Sustainable management of marines’ resources in Algeria: the contribution of an empirical approach.

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In this respect, the purpose of this paper is to put into evidence the contribution of empirical approaches to help taking decisions for sustainable management of marine resources.

Environmental problems are very often ascribed to pollution. Nevertheless, various other environmental impacts are also associated with abusive exploitation of natural resources that remain abundant in many developing countries. An urgent public intervention, therefore, seems necessary and reasonable public policies must be found.
Urgent need for an intervention of public authorities

The use of bio economics models

The lack of data conjugated into unreliable statistics, the marginal interest given to the research in this field and the absence of multi-disciplinary approaches, make the approach increasingly difficult in developing countries.

Could Empirical approach resolve this problem?
1. Method and tools.

- Method.

Our approach consists of pursuing the fishing activity over five years in Ziama’s Gulf. We gathered all information daily on the whole of the flotilla. We constituted a data base concerning fishing effort and cutch. It about analyzing the relationship between the tow variables
2- Investigation Results and Discussions.

- *Is there a correlation between the fishing effort and captures?*

- It is even the object of this stage of analysis which consists of searching for the relation, if there is, between the dependent variable $C$ and the explanatory variable $E$ to try to model the evolution of $C$ according to $E$, therefore to express mathematically that $C = F(E)$. 

Small trades effort - small trades captures relation.

Correlations analysis.

$C_{pm}$: Captures

$E_{pm}$: Fishing effort

- with a very significant Pearson’s correlation, about 0.729, one can confirm that the level of captures $C_{pm}$, realized by the small trades, is strongly dependent on the effort $E_{pm}$, exerted by these.
Methodologically, one can search for the tendency of $C_{pm}$ in other words, identify the function $C_{pm} = F_{pm}(E_{pm})$ while proceeding to a mathematical modelling.

Adjustment’s results

**Graph 01.**

\[ C_{pm} = F_{pm}(E_{pm}) = -0.0002 E^2 + 0.2206 E \quad (1) \]

Source: The investigation statistical treatment results.
Interpretation and discussion.

With a coefficient of determination, $0.714$, the quadratic correlation is very significant. This means that, in our case, the captures realised by the small trades remain dependent on the fishing effort exerted by these, and that the evolution of captures according to the fishing effort, for this fishing system, must without any doubt go under a law.

$$C_{p_m} = F_{p_m}(E_{p_m}) = -0.0002 E^2 + 0.2206 E$$
At first glance, the results appear quite interesting because this tendency comes closer to the classical theoretical models in this case the Gordon–Schaefer model (Gordon, 1953; Schaefer, 1957) where the variation of captures according to the fishing effort is in the form: 

\[ C = -aE^2 + (a \cdot b) \cdot E \]

where \( a \) and \( b > 0 \).

By identification we have:

- \( a = -0.0002 \)
- \( b = \frac{0.2206}{0.0002} = 1103 \)
- \( a \cdot b = 0.2206 \)
contribution to the decision-making aid: The case of small trades.

- We have solve the problem linked to biological parameters (a and b). In second step, we will try to demonstrate, how these results could, partially, orientate the public intervention. We will these data in bio-economic model.

- In addition, it should be noted that the objective of this research is primarily methodological; the decision-making ought to be, in this case, taken with precautions.
Beginning

Introduction of data.

processing of data.

Storage of the obtained results out of the processing.

Presentation of results of the processing:

synthesis and graphic.

Orientations of the public intervention

Choice of objectives: 1- Equi. MSY - 2- Controlled access - 3- Free access.

To apply orientations for the public policy choice.

attainable objectives?

End

Simulation of the public intervention: Choice of measures (instruments).

Fig. 1: Organization chart summarizing the functioning of the PES
<table>
<thead>
<tr>
<th>Type of information</th>
<th>Data</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological</strong></td>
<td>$a$</td>
<td>Biological parameter of the captures function.</td>
</tr>
<tr>
<td></td>
<td>$b$</td>
<td>Biological parameter of the captures function.</td>
</tr>
<tr>
<td><strong>Economical</strong></td>
<td>$Im$</td>
<td>Middle value of acquirement of a fishing unit.</td>
</tr>
<tr>
<td></td>
<td>$Taxes$</td>
<td>It is about the total value of taxes for the whole of the flotilla and the marine strength by period of analysis (month).</td>
</tr>
<tr>
<td></td>
<td>$Insurance$</td>
<td>It is about the total value of insurances for the whole of the flotilla and the marine strength by period of analysis (month).</td>
</tr>
<tr>
<td></td>
<td>$Role$</td>
<td>It is about the total value of roles for the whole of the flotilla and the marine strength by period of analysis (month).</td>
</tr>
<tr>
<td></td>
<td>$pe$ :</td>
<td>Cost by unit of effort.</td>
</tr>
<tr>
<td></td>
<td>$pc$ :</td>
<td>Price of sale of a captured unit.</td>
</tr>
<tr>
<td></td>
<td>$a$ :</td>
<td>Express the part of endowments independently to amortizations of the effort.</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>$N$</td>
<td>Size of the registered flotilla exercising in the fishery.</td>
</tr>
<tr>
<td></td>
<td>$t$</td>
<td>The length of life, in year, of a fishing unit (Boat)</td>
</tr>
<tr>
<td></td>
<td>$S$</td>
<td>The average number of Units of effort (come out) by unit of fishing (vessel) and per year.</td>
</tr>
<tr>
<td><strong>Period of analysis.</strong></td>
<td>The period of analysis is tributary of the period of observation in the case of empiric approaches.</td>
<td></td>
</tr>
</tbody>
</table>
The Pêchakour Expert System (PES):

