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Characterization of socio-economic fishing activity in tunisian reservoir: Sidi Saad (center of Tunisia) as a case study

Abstract

This paper analysis of the socio-economic situation of the fishing activity in Sidi Saad reservoir in order to estimate the real production of fishing in this dam, to determine the demographic structure of the fishermen and to provide information on the profitability of this fishing activity.

The results of this study indicate that the fishermen operating in this reservoir are young (average 39 years), with an education level reached limited to primary school (64%) associated to a low monthly income (do not reach the minimum wage). Estimated fishing productions from the survey made in 2 successive years are higher than those indicated in the statistics of the fisheries administration (95 tons against a declared production of 62 tons in 2007 and 112 tons against 72 tons in 2008). In addition, the socio-economic investigation showed that the majority of fishermen practice a second activity in addition to fishing (61%).

Continuous scientific monitoring of the fishing in this reservoir is necessary for the sustainability of this activity and to fix the populations of fishermen in their village.

Keywords: socio-economy, profitability, fishing, Sidi Saad reservoir, Tunisia

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Abbreviations: CA_i, Turnover for species i; P_i, Average unit price per species i; Q_i, Total quantity landed of the species; T, tons; TD, Tunisian Dinar; CPUE, catch per unit effort.

Introduction

In Tunisia, the fisheries exploitation in reservoir dates back to the 1960s. Therefore, in the 1990s, within the framework of the Tunisian-German cooperation project, introduction of new species was initiated, including the introduction of non-native carp, pikeperch, Rudd, roach, black bass and the continued stocking of mullets.[1–3]

Currently, 33 reservoirs and lakes are involved in this type of activity. These artificial lakes are widely used as aquaculture sites where juvenile mullet are regularly released to promote fishing.[4,5] Reservoirs created fisheries to compensate the lack of marine fish landings in order to provide an alternative source of animal protein to rural populations and to increase their income.[6–9] The main species exploited in the Tunisian reservoirs are carp *Cyprinus carpio*, barbel *Barbus callensis*, roach *Rutilus rubilio*, rudd *Scardinius erythrophthalmus*, catfish *Silurus glanis*, eel *Anguilla Anguilla*, mullet (*Mugil cephalus* and *Chelon ramada*) and pikeperch *Sander lucioperca*.[1–3,10–12] Production in Tunisian reservoirs increased from 831.5 tons in 2000 to more than 1073.194 tons in 2020, of which 37.6 % came from the reservoir of Sidi Saad.[3,9,13,14]

On the other hand, extensive inland fish farming offers to fishermen the opportunity to profitably production of fish species.[15] Although there is limited potential for freshwater fisheries, this activity provides jobs in rural areas of Tunisia where employment opportunities are scarce.[16]

In this study, we focus on the socio-economic characteristics of the fishermen population working in Sidi Saad reservoir as well as the analysis of the exploitation state and strategy.

The main objectives of this paper are:

I. The socio-economic characterization of this activity: fishermen in Sidi Saad reservoir;

II. The characterization of the fishing effort: boats and fishing gear;

III. Analysis of fishing activity: catches, fishing effort and yield based on official data from the DGPA and information from field surveys;

IV. The identification of the difficulties which slow down the development of this activity and the improvement of the socio-economic situation of the fishermen;

V. The highlighting of indicators to measure the economic profitability of this activity.

Material and methods

Study areas: Sidi Saad is a reservoir located in center of Tunisia in Kairouan province (35°22'N, 09°40'E) where the climate is semi-arid.[17] The reservoir, filled in 1981, is used for irrigation, to protect the Kairouan plain against flooding and fish production. This reservoir has a surface area of 1700 ha, and a mean depth of 30m (Figure 1). The fish community in this reservoir is composed by carp (*Cyprinus carpio communis*), mullets (*Mugil cephalus* and *Chelon ramada*), catfish (*Silurus glanis*), barbel (*Barbus callensis*) and eel (*Anguilla anguilla*) with an annual yield of 511.14 T.[3,14]

Socioeconomic data: The economic and social study is based on data obtained from interviews with fishermen. These interviews were carried out during the period from January 2007 to December 2008. The survey database was sub devised in two parts, the first one focus on socio-economic issues such as the fisherman's age, their level of education, and their family situation, etc. The second

part includes information's related to the fishing activity such as the characteristics of the boat, the fishing gear used, the target species, and the commercialization of catches. The field survey reached 60% of the fishermen working in the reservoir.

