



Profitability and economic drivers of small pelagic fisheries in West Africa: A twenty year perspective



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ABSTRACT

Small pelagics are the main fish resource in North West Africa. In Senegal, these are mainly sardinellas (*Sardinella aurita* and *S. maderensis*) and bonga shad (*Ethmalosa fimbriata*). The fisheries, mainly encircling gillnets and purse seines, are predominantly performed by artisanal fishers and are of great importance for the Senegalese economy and for food security in the region. However, in recent years, the main conditions for these fisheries have changed and recent observations have shown strong declines in profit. An analysis over the last twenty years (1993–2013) show that the fisheries lost profit between 65% and 100% while operating costs increased by 25% and 90%, for encircling gillnet and purse seine, respectively. While the fuel price dominates as determining factor during the survey period, important other drivers during the last five years were a decrease in fish biomass and an increase in fishing effort.

1. Introduction

Small pelagic fish are abundant in the Canary and Guinea current system off West Africa [1,2]. Along the Mauritanian and Senegalese continental shelf, the dominant species of pelagic fish are sardinella (*Sardinella aurita* and *Sardinella maderensis*) [3] and bonga shad (*Ethmalosa fimbriata*). These small pelagic fish, mainly *S. aurita*, perform a seasonal migration between southern Morocco and southern Senegal [2–4]. They are predominant in landings (volume and value) within the small pelagic fishery in Senegal. The fishery in Senegal has expanded significantly in the 1970s with the adoption of purse seines in the artisanal fishery [5]. Since then, small pelagic fish are the main component of the Senegalese artisanal fishery with on average 230,000 t per year and between 70% and 77% of the total landing over the period 1990–2012 and the total value of small pelagic landing was estimated to be 74,000 k€ in 2014 (Fig. 1). Overall, the exploitation of small pelagic fish is strongly marked by the predominance of round sardinella (*S. aurita*) and flat sardinella (*S. maderensis*), with on average 52% and 37% in landings of small pelagics [6]. These species contribute especially to the supply of the local market [7] and play a dual role in the Senegalese economy, through their contribution to food

security, and through employment in the fishery and the processing sector. The revenues generated by sardinella landings are shown in Fig. 1, and are representing 30,000 k€ on average per year between 1995 and 2009. However, the value has doubled since 2009.

The fishery is subsidized by the state since the 1960s in different ways ranging from facilitating credit contracts to direct subsidies on fuel and fixed costs and also zero-rating of inputs. These subsidies are motivated among others by the development of the sector but also to guarantee food security. However this kind of policy is highly criticised to have detrimental effects in a *de facto* open access fishery situation by several authors [8,9].

However, due to the high spatiotemporal variability of sardinella abundance [1,3,10], the increase in fishing effort and in fishing capacity, a decrease in individual income of fishers targeting these species has been observed between 1993 and 2011 [11]. In addition, since 2001, the FAO working group on the assessment of small pelagic fish off Northwest Africa (CECAF) indicated that these stocks are becoming overexploited. They recommended a reduction in fishing effort (see also FAO [12]).

Purse seine and encircling gillnet are the main fishing gears used to catch small pelagic fish. The economic and financial profitability of

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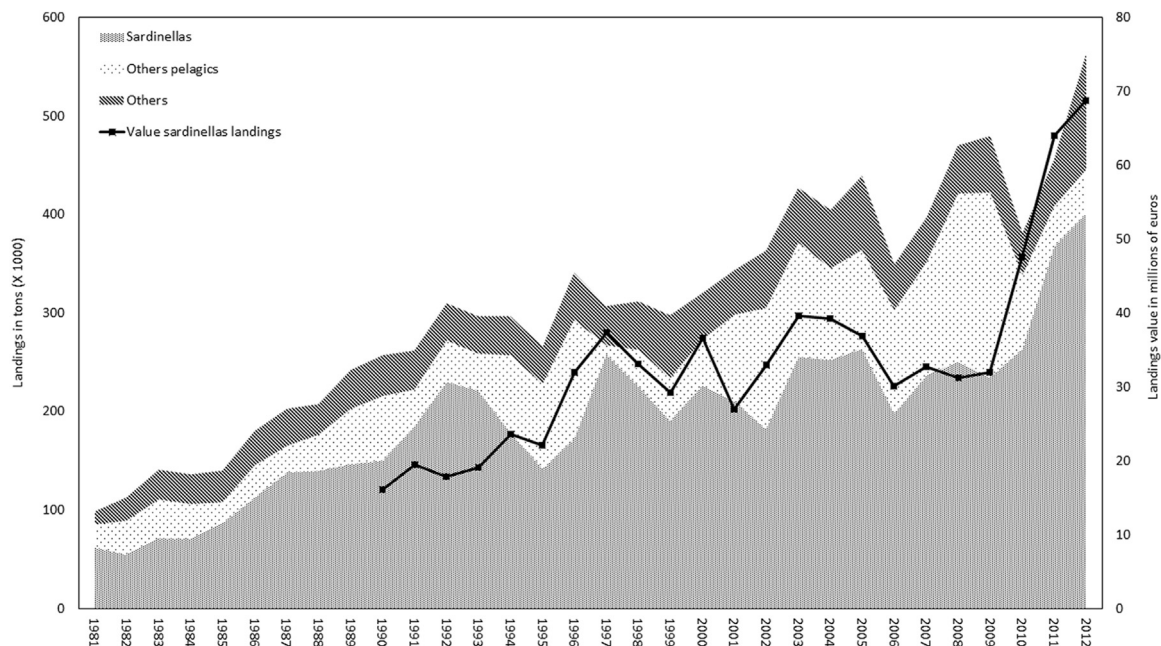