THE

PÊCHAKOUR EXPERT SYSTEM (PES)

An « Expert System » for sustainable management of fisheries

Version 1.0
### Summary table and comparison

#### The equilbrium

<table>
<thead>
<tr>
<th>Models</th>
<th>Necessary effort for equilibrium</th>
<th>Profit In thousand of monetary units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordon-Schaefer model</td>
<td>E = 1053,000000</td>
<td>Pi = 0</td>
</tr>
<tr>
<td>Adapted model &quot;Pêchakour&quot;</td>
<td>E1 = 0.534957  E2 = 996,965043</td>
<td>Pi1 = 0     Pi2 = 0</td>
</tr>
<tr>
<td>Gordon-Schaefer model</td>
<td>E = 551,500000</td>
<td>Pi = 16594,635000</td>
</tr>
<tr>
<td>Adapted model &quot;Pêchakour&quot;</td>
<td>E = 551,500000</td>
<td>Pi = 14726,140000</td>
</tr>
<tr>
<td>Gordon-Schaefer model</td>
<td>E = 526,500000</td>
<td>Pi = 16632,135000</td>
</tr>
<tr>
<td>Adapted model &quot;Pêchakour&quot;</td>
<td>E = 498,750000</td>
<td>Pi = 14893,093750</td>
</tr>
</tbody>
</table>

#### Values and Parameters

<table>
<thead>
<tr>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pc</td>
<td>300</td>
<td>b</td>
<td>1103</td>
<td>Bêta</td>
</tr>
<tr>
<td>a</td>
<td>0.0002</td>
<td>Alpha</td>
<td>0.001</td>
<td>l</td>
</tr>
<tr>
<td>taxes</td>
<td>9</td>
<td>Role</td>
<td>8</td>
<td>Insurances</td>
</tr>
<tr>
<td>N</td>
<td>40</td>
<td>Pe</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Graphics with indicators

Legend:
- RT
- CT
- Pi

Pe'chakour:
- $a=0.0002; b=1103; l=10000; n=3000; P_c=300; P_e=3; C_F=22; Beta=0.999; Alpha=0.001$
- $E=551.500, RT=18249.135$
- $E=498.750, RT=18082.181$
- $E=996.965, RT=6342.789$
- $E=0.535, RT=35.386$

Gordon-Schafer:
- $a=0.0002; b=1103; P_c=300; P_e=3$
- $E=551.500, RT=18249.135$
- $E=526.500, RT=18211.635$
- $E=1053.000, RT=3159.000$
Public orientation

File

26/01/2006

Pêchakour model

PROJECT: ZIAMA GULF
HARNESSING OF THE FISHERY.
CONTRIBUTION TO HELP TO THE DECISION
Orientation of the public intervening: Action on the effort of fishing

Period: Month.

The control of the fishing activity in this fishery can be based on the cutoff of the fishing effort.

1- Determination of the effort limits.

It is about, in fact, to determine the effort of fishing that corresponds to the maximal value of captures or the level of capture supportable maximum represented by the MSY abbreviation (Maximum Sustainable Yield), so that the effort of fishing doesn't pass, in no case, the limit that is not other that:

\[ E = E_{AM} = 551,5000 \]

2- Determination of the size of the flotilla can exercise in the fishery.

In means term, the number of fishing units exercising in the fishery must not pass: 44,12 units.
Instead of controlling the effort of fishing, we can manage marine resources while opting for the system of quotas. If for political, economical or social grounds, raising its strategy of development of the sector, the administration sees himself obligated to let make i.e. to allow the investment; then, only one decision would be in measure to answer to this problematic: to assure an everlastingness of the fishing activity while permitting a fishing ecologically acceptable, so, durable.

In this case, the best decision would be to opt for the system of quotas.

**How? and what will limits be?**

The principle is the next one: Whatever is the number of fishing units (N), the total captures must not pass the doorstep that is the level of captures CM corresponding to the effort EM.

1. Determination of the capture volume allowed in the setting of quotas
   a. Determination of the capture level authorized CM:

   The middle level limits of the total captures, to not pass, by the whole of fishing units exercising in this fishery is:

   \[ CM = MSY = 60,8304 \]

   Tons by: Month

   b. Determination of quotas:

   Thus, whatever is the number of fishing units exercising in this fishery, captures, for every unit, would be distributed in quotas so that quotas are equal to:

   \[ q_n = CM / N = 1,5208 \]

   Tons by: Month, and by unit of fishing.
Simulation: Action on the fiscal policy and on the policy of prices.

**Subsidies**
- Subsidy by 15% for one ton
- If we reduce the cost of fish by: 0%

**Action on Prices**
- If we reduce the CV by: 20%
- If we increase the CV by: 0%

**The fiscal policy**
- If we reduce the tax by: 14%
- If we increase the tax by: 0%

**The investment policy**
- If we reduce the investment by: [___]%
- If we increase the investment by: 0%
Conclusion

Throughout this research, we tried to highlight the interest and the need, at the same time, for an empirical work based on field-investigating for a possible bio-economic modelling which can help in making decision in the field of durable management of fishing in Algeria. It was, also, about showing the possibility of avoiding the constraints related to unavailability and reliability of statistics, on the one hand, and the difficulty met regarding the introduction of biological parameters, on the other hand.
Another objective of this work is to suggest, even in the absence of multidisciplinary approaches (which causes rather conceptual analysis difficulties than methodological), the possibility of designing simplistic models for orientating the public choices.
Our objective was, also, to come out onto indicators able to constitute a dashboard, basis even for any decision in the short and medium terms in a durable development context. This way, the identified limits and constraints will be used as basic information upon which optimization models and, as a consequence, development strategies will be founded.
Thank you
For Your attention.