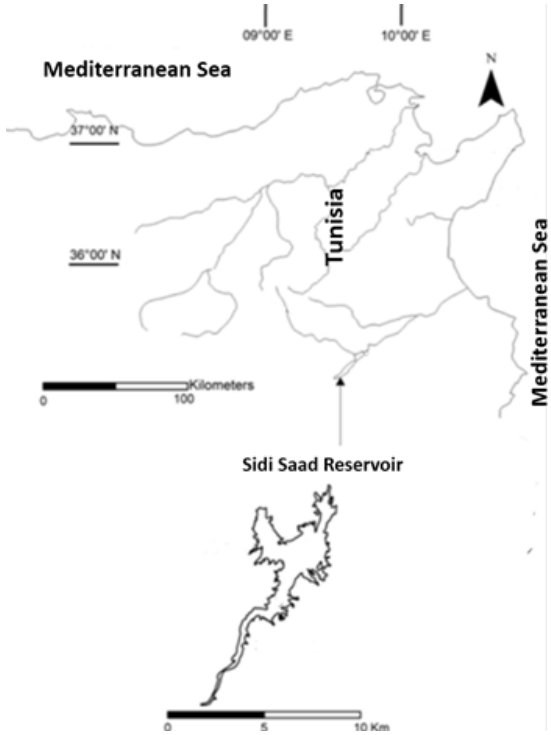

Figure 1 Study area: Sidi Saad reservoir (Center of Tunisia).

Income and profitability: The turnover correspond to the value of the fish production and it is related to prices and the quality of the production[18]. The determination of the landed species by fishing unit according to each species was used for the calculation of the turnover:

$$CA_i = \sum_i P_i \times Q_i$$

With:

CA_i: Turnover for species i

P_i: Average unit price per species i

Qi: Total quantity landed of the species

We distinguish two categories of operating expenses:

- Costs borne by the owner and the crew: ice, food, transport and social security;

- Costs borne by the owner: maintenance (boat and fishing gear), fish boxes, boat insurance, boat depreciation and fishing license.

The information collected during the field survey allows us to reconstitute the general operating accounts per fishing unit and per years. In addition, they allowed calculating economic indicators such as gross operating income and the rate of return expressed as the quotient of gross operating income over turnover.

Analysis of fishing activity: In this study, we analyze the evolution of the total catches by species as well as the fishing yields. Data used becomes from the statistics of the General Directorate of Fisheries and Aquaculture (DGPA) for 10 successive years as well as from the surveys made with the fishermen working in Sidi Saad reservoir.

Additionally, we analyze yields (Kg / boat) using data from the DGPA and those calculated from surveys which allows to make comparison between the two databases. In addition, the survey data allows to calculate the yields in a disaggregated way and to analyse yields in Kg / output.

Results

Social study: The conducted survey enabled us to meet 36 fishermen, which represent 60% of the active worker population. The direct questionnaires revealed the following information:

Age structure of fishermen: The data analysis indicates that the average age of fishermen is 39 years, ranging between 25 and 60 years. The age structure shows that 31% of fishermen are under 35 years old and 11% of them are over 50 years old. The most represented age group is 35 to 45. There are no fishermen under 20 years old (Figure 2).

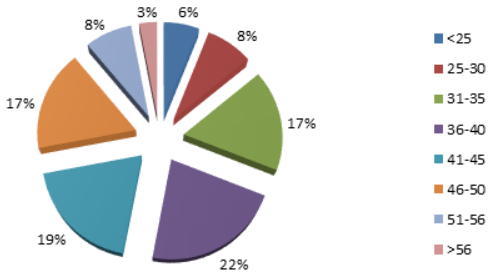

Figure 2 Distribution of fishermen working in Sidi Saad Reservoir by age.

Level of study of fishermen: Regarding the level of education reached by fishermen, 64% of them have a primary education level. We noted also a relatively low illiteracy rate (11%) (Figure 3).

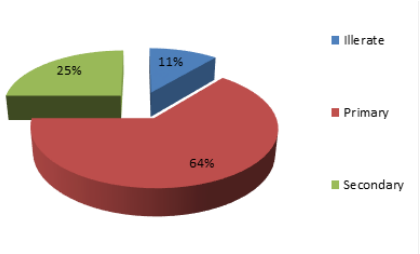

Figure 3 Level of study of fisherman working in Sidi Saad Reservoir.

Professional experience: This parameter is proportional to the age structure of the fishermen. Indeed, we note that 70% of fishermen have more than 10 years of experience in the activity, these are fishermen over 35 years old (Figure 4).

