

Influence of Anthropogenic Activities on Surface Water Resources—Case of the Sub-Prefecture of Kamsar-Boké

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Abstract

Living fishery resources, although rich and important for human populations, are subject to strong anthropization, thus causing a change in the environmental parameters of aquatic ecosystems. These multiple combined pressures: chemical, hydro-morphological, thermal or trophic, affect and disrupt the functioning of aquatic organisms. The objective of this study was to assess the main human pressures influencing the surface water resources of the Kamsar sub-prefecture, in order to propose mitigation measures. The following methodological approach was adopted: 1) Survey of managers and analysis records; 2) Survey of stakeholders; 3) Assessment of the effect of human activities on surface water resources; 4) Data processing; 5) Corrective measures. The survey farmers working near aquatic environments, revealed a low use of chemical substances, in particular 3 to 11 kg of fertilizer and 0 to 3 boxes of herbicide on fields of 40 m² to 2 ha. Some physico-chemical parameters have been determined: Temperature (28.5°C, 23.7°C, 22.8°C, 21.3°C, 21.6°C), Salinity (26.9‰, 21.9‰, 21.5‰, 15‰, 15.3‰) and Turbidity (21.3 UTN, 19.3 UTN, 17.8 UTN, 16.7 UTN, 17 UTN). These values show a fluctuation in the environmental parameters of aquatic ecosystems, which constitutes an obstacle to the development and survival of the resources.

Keywords

Influence, Anthropogenic Activities, Water Resources

1. Introduction

The demographic expansion and economic growth experienced by the countries of the world, without overshadowing those in Africa, have serious consequences

on the environment. Thus, surface water resources are subject to strong pressure exerted by anthropogenic activities (agriculture, industry, livestock breeding, fishing, etc.). These anthropogenic activities of a socio-economic nature coupled with those of natural processes (soil erosion, evaporation, earthquake and volcanism) accelerate the degradation of surface water resources. They cause disturbances in the natural balance and increase the organic load of water and sediments, then the congestion of water resources with problems of eutrophication, asphyxiation of the aquatic environment as well as health problems of populations (Adjagodo et al., 2016).

In Guinea, all determined trends reflect the decline in coastal, maritime and oceanic resources due to anthropogenic activities aggravated by the effects of natural phenomena. The total biomass of pelagic resources estimated at nearly 135,000 tonnes in 1990 fell to around 80,000 or even 60,000 tonnes in 1993 (Richard et al., 2006). The Sub-Prefecture of Kamsar (Boké) is the seat of numerous anthropogenic activities (mining, deforestation, urbanization, fishing, agriculture, etc.) seriously affecting marine and continental biodiversity. These are the reasons which motivated the direction of our scientific research on the theme “Influence of anthropogenic activities on surface water resources—case of the Sub-Prefecture of Kamsar-Boké” in order to make our modest contribution to the safeguarding of water resources. To carry out this work, we followed the framework below:

Damages to aquatic biodiversity are the result of growing human demography and expanding economic activity, whose needs for renewable (fishing) and non-renewable (mineral) resources continue to increase. Man has thus become, along with climate and geological phenomena, one of the major factors affecting the biosphere and its processes.

2. Material and Methods

2.1. Material

Geographic location and population

Kamsar is one of the ten (10) Sub-Prefectures of Boké located 35 km southwest of the capital. It covers an area of 472 km² with a population of 356,200 inhabitants. The main ethnic groups are the Yolas, the Nalous, the Peuls, Landoumas, Bagas and Soussous. This population is growing following the development of mining and fishing activities. This demographic growth promotes an increase in demand for fishery products, overcrowding of the coasts and consequently, human pressure on aquatic environments, thus causing the disappearance of certain species in surface water (Ministry of Planning and Cooperation, 2014).

The Sub-Prefecture of Kamsar as shown in **Figure 1** and **Figure 2** is limited

- To the east by the sub-prefecture of Kolabouji;
- To the west by the Atlantic Ocean;
- To the North by the Rio Nunez and the sub-prefecture of Kanfarandé;
- To the south by the sub-prefecture of Bintimodia.

The equipment used is listed in **Table 1**.

