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Current status of inland fisheries in the prefecture of Tougué (Middle Guinea, Republic of Guinea)

Abdoulaye Mountaga Baldé [1,*], Mamadou Bhoyi Baldé [1], Daouda Konaté [2], Rassy Cisse [2], Alpha Oumar Silly Diallo [2] and Hadiatou Diallo [2]

[1] *Marine and Coastal Research Center (CEREMAC), Conakry, Republic of Guinea.*
[2] *Higher Institute of Veterinary Sciences and Medicine (ISSMV), Dalaba, Republic of Guinea.*

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Abstract

Inland fisheries in Middle Guinea remain poorly documented although they contribute directly to the food security of riverside communities. This study assessed the status of inland fisheries in the prefecture of Tougué in order to characterise stakeholders, fishing gear, exploited species and constraints, and to propose sustainable management measures. Data were collected from 5 September to 12 November 2023 in five sub-prefectures by combining analysis of the archives of the Prefectural Directorate of Fisheries and Maritime Economy, interviews with sector officials, and questionnaire surveys of fishers (n = 40), fish sellers (n = 30) and net makers. The archives listed 1,002 fishers, including 734 women, 700 fishmongers and processors, including 687 women, and a fleet of 63 dugout canoes. Five gear types were recorded: set nets, traps, longlines, conical nets and hooks. Half of the fishers surveyed were over 50 years of age and 62.5 % had 30 years or more of experience; all combined fishing with farming, livestock keeping or trade. Six species belonging to six families were exploited, dominated by *Oreochromis niloticus*. Catches ranged from 2 to 10 kg per trip and were reported to be declining. Mesh sizes as small as 10 mm and non-selective traps retained juveniles and by-catch. Marketing relied on a single fish market built at Koïn under the PGIRE II project, and two thirds of the sellers traded marine species imported from Labé. Absence of a cold chain, rudimentary gear, poor road access and weak technical supervision were the main constraints identified.

Keywords: Inland Fisheries; Ichthyofauna; Fishing Gear; Sustainable Management; Guinea

1. Introduction

Inland fishing covers all gathering, fishing, hunting and aquaculture methods applied to inland waters, and is defined by the Food and Agriculture Organization of the United Nations as any activity carried out to extract fish and other aquatic organisms from inland waters [1,2]. Inland waters supply a substantial share of the animal protein consumed in developing countries and play a strategic role in the fight against food insecurity and malnutrition. Their contribution cannot be separated from the agricultural fabric of the countries concerned: their management depends closely on farming practices, on land and water resource management, and on the conservation of biodiversity and ecosystems. Average world fish consumption per capita, estimated at about 6 kg per year in 1950, now exceeds 20 kg per year, a rise largely driven by the expansion of aquaculture [3].

In Africa, inland fishery resources constitute renewable natural capital from which the continent can derive lasting benefits. Fisheries, both marine and inland, together with aquaculture, represent natural resources that can contribute significantly to inclusive development [4]. Long regarded as a subsistence activity carried out alongside farming and livestock keeping, inland fishing is now viewed as an alternative to the overexploitation of marine stocks and as a lever

* Corresponding author: Abdoulaye Mountaga Baldé.

for job creation and poverty reduction [5]. Overfishing, habitat degradation and non-selective fishing practices have nevertheless reduced stocks in several regions, and the selectivity of fishing gear directly determines its ecological impact [6].

In the Republic of Guinea, fisheries and aquaculture are identified in the National Programme for Economic and Social Development (PNDES) as a growth-generating sector contributing to food and nutrition security and to poverty reduction [7]. Inland fisheries nevertheless operate within a weaker legal and institutional framework than marine fisheries [8,9]. Guinean coastal fisheries have been documented in some detail [10], whereas the country's inland ichthyofauna remains imperfectly known despite several studies; it is irrationally exploited and is deteriorating at a worrying rate, while protection and conservation measures remain insufficient and, in places, non-existent [7].

The prefecture of Tougué, in north-eastern Middle Guinea, is drained by three major hydrographic systems — the Falémé, the Gambia and the Bafing — which give it a genuine fishery potential and place it within basins of regional importance [11]. Fishing is nevertheless practised there with rudimentary means and faces persistent constraints: limited knowledge of the fish resources, low technical level of the gear, poor dissemination of national fisheries regulations and an almost complete absence of preservation infrastructure. No recent comprehensive study documents the state of this fishery, which restricts the capacity of the technical services to monitor and manage it.

The general objective of this study was to assess the current status of inland fisheries in the prefecture of Tougué. Specifically, it aimed to (i) enumerate the stakeholders of the sector and the canoe fleet; (ii) identify and characterise the fishing gear used and its origin; (iii) inventory the species exploited and marketed; (iv) assess the impact of fishing on fish populations; and (v) formulate proposals for the sustainable management of the aquatic resources of the prefecture.

