Management of Fishery in Oman Sea Coastal

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Abstract: The systematic management and planning in fishery resources seems to be inevitable in order to maintain stability in aquatic resources and gain the various economic, biologic, social and political objectives. In this research, the process of planning of fishery management is carried out in order to achieve various objectives by the use of Multi Criteria Decision Making (MCDM) through Goal Programming (GP) Models and via the participation of stakeholder groups. Regarding the approved findings, the use of small fishing fleet will increase the stable expenses and consequently will decrease the resources. Therefore, the use of big scale fleets is suggested in order to decrease the expenses.

Key words: Goal programming-objective-fishery · Multi Criteria Decision Making

INTRODUCTION

Many stakeholder groups can be found in fishery Management which have different viewpoints about the classification and nature of objectives. Several multi criteria decision making techniques are defined in order to define several objectives for policy making or fishery Management simultaneously. One of the designed techniques for helping management is the multi objective decision making model [1]. According to stakeholders, each one of these objectives in the model has different priority in which the priority of each objective in such a decision making method can be calculated by the use of Hierarchy Analysis Method (AHP) [2] that weights for each criterion were obtained by using pairwise Comparison of the identified goals [3]. This process helps technical project personnel as well as decision makers and stakeholders to systematically consider and apply value judgments to derive an optimal policy alternative [4].

The recognized stakeholder groups in the south fishery domain are fishermen and fishery cooperation, fishery processing industry, labor unions, scientific research centers (Iran Fishery Research Center and Iran Shrimp Research Center) and the Organization of Environment and Natural Resources Protection. Therefore, the present stakeholders in Iran Fishery Industry compose of 6 groups in which the priorities of each group should be evaluated about the (economic, biologic and political) objectives. These evaluations are applied for fishery management by the use of a multi criteria decision making (MCDM) model [5]. The application of MCDM in the fishery issues was lower than other cases comparing with jungle, water resources and agriculture planning and financial issues in the world. Generally, simultaneous attention to various economic, biological, social and political objectives along with the participation of stakeholders groups are of the most important aims of this research. The necessity of the stability in fishery resources seems to be a vital matter in the research. Mardle and Pascoe [6] considered the expansion of a representative criteria hierarchy and use data achieved from a pair-wise comparison investigation based on the UK fisheries of the English Channel to consider priorities that exist between various stakeholders in the fisheries.

Rodriguez *et al.* [7] analyzed the striped venus (*Chamellea gallina*) and the red sea bream (*Pagellus bogaraveo*) fisheries. Optimum management policies have been designed using multi-criteria decision-making techniques. In order to do that, account of biological, economic, social and political objectives was taken. Kjaersgaard and Andersen [8] applied a multi-objective bioeconomic model by using the preference structures of different stakeholders regarding the objectives and it was ascertained how the optimally managed fishery would look from the perspective of stakeholders belonging to different interest groups, ideally achieving a best overall compromise solution. Weithman and Ebert

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[9] (in Lake Taneycomo) applied WGP for fishery management to organize a stock management plan for a multi species of trout fishery. The following subsections describe the GP techniques a fisheries applications using goal programming in generating methods.

Introducing a new system and method is of the important objectives of this research for fishing and fishery management in the country as well as the awareness with stakeholder groups and their participation in fishery management domain.

MATERIALS AND METHODS

There are different stakeholder groups in fishery industry domain of Oman Sea which have almost contradictory fishery objectives[3]. Some of these stakeholder groups are fishers and fishing unions, labor unions, legislators and environmental groups. Due to this fact, the fishing industry should be studied and analyzed through a multi objective framework which includes the viewpoint of each groups in AHP category and priority. It is necessary to generalize and expand a biological economic model in order to observe optimum fishery management from the viewpoint of each stakeholder group. The model is conducted based on a multi objective framework of decision making which will be optimized by the Lingo software. The goal values are determined for all these goals in decision making (there is one major goal and several minor goals (the goal limitation) as the overall goal is to minimize all its deviations. Some weights and priorities are applied for each one of the goals in these models (**GP**) in order to minimize the total weight of deviation variables in the major achievement function [10]. The model is based on the data of 2010 with four types of fleets including three types fishing fleet and fishing boats. More than 40 types of fish is been fishing in the fishing region which are divided into three groups of surface-living, bottom-living and tune fishes in this research. There are two endogenous variables for solving the fishing **GP** model of this region which includes the number of spent days and the number of vessels. Two different time scenarios (long term and short term) are supposed in the model. The number of boats features and general their frameworks will not change in the short term scenario but the number of spent days in the sea will be changed. Therefore, the number of spent days in sea in the short term is the only changing variable. The both variables can be changed in the long term scenario[3]. Therefore, they can be supposed as endogenous. There are three major sections in order to formulize the model:

A : The target function
B : The limitations of the goal
C : The common general limitations of the model (short term and long term)

According to the above descriptions, the GP structure of the research can be written as the following:

$$\min z = \sum_{i=1}^{k}(u_i n_i + v_i p_i)$$

$$(for\, i = 1\ldots\ldots\ldots k) \tag{A}$$

$$fi(X,Y) + ni - pi = ff^* \quad for \quad i = 1\ldots\ldots\ldots k \tag{B}$$

$$x \in X, y \in Y \quad `ni, pi \geq 0 \quad for\, i = 1,\ldots\ldots\ldots k \tag{C}$$

X and Y are the vectors of endogenous variables (the number of boats and the spent days in sea for boats or every boat).