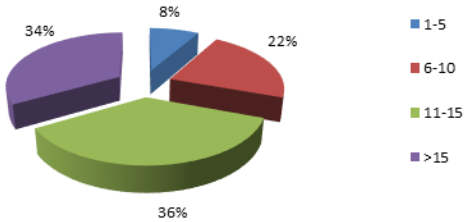

Figure 4 Distribution of fishermen working in Sidi Saad reservoir according to their professional experience.

Characterization of the fishing effort: The fishing effort used by fishermen in Sidi Saad reservoir is modest composed mainly by a boat, few fishing nets, fish boxes and in some cases a cooler. The majority of fishermen report the lack of coolers, a problem related to transport, fishing nets and the lack of ice for storing fish.

The boats used are made of wood, with a flat bottom and their length does not exceed 5 m (average 4.5 m). The fishing unit seniority varies between 3 and 12 years. There is no single point of boats docking in the reservoir and they are scattered all along the coast. A total of 2 fishermen are embedded per boat, one of them is responsible for navigation and the second one is called to cast or pick up the nets. The Sidi Saad reservoir contained 30 active boats.

All the fishermen operating in Sidi Saad reservoir used gillnets. The net does not exceed 50 m in length and each boat used 8 nets (6 to 10). The fishing nets used present a various mesh size (40, 60 and 70 mm). Survey data shows that 67% of fishermen use the 40 mm meshes nets, 54% use the 60 mm nets and 26% of them use the 70 mm mesh nets. Nets, with 40 and 60 mm mesh size are mainly used to caught mullet and carp. Fishermen do not have an adequate fishing technique for catfish and eel.

Fishing activity

Analysis of data from DGPA: The fishing activity in Sidi Saad reservoir according to the official data of the DGPA between 2004 and 2014 shows a certain stability of production (average 76.42 tons/year) with a maximum of 90.2 tons recorded in 2010 and a minimum of 59.4 tons in 2011 (Figure 5). The slight inter-annual fluctuations are linked to the quantities fish stocked. However, the significant drop in production can be due to the decrease in fry stoking quantity in previous years, the failure of fish transfer operations and the irregularity of fishing activity. In 2011, the reduction of fish landed is due to the fact that this year was marked by an unstable security situation of the country.

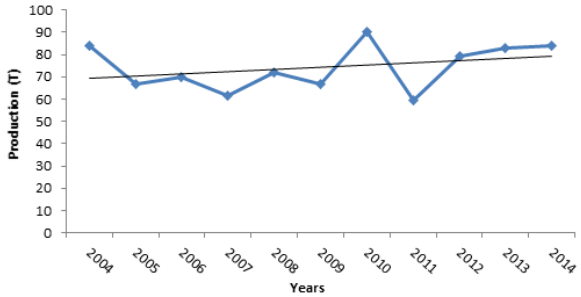

Figure 5 Fishing production in the reservoir of the Sidi Saad between 2004 and 2014.[14]

The monthly fish production variability in Sidi Saad reservoir indicates that the largest catches are made in autumn and winter (Figure 6). The monthly peak of production is recorded in December while the production is zero between March and April. This period corresponds to the prohibition of fishing activity in the Tunisian reservoirs. We also noted a drop in production during the summer with a minimum in June.

In Sidi Saad reservoir, the most caught species are mullet and carp. The figure below (Figure 7) shows a decrease in carp catches against an increase in mullet production particularly from 2012.

Analysis of data survey: Data analysed in this part of the work become from our field surveys. A total of 11 boats were regularly analysed from January until December in two consecutive years.

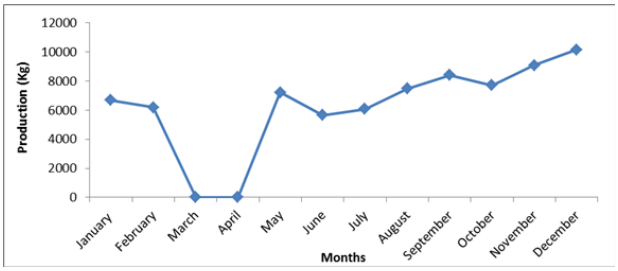

Figure 6 Monthly fishing production in Sidi Saad reservoir between 2004 and 2014.[14]