2. Material and methods

2.1. Study area

The prefecture of Tougué belongs to the administrative region of Labé. It lies in the north-eastern part of Middle Guinea, between latitudes 11° and 12° N. It covers 6,400 km^2 and has a population of 148,612 inhabitants, comprising 81,542 women and 67,070 men, giving a density of 23 inhabitants per km^2. It comprises nine sub-prefectures — Fatako, Fello Koundoua, Kansangui, Koïn, Kollet, Konah, Konllangui, Kouratongo and Tangaly — together with one urban commune. It is bordered to the east by the prefecture of Dinguiraye, to the west by those of Labé and Koubia, to the north by the Republic of Mali and to the south by the prefectures of Mamou and Dalaba [12].

The relief combines mountain massifs and lateritic plateaux dissected by abrupt depressions and dotted with forest islands, plains and lowlands. The main plains lie in the sub-prefectures of Koïn (Koloun, 7,000 ha; Malipan, 280 ha; Moukidjigué, 180 ha), Konah (Konah and Parawi, 150 ha in total) and Fatako (N'douka, 600 ha). With a mean altitude of 868 m, the prefecture has a Fouta-type climate with two contrasting seasons: a rainy season from May to October and a dry season from November to April, the latter now tending to extend over seven months as a result of climate change. Temperatures range from 18 to 33 °C, mean annual rainfall is about 1,550 mm, and the harmattan prevails from December to January. The vegetation consists of forest islands and wooded savannah, with grasses predominating on the lateritic hardpans (bowé) and gallery forests along the watercourses [12].

Hydrographically, the prefecture is drained by three systems: the Falémé and the Gambia to the north and the Bafing to the east. The main watercourses are the Kioma, the Fanhan, the Bafing and the Kaliwolon. Ninety per cent of the population is engaged in agro-pastoral activities; fishing is essentially destined for the self-consumption of communities living along the Kioma, the Koloun and the Bafing [12].

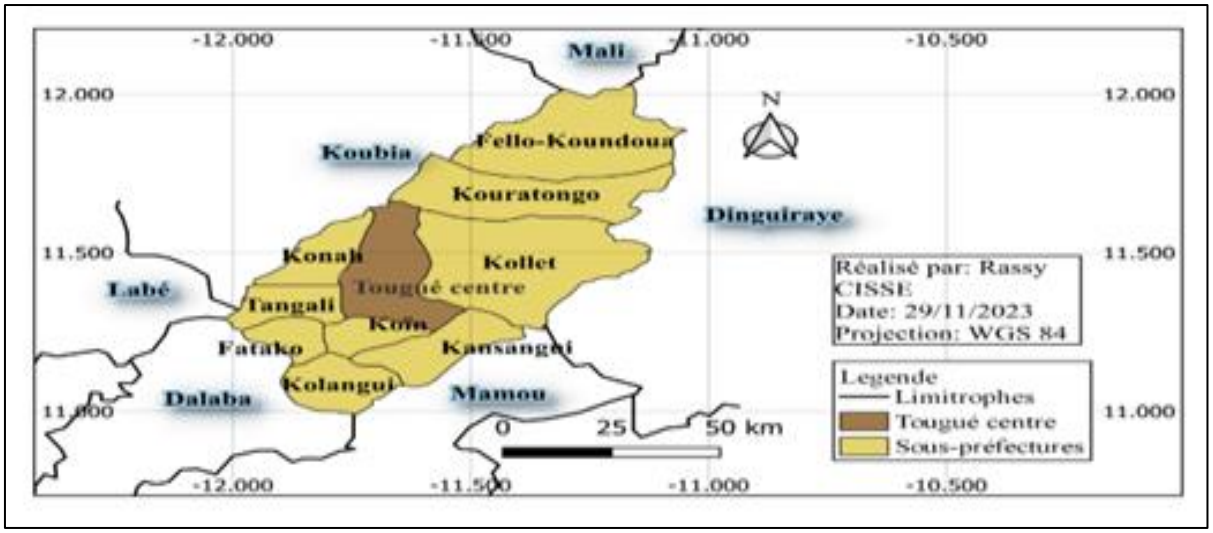

Figure 1 Location map of the prefecture of Tougué

Field work covered five sub-prefectures selected for the intensity of the fishing activity practised there: Kollet, Fatako, Koïn, Kansangui and Konllangui (Figure 2).

