenance. The results of the survey showed that the equipment of the national vessels is older and less equipped than the European chartered

vessels. The boat and the fishing equipment are only sold abroad but also in the Nouadhibou free zone in the second-hand markets of port facilities.

The socio-economic survey shows that the majority of national ship owners (52%) acquired their fishing gear with their own funds and the others acquired it through a European ship owner (chartering). Overall, the initial investment is about 5.35 billion ouguiyas or 13.37 million euros (with 1 € equal to 400 MRO). The Investment of nationals (locals) in the experimentation of lobster is estimated at about 2.5 billion ouguiyas, whereas it is 300 million ouguiyas less than for the chartered European fishery (Table 2).

Table 2: Total capital invested (in ouguiya) and average depreciation of experimental lobster fishery, period time of February 2015- to January 2016.

	European Charters	Nationals	Total
Boats	1 870 000 000	2 040 000 000	3 910 000 000
Equipment and fishing materials	960 000 000	480 000 000	1 440 000 000
Total	2 830 000 000	2 520 000 000	5 350 000 000
Depreciation			
Boats (20 yrs)	93 500 000	102 000 000	195 500 000
Equipment and fishing materials (10 yrs)	96 000 000	48 000 000	144 000 000
Total	189 500 000	150 000 000	339 500 000

Source: Socio-economic survey LESE-IMROP, January 2016

The average lifespan of a used boat is about 20 years and for the fishing gear is about 10 years. Their average annual renewal cost is respectively (depreciation per year) 189.5 million for chartered Europeans and 150 million for nationals. The investment created is not only individual by vessel but also collective; it also induces territorial effects since the segment of the experimental lobster fishing is a

central element of the development of the fishing pole of Nouadhibou Free Zone.

Analysis of the economic performance of experimental lobster fishing

The results of the economic analyzes have showed that the experimental lobster fishing has achieved a total turnover estimated at about 4.26 billion ouguiyas (Table 3). The national

government contributes 56.3% of this turnover, or 2.40 billion ouguiyas. Overall, the sale of lobster is very important in this turnover. Indeed, this

highly profitable species constitutes 98% of the target species. The main results of the turnover are summarized in the following table (Table 3):

Table 3: Estimated turnover of the experimental lobster fishery per day, tide, month and vessel (in ouguiyas), period time of February 2015- to January 2016.

Sales of experimental fisheries (Production X price)	European charters	National	Campaign experimental
Total Turnover	1 862 566 970	2 402 203 257	4 264 770 227
Turnover / day	1 529 201	1 366 441	2 895 642
Turnover / tide	16 056 612	10 309 885	26 366 497
Turnover / month	372 513 394	400 367 210	772 880 604
Average Turnover / Boat	169 324 270	200 183 605	369 507 875

Source : LESE-IMROP, 2016

Intermediate consumption of the experimental lobster fishery

The overall Intermediate Consumption (IC) of the experimental fishery represents production costs which related to fuel / lubricant, ice, crew meals, maintenance and repair, port taxes, seafarers' transport and miscellaneous expenses which directly related to the activity of the experimental lobster fishery. The branches of activity are detailed in the table below with the values of the corresponding intermediate consumption.

Overall, the value of intermediate consumption (IC) amounts to 653.56 million ouguiyas or about 15% of turnover. More than 64% of the value of intermediate consumption is mobilized by the national regime. Independently of the concessions, the structure of the intermediate consumption shows a predominance of the budget of the fuel / lubricant on the other consumptions. In terms of value, the share of fuel / lubricant amounts

reached to 400.5 million ouguiyas or 9% of the overall turnover of the fishery. While maintenance and repairs represent 2.51% of sales, food 1.33% of turnover, handling 1.22% of sales and 0.86% of sales are divided between port taxes, purchase ice and the transport of sailors.

Added value of the experimental lobster fishery

The added value (VA) of the experimental lobster fishery is defined as equal to the sum of the commercial margins on these products. It is equal to the difference between the values of production minus intermediate consumption. The table below provides the overall VA of the experimental lobster fishery during the period time of February 2015 to January 2016. Overall, the results evaluated the wealth created by the experimental lobster fishery at 3.62 billion ouguiyas of value added or 85% of the turnover of the fishery.