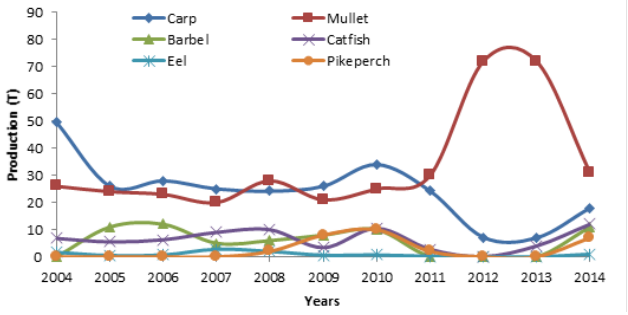

Figure 7 Production by species in Sidi Saad Reservoir between 2004 and 2014.[14]

Total production estimated from surveys is around 95 tons in 2007 and 112 tons in 2008 (Figure 8). Figure 8 shows large fluctuations in total production per month. The maximum productions were recorded in February (1546 Kg). The monthly evolution of the production shows that the most productive period is September-February. Smaller production is recorded during May and August, while the minimum production is observed in June. March and April correspond to the seasonal fishing closure in the reservoir.

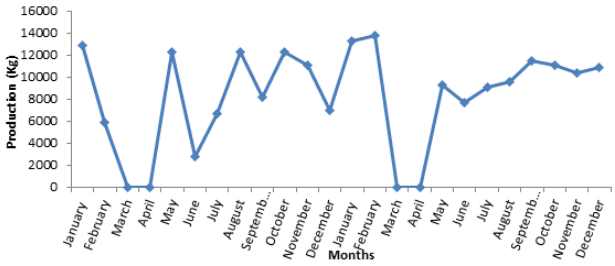

Figure 8 Monthly fishing production in Sidi Saad reservoir (2007-2008).

The composition of the landed fish in Sidi Saad reservoir shows that the carp is the most abundant species followed by mullet. The estimated productions in 2007 are 68.23 T for carp and 24.56 T for mullet. However, it was 76.2T for carp and 30.14T for mullet in the next year.

Additionally, these species are associated to other fish like eel, catfish and barbell, but they are negligible in the total production (2.16% in 2007 and 4.94% in 2008).

Carp production during the two years is dominant with a maximum recorded during the months of November and May. The minimum production of this species is observed during the month of June. Mullet production is highest in January-February and low in summer (Figure 9).

Citation: Hajlaoui W, Fatnassi M, Mili S, et al. Characterization of socio-economic fishing activity in tunisian reservoir: sidi Saad (center of Tunisia) as a case study. *J Aquac Mar Biol.* 2022;11(3):93–98. DOI: 10.15406/jamb.2022.11.00342

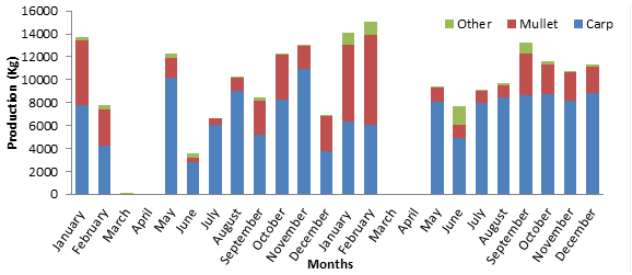

Figure 9 Monthly fish production by species in Sidi Saad reservoir (2007-2008).

Analysis of returns: The comparison of the annual yields in kg/boat obtained from the field surveys with those calculated from statistical data from DGPA shows that these values are higher than those recorded by the DGPA (Table 1). This observation confirms that around 35% of the annual catches escape from the official statistics.

Table 1 Comparison of annual returns from surveys data and DGPA database

Yield (kg / boat)	2007	2008
Results from survey	3161	3728
Data from DGPA	2060	2407

Evolution of yields in Kg / boat: The CPUE average changed monthly in (kg/boat) in Sidi Saad reservoir for the period 2007-2008 shows some significant fluctuations between month. The maximum of 502 kg/boat was observed in February 2008 and the minimum of 118 kg/boat recorded during June 2007. During the two years of the study, we noted that after reaching a minimum during the month of June, the yields increased gradually from the month of July (Figure 10).

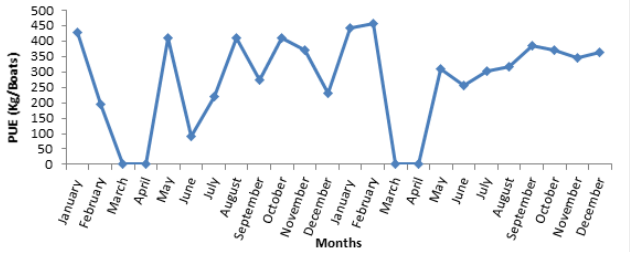

Figure 10 Monthly yield variability in Sidi Saad reservoir (Kg/boat) between 2007 and 2008.