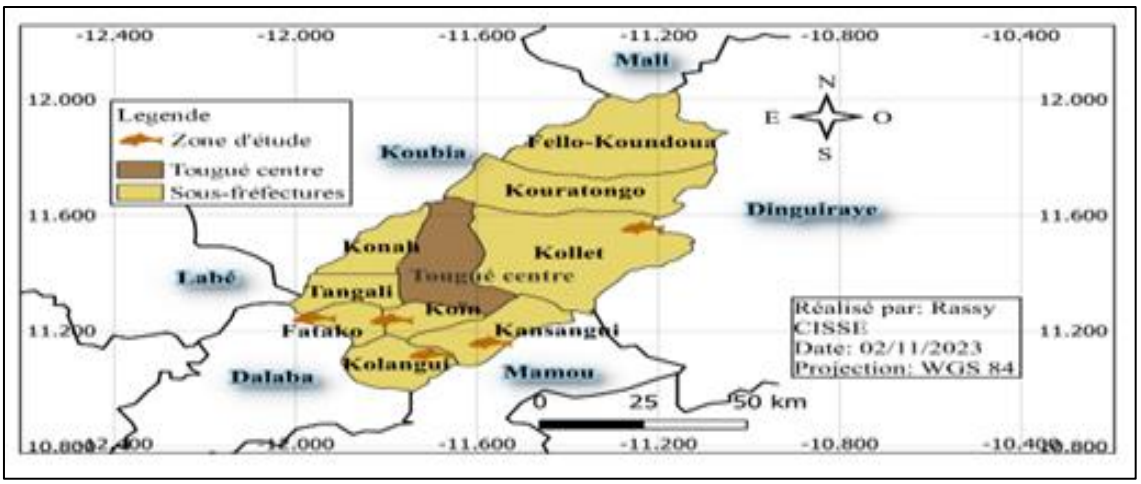

Figure 2 Map of the survey area

2.2. Material

Table 1 Material used for data collection and processing

Material	Quantity	Use
Survey forms	60	Semi-structured interviews with stakeholders
GPS receiver (GPS Essentials)	1	Georeferencing of fishing sites
Google Earth	1	Mapping and location of the study area
Digital camera	1	Documentation of gear, canoes and catches
Zotero	1	Management of bibliographic references

2.3. Data collection

Data were collected from 5 September to 12 November 2023 and drew on three complementary sources.

Interviews with officials and analysis of archives. Interviews were held with the former prefectural director of fisheries and maritime economy in order to identify the areas where fishing is most intensively practised. The archives of the prefectural directorate were then examined to record the gear types in use and their origin, the number of stakeholders in the sector and the size of the canoe fleet.

Surveys of stakeholders. Three categories of stakeholders were surveyed using pre-established forms. Fishers (n = 40) were questioned about their age, their seniority in the activity, their secondary activities, the species caught, the gear and canoes used, the quantities landed per trip and the perceived trend in fish populations. Fish sellers at the Koïn market (n = 30) were asked about the species marketed, their origin, consumer preferences, the determinants of price and the preservation methods used. Net makers were questioned about the types of gear they build and the materials from which these are made.

Direct observation. Gear and canoes encountered in the field were observed, measured and photographed in order to establish their technical characteristics (length, drop, mesh size, constituent materials) and to assess their effect on fish populations.

2.4. Data processing

Survey forms were processed manually and then entered into a spreadsheet. Results are expressed as counts and relative frequencies and presented in tables and graphs. Species were identified on the basis of external morphological characters and vernacular names, and assigned to families following currently accepted nomenclature. Bibliographic references were managed with Zotero.

2.5. Limitations of the study

Three limitations should be noted. First, the planned in-depth interview with the prefectural director of fisheries and maritime economy — the only officer posted to the directorate — could not be held because she was absent during the field period. Second, landed quantities are based on fishers' declarations rather than on systematic weighing, which limits the precision of production estimates. Third, species identification relies on external characters and should be confirmed by taxonomic examination of voucher specimens, particularly for the Cyprinidae of the genus *Labeo*.

3. Results and discussion

3.1. Fishing gear recorded and its origin

Examination of the archives identified five types of fishing gear, whose origin and conditions of use are given in Table 2.

Table 2 Fishing gear recorded, origin and conditions of use

Gear type	Origin	Conditions of use
Set net	Conakry, Kankan, Côte d'Ivoire	Large watercourses
Trap (nasse)	Local manufacture	Small watercourses
Longline	Conakry, Kankan	Large watercourses
Conical net	Conakry, local manufacture	Small watercourses
Hook	Conakry, Labé, Tougué market	Large watercourses

Gear is mainly obtained from urban centres outside the prefecture, the only exception being the bamboo trap, which is made entirely on site. Its use is differentiated according to the size of the watercourse: large passive gear is reserved for the main hydrographic axes, whereas traps and conical nets are used in small watercourses.