The comparison by regime underlines the importance of the VA created by the national segment, which generates 1.99 billion ouguiyas against 1.62 billion ouguiyas VA for the European charter share. While 55% of the overall economic impact of value added is generated directly by the national system, the social weight of these latter also amounts to 52% of the employment generated (557 jobs) because of the large number of direct and indirect employment created. Figure 2 illustrates the results of the economic performance of the two experimental lobster fisheries.

The results of the economic analyzes show that the production costs can be divided into total fixed costs (access fees, scientific observation, municipal tax, coast guard, export tax) and total variable costs [salary costs, intermediate consumption (maintenance, food, fuel-lubricant)]. After deduction of the expenses of the turnover, the rest minus depreciation is shared between the ship owners and the charterers. Overall, diesel and labor costs are the largest expenses in the fishery and represent 35.6% of turnover. Government revenue from access fees, surveillance (guard coast), scientific observation and taxes (port, municipal and customs) amounted to 1.36 billion ouguiyas and stood at around 32.1% of the turnover of the fishery. Salary costs and social charges in the fishery were estimated at 896.69 million or 20.6% of turnover. Gross Operating Surplus (GOS) is positive for both segments and amounts to 1.35 billion ouguiyas or 32.3% of sales. The

European part is more efficient in terms of GOS than the national part is respectively 16.7% and 15.6% of turnover. Nevertheless, it is important to point out that the national share participates, on the other hand, largely in the VA with a rate of 46.9% of the turnover.

In terms of financial and economic profitability, it is positive for both parties since the amount allocated to depreciation represents only about 8% of turnover. Thus, the financial profitability amounts to 1.0 billion ouguiyas or 24.1% of turnover. The share of the European segment represents 508.04 million ouguiyas (or 13.8% of sales), 35% of which goes to the Mauritanian charterer or 177.82 million ouguiyas of profit. As for the estimated net profit for nationals, it amounts to 502.48 million Ouguiyas or 12.0% of turnover.

Discussion

MPEM, through Circular 007 of February 06, 2015, is completely disrupting the management of marine fisheries in Mauritania. In fact, the exploration of fishing quotas in the lobster fishery is a part of a wider regulation of fishing, and a real mobilization of certain establishments to preserve the marine ecosystem. In addition, the Allowable Total of 800 tons of pink lobster allowed has a future only if the integrity of the ecosystems is preserved, because the stock of the pink lobster must be rebuilt to remain productive.

The main objective of this work was to analyze the economic performance of

the Total Allowable Total Allowable Catch of the experimental lobster fishery in Mauritania for the period time of January 2015 to February 2016. The 23 units of the experimental fishery are subdivided into two segments. Forty-four percent of the vessels were European Union charters; they had substantially the same amount of lobsters landed as the nationals. This resulted in comparable gains between the two plans. The contribution of the experimental lobster fishery in the national maritime economy is analyzed in relation to the data available for the period of 2014-2015, concerning the contribution of fishing to the gross domestic product (GDP), to the employment generated in the fisheries sector and exports of the Mauritanian Fish Marketing Company (SMCP).

The income from the experimental lobster fishery is estimated at 4 billion MRO and contributes a high level of government revenue in foreign currency, roughly equal to 7 to 8% of GSPC revenues (\$ 267,934,882 in 2015), where in other national fisheries, other than octopus, it is difficult to exceed a contribution greater than 1 to 3%. The lobster fishery has a gross operating surplus of 1.3 billion MRO for a value added of 3.6 billion MRO. The national scheme creates 10% more AV than the Chartered segment. However, direct value added (2.26 billion MRO) accounts for 13% of fishing GDP in 2014 (estimated at 33.47 billion MRO, BCM 2015). Compared with GSPC exports in 2015, the weight of the experimental lobster fishery was 1% of export quantities

(80,119 tons, GFSC 2015) and 5% of its turnover (93 billion MRO, SMCP 2015).

This scientific study, devoted to the implementation of a vigorous management policy for a TAC and lobster quota, had significant effects on the entire value chain (Copes, 1986). Many questions remain unresolved. The lobster fishery faces years of overexploitation and the gains expected from the increase in export price should not obscure certain baseline bio-economic considerations, including maximum economic return (MER), as well as fishing mortality rate, (FMEY) and the effort, essential for the decision making of the management of the Acceptable Totals of Captures.

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