Fig. 1. Senegalese landing and value of landings of sardinella. The proportion of sardinellas, other pelagics and all other landing in the artisanal Senegalese fishery from 1981 to 2012 and the value of sardinella landings (blackline) (source: CRODT, the Senegalese fisheries research center).

artisanal fishing has been monitored fairly regularly between 1993 and 2007 (Senegalese research center (CRODT) and FAO). The last study carried out in 2010 [11] has shown a financial hardship for the small pelagic fishing sector.

Since this last study [11], several important changes have been observed. The first is a contract (2010–2012) between Senegal and a Russian fleet (29 boats) targeting small pelagic fish that had been in place [3,13,14], but which was terminated in 2012 because of political pressure from artisanal fishermen and local NGOs [15].

In addition to subsidies mentioned above, the government decided in 2015 to reserve more than 7600 k€ to subsidize the investment in engines with 1.5 k€ per engine (in addition to preexisting tax exemptions).

Lastly the government implemented a vessel registration program for artisanal boats in 2006 to control the fishing capacity. This included a yearly fishing license of 38€ per purse seine and encircling gillnet. The fishing license is also an obligation in the new fishing code (2015). The objective is to have a better control over the fishing capacity and in addition to cover the externalities of the artisanal fishing sector. However, only a few purse seine and encircling gillnet fishing units have bought this license yet.

The two fleets subject for the analysis are the traditional, coastal and family-oriented encircling gillnet (EG) fishing units, which are compared with the more progressive, flexible and capital-intensive purse seines (PS). The choice of these fishing units is motivated by the fact that 65% of *E. fimbriata* is caught by the EG and 30% by the PS, 40% *S. maderensis* is caught by EG and 55% PS and 98% of *S. aurita* is caught by the PS. The focus of this paper is on the analysis of the development of the economic viability of these two fleets and the drivers behind this development. The results of the short term analysis based on 2014 data are compared with results from previous studies between 1993 and 2007. This enabled us to follow the development over a time horizon of twenty years, but also having a closer look at the more recent years.

2. Material and methods

For this study, several data sources were used:

- (i) The dataset of the Oceanographic Research Centre of Dakar Thiaroye (CRODT) already described by several authors [16–21] for catch per unit of effort (CPUE) by species and catch data landed by PS and EG and ex vessel prices of fish.
- (ii) The reports of the Senegalese Directorate of Marine Affairs and fisheries (DPM) [13] and the FAO¹ reports of the CECAF² for historical data.
- (iii) Investment data of fishing units are complemented by interviews with the main engine, boat and net retailers.

The study area and the major landing sites are presented in Fig. 2. From these various sources of data the investment value fixed costs, variable costs, the net income and the subsidies of the fishing fleet are estimated. The economic and financial analysis of fishing vessels is calculated using their operating accounts, the internal rate of return, the delay to recovery of invested capital and the net added value. To compare this study with previous studies, the same method was used to calculate the income. The methodology (Fig. 3) is adapted from Kébé and Horemans [22], a study done for the West African artisanal fisheries.

We did a review of studies conducted since 1993 for Senegal (the first study took place before the devaluation of the national currency i.e. CFA³ franc “XOF” in 1994) specifically for the years 1996, 1999, 2004 and 2007, to derive a time series of profitability. Deflation was calculated using the consumer price index with 2014 as base year.

The turnover per year per fishing unit is simply derived by multiplication of catch per unit of effort with the number of fishing trips and the price of the species. The catch is composed of the target species (*S. aurita*, *S. maderensis* and *E. fimbriata*) and all other species caught by the fishing vessels.

Operating costs are assumed to be proportional to the fishing units' activity (effort). They include the sum of fuel costs, food and small maintenance costs. The deduction of these total operating costs (TCO) from the turnover gives the gross operating income. This result is divided between capital and labor according to the share system of the

¹ Food and Agriculture Organization of the United Nations (FAO).

² Fishery Committee for the Eastern Central Atlantic (CECAF).

³ Local currency (FCFA= Franc Coopération Financière en Afrique).

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