3.2. Stakeholders and canoe fleet

The sector is strongly feminised: women account for 73.3 % of the fishers recorded and for almost all fishmongers and processors (98.1 %). The canoe fleet is limited to 63 units, all of the dugout type; no planked or motorised craft was recorded.

Table 3 Stakeholders of the sector and canoe fleet of the prefecture of Tougué

Category of stakeholders	Total number	of which women	Proportion of women
Fishers (all nationals)	1,002	734	73.3 %
Foreign fishers	0	0	–
Fishmongers and processors	700	687	98.1 %
All stakeholders	1,702	1,421	83.5 %
Dugout canoes (monoxyle)	63	–	–
Planked canoes	0	–	–

This pattern contrasts with the observations of Ehlui [13] in the Grand-Oti area of northern Togo, where men account for 80 % of fishers. The divergence may be explained by the recording method used by the prefectural directorate, which places within the category of "fishers" all persons engaged in capture activities, including wading and gleaning in lowlands, which are widely practised by women. It also reflects the central position of women in the downstream segments of the sector: in most West African inland fisheries, processing and marketing are almost exclusively female activities transmitted within fishing families [4]. This finding argues for support measures targeting women as a matter of priority.

3.3. Profile of the fishers surveyed

The age distribution of the fishers surveyed (n = 40) is shown in Figure 3. Half of them (50 %) were over 50 years of age, the 18–30 and 31–50 classes each accounting for 25 %; no fisher under 18 was recorded.

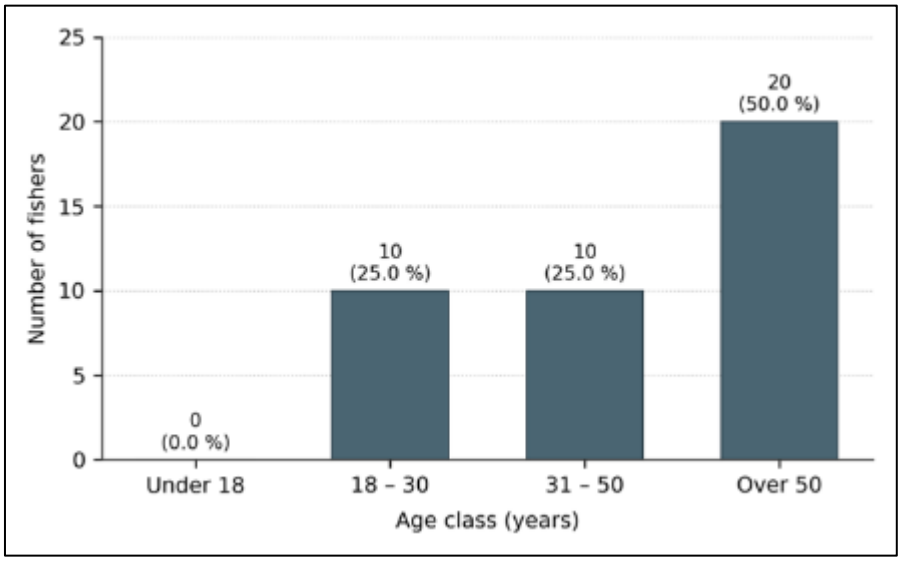

Figure 3 Age distribution of the fishers surveyed (n = 40)

Seniority in the activity (Figure 4) confirms this profile: 62.5 % of respondents had been fishing for 30 years or more, against 7.5 % for less than 10 years.

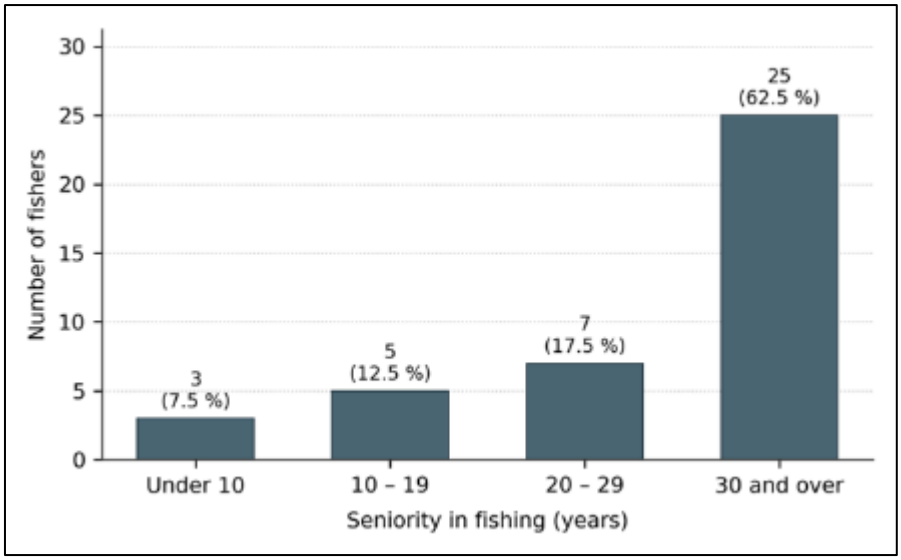

Figure 4 Seniority of the fishers surveyed in the fishing activity (n = 40)