$x \in X$, $y \in y$ shows the common limitations of the model.
$fi(x,y)$ shows the target function of i.
f_1^* shows the value target of the target function which is $fi(x,y)$.
n_i, p_i are the positive and negative deviation variables from f_i^* (the up and down amounts of the target).
w_i is the weight related to i target.

The **A** target function will be minimize with regards to **B** target limitations and **C** common limitations of the model in order to solve the **GP** problem.in fact, this is a solution in which all aims and objectives will be achieved simultaneously through it.

RESULTS AND DISCUSSION

The weights show the preferable decision making structure. The determination of weights is an important task in multi criteria decision making program [6]. A weight vector shows the individual preferences of stakeholder groups about the objectives. The preferences of stakeholders are applied in decision making programs directly by the use of these weights.

The difference between the expenses if second rank fleets and the third rank fleets are lower than the differences among other fleets but the differences between these two fleets is more than other significantly[8]. In other words, although 20-50 tone fishing fleets (Average fleet) have more expenses than 3-20 tone fishing fleets(small fleet), however the interest

Table 1: Results of change in fleet's effort

Fleet	Short time	Long time
Boat (capacity 1 ton)	-15	-18
Small fleet	-11	-13
Average fleet	-4	-7
Big fleet	-10	-15

Table 2: Results of catching calculation

Fleet	Short time	Long time
Boat (capacity 1 ton)	-14	-17/4
Small fleet	-10/2	-11/9
Average fleet	-2/5	-5
Big fleet	-8/7	-13

Table 3: Results of change in divide benefit between various fleets

Fleet	Short time	Long time
Boat (capacity 1 ton)	-4/1	-7
Small fleet	-2	-3/5
Average fleet	4	5/9
Big fleet	-1	-1/3

rate of 20-50 tone fishing fleets is much more than that of 3-20 tone fishing fleets. It means that the efficiency and productivity rate of 20-50 tone fishing fleets is bigger than the smaller fleets. Table 1 shows the calculations related to fishing efforts after conducting optimum decision making model in two short term and long term scenarios [8].

As the results of the table show, a decrease rate can be observed in the rate of dominant activities of fishing fleets but the surprising fact is that the reduction rate of fishing fleets activities means big fleets or 20-50 tone fishing fleets is lower than the other fishing fleets. It shows the relative portion of third fishing fleet in the rate of effort, fishing and interests with regards to the results of the optimum decision making model. On the other hand, it can be concluded that the replacement of fishing fleets with a bigger size like the third fleet with lighter fleets is recommended due to suggested reduction of activities and according to the results.

It is obvious that the stable expenses will be reduced by the increase of the size of fleet and perhaps this fact may lead to the decrease of expenses in which the position of the third rank fleet is better than the others. Table 2 shows the results of the decision making model for the anticipated fishing condition. Regarding the fishing amounts, the fishing rates of the third fleet has less decrease than the other fishing fleets.

Table 3 shows the results of changes in the portion of the obtained interests by fleets in the understudied region [8]. Regarding the findings, the portion of the first

and second fleets is decreased but that of the third fleet is increased as it was expected which is in accordance with the model results about the rate of fishing of different fleets and the fishing efforts. It means that the third rank fleet has the increasing rate of interests' portion due to the following reasons in a certain time process: First, the increase of the size of the boat will lead to the decrease of the stable expenses of the float for every unit which is lower than the light fleets like the first and the second fleets. Second, the relative improvement of activities and efforts of this fleet will positively affect the interest of this fleet. On the other hand, it can be an influencial factor on the rate of interests of the first and the second fleets due to the better fishing portion of the third and the forth fleets. Therefore, the more decrease of the smaller fishing fleets and the increase of the number of bigger size fleets will decrease the fixed expenses and consequently will increase the efficiency and profitability of this industry.

Suggestions and Recommendations: First, it is better to do the similar work in the country other sea shores or in the big projects for all the country sea shores for upgrading better management of fishery by researchers. Moreover, it is suggested that the under studied region should be divided into different areas and to study the fishing efforts of each and every area for better stability specifically.

On the other hand, the findings signify that the use of smaller fleets will lead to the increase of fixed expenses and consequently the decrease of interests. Therefore, the use of fleets with extensive scale for decreasing expenses is suggested. It is obvious that government plays the essential role in proper management of fishers in order to increase efficiency. The related management should search new ways to prevent the reduction of profitability and unemployment as well as to increase the efficiency and productivity of fishery resources in an optimum level. Therefore, maintaining profitability, stable productivity from resources and the other objectives are of high importance simultaneously in the optimum fishery management.

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