The comparison of the monthly yields from surveys with those calculated from the statistics of the DGPA shows a considerable difference. Indeed, the month of February 2008 corresponds to the moast productive month. We notice a stagnation in the evolution of yields between year (data from DGPA). The minimums of production are obtained during the months of January 2007 and August 2008 (Figure 11).

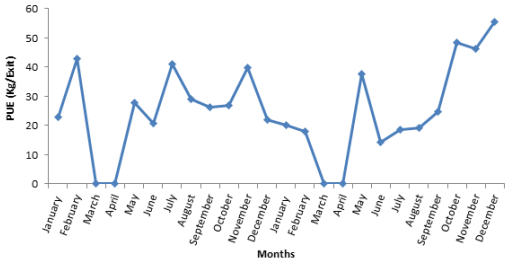

Figure 11 Monthly yield variability in Sidi Saad reservoir (Kg/outlet) between 2007 and 2008.

Evolution of yields in Kg / outlet: The survey data is used in order to analyze the returns (in Kg/output) whish give more information on the advancement of the relative abundance of fish in Sidi Saad reservoir. Indeed, we note variability in the monthly CPUE. It was low in June (14 kg/trip) and hight (57 Kg/trip) in February (Figure 11). Regarding the monthly CPUE of each species, we note that the maximum CPUE for carp is 41 kg/trip was recorded in December (Figure 12) while that of mullet is of 23Kg/release in February.

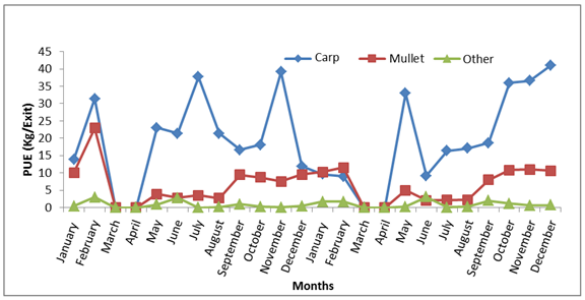

Figure 12 Monthly yield variability by species in Sidi Saad reservoir (Kg/outlet) between 2007 and 2008.

Income and profitability: The estimate annual turnover of the boats monitored as well as the mass costs per trip allows to calculate the remainder shared between the owner and the crew.

In the majority of cases, the winnings are shared by one third: one third for the boat and the nets, one third for the owner and one third for the second fisherman. If the second fisherman is not the owner of the boat, then the income is split in half and half. This allowed us to estimate the crew costs. After deduction of crew costs and costs payable by the owner of the remainder to be shared, we obtained the gross income of the owner.

The results relate to the estimated gross annual income of surveyed ship-owners for the years 2007 and 2008 are reported in Table 2. These results must be taken with caution because they are based on the declarations of the ship-owners of 11 units monitored in the surveys.

Table 2 Estimated gross annual income of surveyed ship-owners (in Tunisian Dinars)

Year	Sales figures	Masses charges	Remains to share	Crew costs	Costs to be borne by the ship-owner	Gross income of the ship-owner	Profitability (gross income / turnover)
2007	6712	901	5811	1937	975	2910	43%
2008	7647	926	6721	2240	1004	3478	45%

We note that Sidi Saad fishermen do not pay significant costs in their activity. They have a satisfactory economic result according to the rate of return which is greater than 40%. However, this activity is carried out with simple fishing effort and the reservoir was characterized by a low resource and dependent on the success of the transfer operations of fry and broodstock.

Citation: Hajlaoui W, Fatnassi M, Mili S, et al. Characterization of socio-economic fishing activity in tunisian reservoir: sidi Saad (center of Tunisia) as a case study. *J Aquac Mar Biol.* 2022;11(3):93–98. DOI: 10.15406/jamb.2022.11.00342

The economic difficulties for fishermen were seen in crew costs and gross income of the ship-owner. Indeed, the annual share of a seafarer was 1.937 TD in 2007 and 2.240 TD in 2008, i.e. a monthly share of 193.7 TD in 2007 and 224 TD in 2008 for the period of activity. For the ship-owner the monthly income is 291 DT in 2007 and 347.8 DT in 2008.