Noumonvi [14] reports ages between 27 and 77 years in Benin, with older classes predominating, which is consistent with the present observations. While this seniority represents a valuable stock of empirical knowledge of the aquatic environment, it also signals a failure of generational renewal: the complete absence of fishers under 18 and the low representation of those under 30 raise, in the medium term, the question of how the activity will be transmitted.

All the fishers surveyed carried out a secondary activity (Figure 5). Farming ranked first (42.5 %), ahead of livestock keeping (32.5 %) and trade (25.0 %). The same pattern is described by Noumonvi [14], who places farming first (38.46 %) ahead of livestock keeping (30.77 %). This diversification reflects necessity rather than choice: catches per trip are too low for fishing alone to support a household.

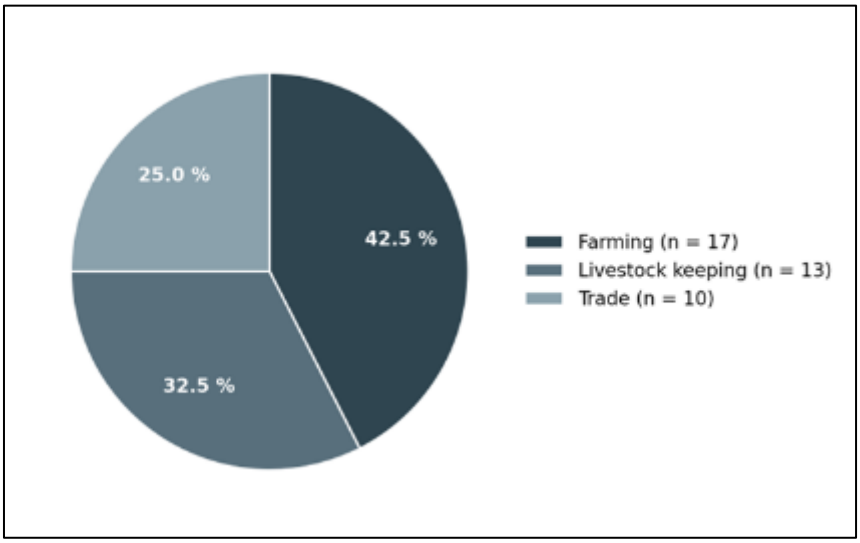

Figure 5 Secondary activities of the fishers surveyed (n = 40)

3.4. Exploited ichthyofauna

Six species belonging to six distinct families are exploited in the prefecture (Table 4).

The species richness exploited, limited to six species, is comparable to that reported by Shep et al. [15] for artisanal inland fisheries, with a partly different composition. This low diversity may reflect gear selectivity and the homogeneity of the habitats surveyed as much as genuine impoverishment of the assemblage; only standardised scientific sampling covering the different habitat types and seasons would allow a firm conclusion.

Table 4 Fish species exploited in the prefecture of Tougué

No.	Family	Scientific name	Vernacular name (Pular / Maninka)
1	Cichlidae	*Oreochromis niloticus* (Linnaeus, 1758)	Teben, Folo
2	Clariidae	*Clarias gariepinus* (Burchell, 1822)	Manoko, Selema
3	Cyprinidae	*Labeo* sp.	Baman, Nanatondo
4	Latidae	*Lates niloticus* (Linnaeus, 1758)	Sâlèn
5	Mochokidae	*Synodontis nigrita* Valenciennes, 1840	Konko malé, Koso konko
6	Arapaimidae	*Heterotis niloticus* (Cuvier, 1829)	Wanga, Fandan

Cyprinid specimens were attributed in the field to *Labeo rohita*. That identification has not been retained here, since the species is native to South Asia and is not recorded from natural waters in West Africa. The specimens are provisionally assigned to the genus *Labeo* pending taxonomic confirmation on voucher material; several African congeners, including *L. senegalensis* and *L. coubie*, occur in the Gambia and Senegal basins and may correspond to the specimens observed.

3.5. Gear actually used and technical characteristics

The gear declared by the fishers surveyed is presented in Figure 6. The set net, associated with the cast net, is the most widely used (37.5 %), followed in equal proportions by the trap and the conical net (25.0 % each); the hook mounted on a line concerns only 12.5 % of respondents.

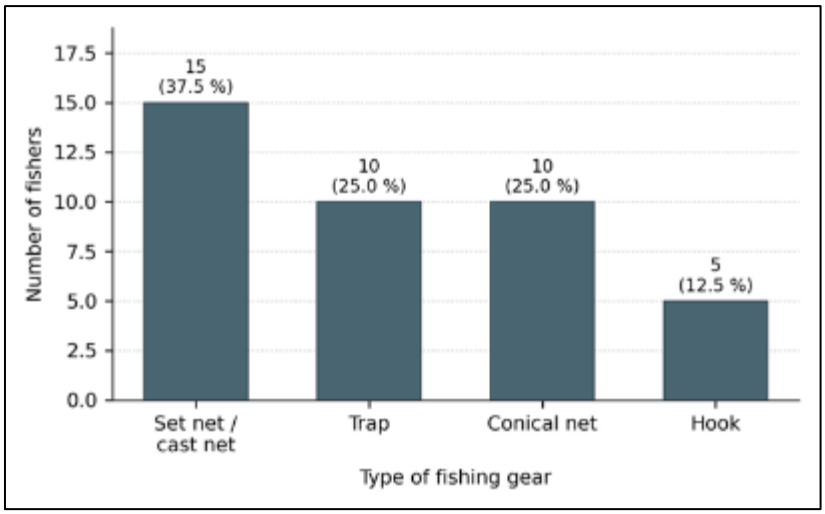

Figure 6 Fishing gear used by the fishers surveyed (n = 40)

Table 5 Technical characteristics of the main gear used

Gear	Length	Drop	Mesh size	Constituent materials
Set net / cast net	5–50 m	2–20 m	10–100 mm	Nylon netting, tie lines, stone sinkers, floats
Trap (nasse)	1–10 m	1–5 m	10–100 mm	Woven bamboo, tie lines
Hook and line	Variable	–	–	Rod, line, hook

The finest mesh sizes recorded, of the order of 10 mm, are far below the size at first sexual maturity of the target species and retain a substantial proportion of juveniles. The predominance of the set net and cast net (37.5 %) differs from the typology established by Adou et al. [16] on the Agnéby river in Côte d'Ivoire, where gill nets account for only 28.72 % of seven gear types inventoried. Lamboj et al. [17] show that the impact of fishing on fish populations is exerted, depending on the gear, through selective pressure either on spawning adults or on juveniles. The combination observed at Tougué — low-mesh passive gear together with non-selective traps — cumulates both effects, which is consistent

with the decline in yield reported by the stakeholders and with the general relationship between gear selectivity and ecological impact [6].

3.6. Canoes

A single type of craft was identified: the dugout canoe, 3 to 5 m long and able to carry a maximum of three persons. Propulsion is exclusively manual, by paddle. No motorised craft and no safety equipment, in particular life jackets, were observed at the sites visited. This uniformity is consistent with the observations of Thiam [18] in the watercourses of Nioro, Saboya, Koutango and Mandera in Senegal, and is explained by the availability of local materials and by the suitability of these light craft to shallow watercourses. It nevertheless limits the range and safety of fishing trips and confines fishing effort to the reaches closest to the villages.

3.7. Production per fishing trip

Table 6 Quantities of fish declared per fishing trip by locality

No.	Locality	Declared quantity (kg per trip)
1	Koïn	10
2	Konllangui	10
3	Fatako	9
4	Kansangui	5
5	Kollet	2

Landings per trip range from 2 to 10 kg, with a mean of 7.2 kg. Koïn and Konllangui record the highest catches and Kollet the lowest. The fishers surveyed unanimously report a decline in the quantities caught per trip over recent years.

These figures are far below the 40 to 80 kg per trip reported by Thiam [18] for the Senegalese sites mentioned above. The difference is attributable to the size of the hydrosystems, the absence of motorised craft, the duration of trips and the seasonal character of the activity. It confirms the subsistence status of the Tougué fishery and accounts for the systematic pluriactivity of fishing households.

3.8. Marketing of the products

Only one locally caught species is marketed at the Koïn fish market: *Oreochromis niloticus* (folo). The other species caught are sold directly at the landing sites or are available only seasonally and often incidentally. Price, determined by weight, species and availability, ranges from 20,000 to 30,000 GNF per kilogram.