Discussion

According to the study conducted by Mili et al.[19], the fishing activity in Tunisian reservoirs is 100% carried out by men, 73% of whom are married. A large proportion of fishermen (45%) is formed by men aged between 35 and 45.

The results of the survey made in Sidi Saad reservoir indicate that the fishermen average age (39 years) is relatively high in comparison with the average ages of fishermen working in Bou Heurtma and Sidi Salem reservoirs which are respectively 30.2 and 34.3 years. On the other hand, the average age of the fishermen of the Mellegue reservoir is 47 years.[15]

In addition, we noted that there are no fishermen under the age of 20 in Sidi Saad reservoir. This could be due to the low remuneration of this activity and that young people would have more chance to work in other sectors and activities. This observation shows that this activity attracts relatively the youth, which ensures moderately its long-term sustainability.[19]

Regarding the education level, the majority of fishermen (64%) have a finished the primary education, 25% secondary and 11% are illiterate. Our results corroborate with those found by Mili et al.[19]: the majority of fishermen (48%) have a primary education level; 39% have secondary level and 11% are illiterate. We note the absence of fishermen with a higher level of education, unlike the fishermen of Bouhertma and Sidi Elbarrak. The young age of fishermen and their acceptable level of education guarantee their ability to assimilate and learn new fishing techniques.[19]

The annual production estimated from data based on fishermen's declarations are around 94.84 tons in 2007 and 111.87 tons in 2008. The production was 61.8 in 2007 and 72.2 T according the Directorate General of Fisheries and Aquaculture. This confirms that 35% of the annual catches escape from the official statistics. The differences in the production are also observed (according to species), particularly for carp and mullet. The landing recorded for these species, during the survey, are higher than those of the DGPA. Contrarily, the estimated values for barbel, catfish and eel are lower than that of DGPA landing stats.

According to data survey, carp production is the most abundant in catches (72% in 2007 and 68% in 2008), followed by mullet (26% in 2007 and 27% in 2008). Barbell has the smallest biomass the reservoir and its production do not exceed few kilos. The pikeperch landing was also negligeable.

Regarding the monthly production, the reservoir of Sidi Saad is more productive in winter. The increase in fish landing is linked to the capture of mules. Indeed, the increase in turbidity makes mullets more vulnerable to fishing gear, which facilitates their capture. These results are comparable to those found by Haj Salah[16] in 2000 and Djemali[20] in 2005.

The share of a sailor in 2007 was 193.7 DT/Month and 224 DT/Month in 2008. Despite this increase, we note that the fisherman income is lower than the minimum wage (209.456 in 2007 and 221.520 in 2008), and it remains unstable. The owner's income is 291 DT/Month in 2007 and 347.8 DT/Month in 2008, although this gross income for a ship-owner is higher than the minimum wage which is insufficient to earn a living. Indeed, 61% of fishermen carry out an additional activity (agriculture, construction, etc.). The same results are found by Mili et al.[19] after surveying 14 Tunisian reservoirs (in the north and center of the country). These authors confirm that the income of fishermen is low and irregular, forcing 52% of them to perform additional work. In order to improve their quality of life, fishermen should increase the quantity of fish caught or the selling price. The fishermen of Sidi Saad can also develop fishing techniques to target species of high commercial value such as the eel.

Sales prices vary depending on the species, time of year and customer demand.[19] By comparing our results with other work carried out in different reservoirs, we find that in the Sidi Salem dam the predominant class of fishermen earns less than 300 DT/Month, which is the case of BouHeurtma reservoir. On the other hand, Sidi El Barrrak and Mellegue fishermen are the well paid and 80% of them earn between 300 and 500DT/Month.[15]

The majority of fishermen ask for an increase in the mullet fry stoked and the introduction of new species with a high commercial value such as pikeperch.

Conclusion

The analyses of the catches in Sidi Saad reservoir showed that the barbell is endangered in the reservoir. The common carp is the most fish caught in this reservoir followed by mullet. Additionally, we did not note the presence of pike perch in the catches.

The survey made with fishermen revealed that fish production was estimated at 94.89 tons in 2014. These values are significantly higher than those of the General Directorate of Fisheries and Aquaculture.

The fishing activity in Sidi Saad reservoir is remains underdeveloped. The evaluation of profitability shows that this sector does not constitute a stable source of income for fishermen necessary for the needs of their households. This is mainly explained by factors related to exploitation (fishing gear, marketing problems, low capital, etc.).

Acknowledgements

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Conflict of interest

Authors declares there are no conflicts of interests.

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