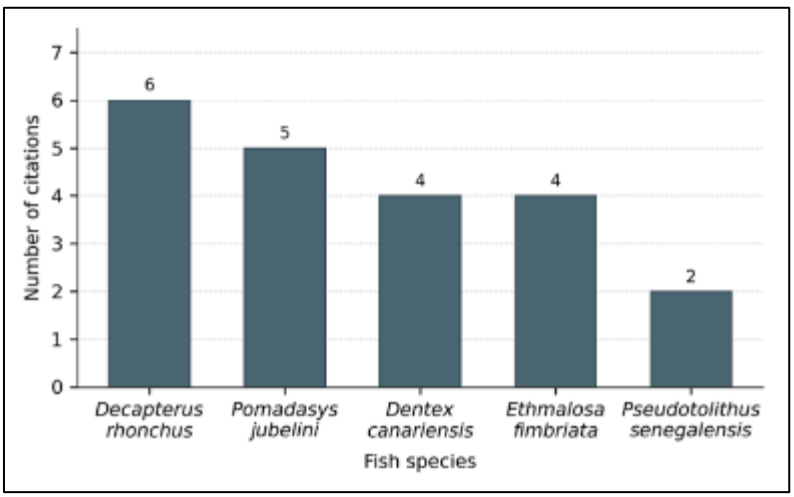

Figure 7 Species most sought after by consumers according to the sellers surveyed (21 citations)

Asked which species are most sought after by consumers, sellers cite mainly imported marine species (Figure 7). Taste is the main reason for preference; for *Ethmalosa fimbriata*, affordability is added to eating quality.

The structure of supply reflects this demand (Figure 8): two thirds of the sellers (67 %) offer marine species brought from Labé — *Dentex canariensis*, *Decapterus rhonchus*, *Pomadasys jubelini*, *Pseudotolithus senegalensis* and *Ethmalosa fimbriata* — whereas one third (33 %) deals exclusively in the local tilapia from Koloun.

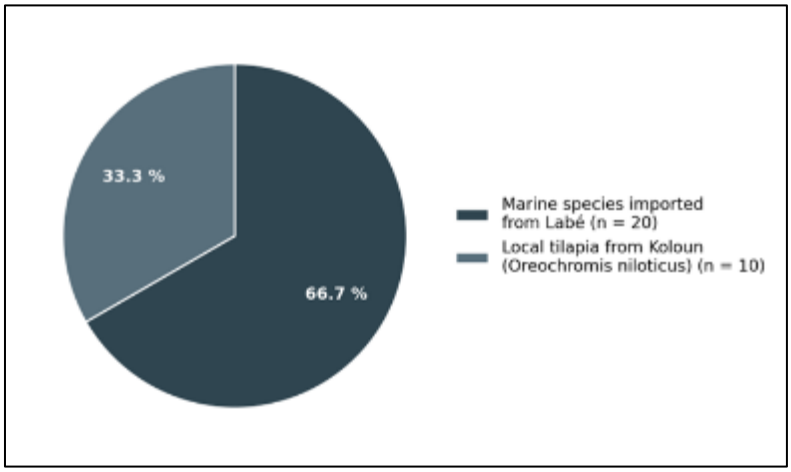

Figure 8 Origin of the products marketed by the sellers of the Koïn market (n = 30)

Drying is the only preservation method practised, and only for locally caught fish; sellers of imported fresh fish have no means of preservation at all. The prefecture has a single fish market, located in the rural commune of Koïn and built by the Senegal River Basin Development Organisation (OMVS) under the Integrated Water Resources Management and Multipurpose Use Development Project (PGIRE II). The development of this market and of the Koïn landing stage led to the creation of a cooperative of fishers, sellers and fish processors named CONAKO de Koloun.

The absence of a cold chain is the main bottleneck of the sector. Drying remains the only technique in use, exactly as described by Adeoti et al. [4] in the communes of Adjohoun and Dangbo in south-eastern Benin, where the lack of access to minimal preservation services obliges women traders to dry all products in order to avoid heavy losses. At Tougué this constraint is compounded by poor road access and by the existence of a single fish market, which accounts for the paradox of a prefecture endowed with fishery potential whose markets are supplied to the extent of 67 % with marine species imported from Labé.

3.9. Gear manufacture

Table 7 Locally manufactured gear and constituent components

Gear manufactured	Constituent components	Origin of materials
Net	Tie lines, stone sinkers, floats	Mixed (local and imported)
Line	Rod, line, hook	Mixed (local and imported)
Trap (nasse)	Woven bamboo, tie lines	Mainly local

Tie lines are common to nets and traps, and sinkers to nets and lines. Net makers report increasing difficulty in obtaining materials and the high level of skill required to assemble nets.

3.10. Effect of fishing on fish populations

The impacts recorded are mainly attributable to the gear used. The small mesh size of nets and the non-selective character of traps lead to the capture of juveniles and to by-catch, notably of aquatic reptiles. The stakeholders interviewed associate the observed decline in yields with these practices and with the concentration of fishing effort on short reaches of watercourse.

3.11. Constraints faced by the stakeholders

Table 8 Main constraints reported by the stakeholders of the sector

Category	Constraints reported
Fishers	Presence of dangerous animals (hippopotamuses, crocodiles, snakes, leeches); lack of protective and safety equipment; non-motorised canoes; high cost of nets; absence of cold rooms, leading to spoilage of catches
Sellers	Difficulty in selling; complete absence of preservation facilities, particularly for fresh fish; poor road conditions restricting access to markets
Net makers	Difficulty in obtaining manufacturing materials; high technical skill required to assemble gear

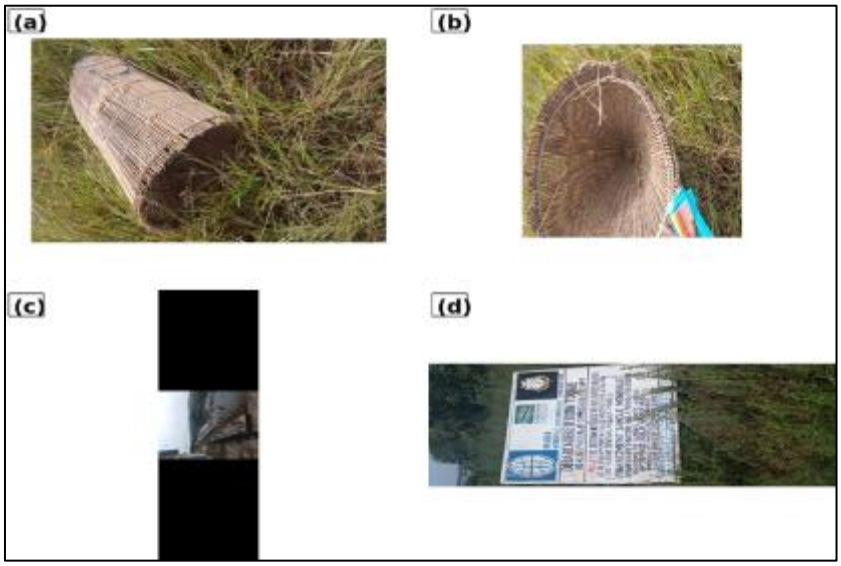

Figure 9 Field illustrations (prefecture of Tougué, September–November 2023): (a) woven bamboo trap; (b) landed catches; (c) and (d) watercourses exploited for fishing

4. Conclusion

The assessment of inland fisheries in the prefecture of Tougué reveals a subsistence fishery that is structurally poorly equipped yet socially important. It involves 1,002 fishers, including 734 women, and 700 fishmongers and processors, including 687 women, with a fleet of 63 canoes, all of the dugout type. Five gear types are recorded — set net, trap, longline, conical net and hook — most of which are obtained from urban centres outside the prefecture. Six species belonging to six families are exploited, dominated by *Oreochromis niloticus*, the only local species regularly marketed.

The stakeholders are characterised by advanced age, long seniority and systematic pluriactivity. Catches per trip, between 2 and 10 kg, are low and declining according to the declarations collected. The small mesh size of the gear and the non-selective character of the traps exert pressure on juveniles and generate by-catch. The absence of a cold chain, poor road access and weak technical supervision further limit the valorisation of catches.

On the basis of these findings, the following measures are recommended: awareness-raising and vocational training programmes for fishers on sustainable fishing practices and on the regulations in force; support for the infrastructure of the sector (landing stages, markets, processing units) and the installation of cold rooms in the sub-prefectures where fishing is intensive; incentives for the adoption of selective gear and the modernisation of equipment; the introduction of aquaculture in order to domesticate the most vulnerable species and reduce pressure on natural stocks; and the strengthening of the human, material and logistical capacity of the prefectural directorate.

These results also call for further work, in particular standardised ichthyological sampling covering all hydrological seasons and regular statistical monitoring of landings, which alone can provide a reliable assessment of the state of the stocks.

Compliance with ethical standards

Acknowledgments

The authors thank the Prefectural Directorate of Fisheries and Maritime Economy of Tougué and the former prefectural director of fisheries, as well as the fishers, sellers and net makers of the sub-prefectures of Fatako, Kansangui, Koïn, Kollet and Konllangui, for their availability and for the quality of the information provided. This research received no specific grant from any funding agency.

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Statement of ethical approval

The present study did not involve any experimentation on human or animal subjects, nor any invasive procedure. It was based exclusively on non-invasive questionnaire surveys of consenting adult stakeholders and on the analysis of administrative archives; therefore, no formal ethics committee approval was required.

Statement of informed consent

Informed verbal consent was obtained from every person surveyed prior to the interviews. All data were processed anonymously.

Author contributions

All authors contributed to the conception and design of the study, to data collection and analysis, and to the drafting and critical revision of the manuscript. All authors read and approved the final version of the manuscript.

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