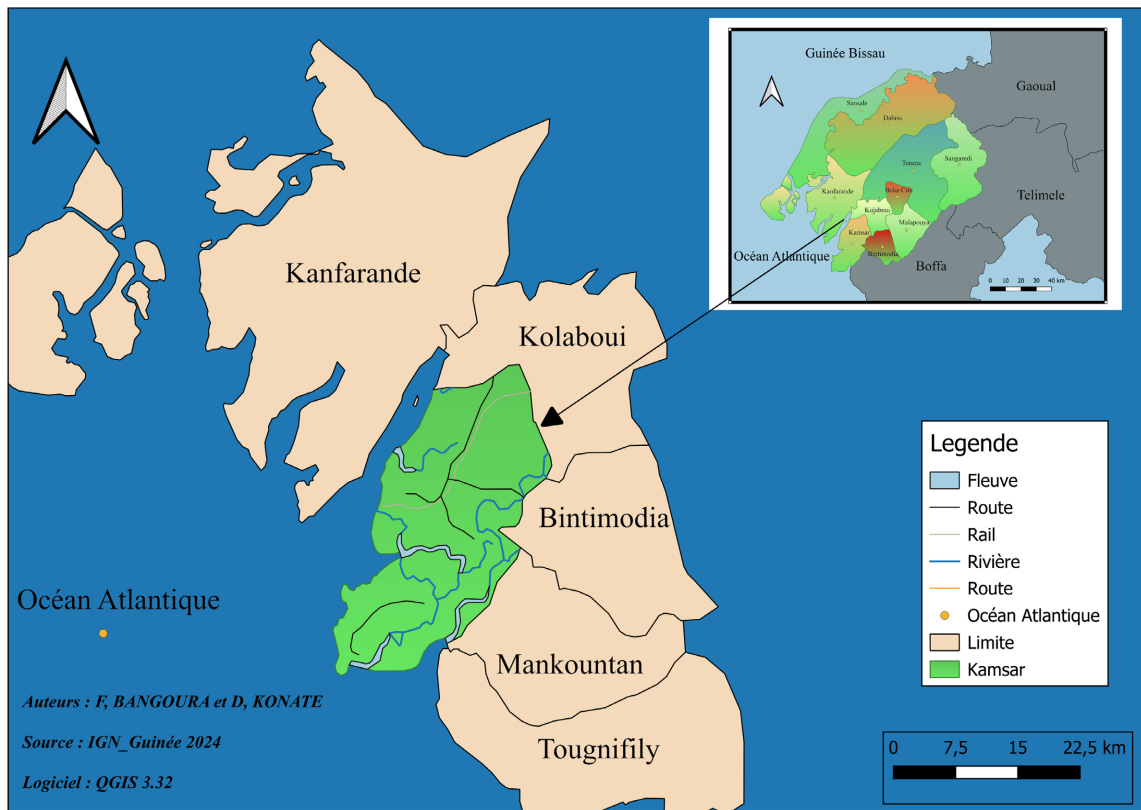


Figure 1. Map of the kamsar sub-prefecture.

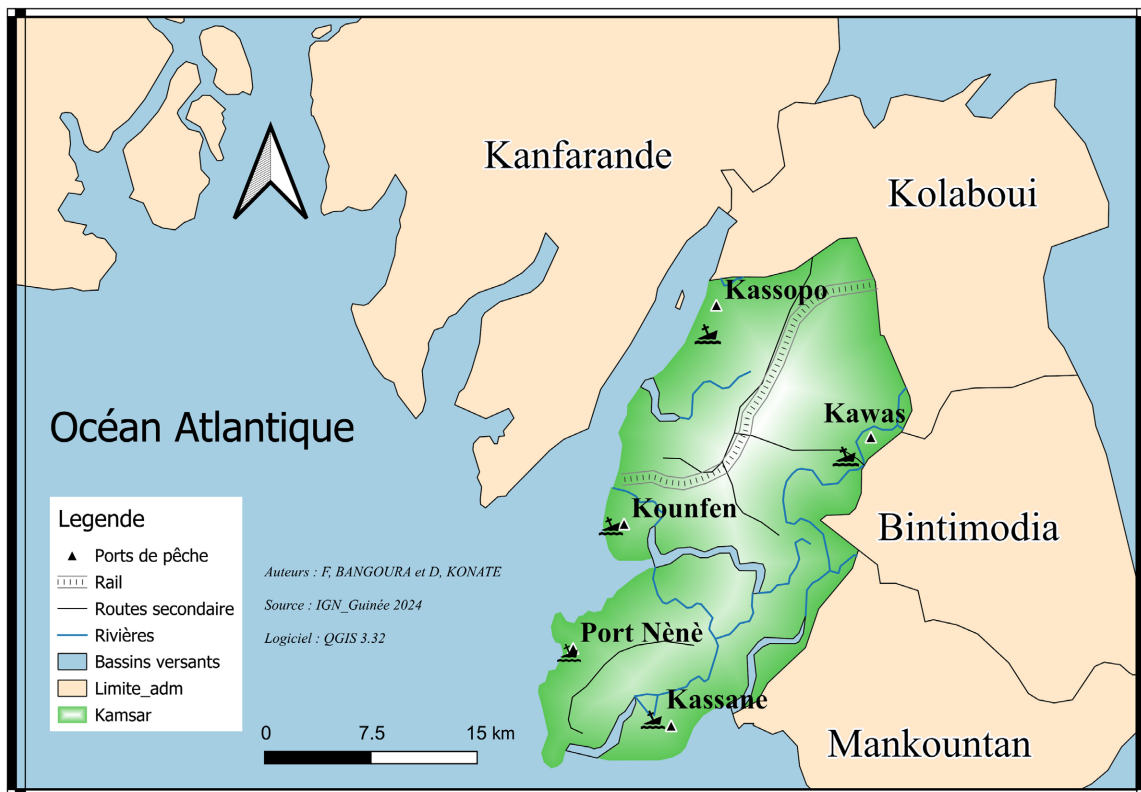


Figure 2. Map of the study area.

Table 1. Material used.

No.	Designation	Quantity
Biological material		
	Fish (individuals)	191
Physical material		
1	Survey sheets	151
2	GPS (Garmin)	1
3	Safety jacket	1
4	Identification guide	1
5	Refractometer	1
6	Secchi disk	1
7	Sounder	1
8	Centimeter	1
9	Boats	3
10	Camera	1
11	20 kg lockers	10

2.2. Methods

The objective of this study was to evaluate the main human pressures influencing the surface water resources of the sub-prefecture of Kamsar, in order to propose mitigation measures.

The following methodological approach was adopted: 1) Survey of executive's and analysis archives; 2) Survey of stakeholders; 3) Assessment of the effect of anthropogenic activities on surface water resources; 4) Data processing; 5) Corrective measures.

To understand the subject, several investigations were carried out among executives, fishermen, smokers and lumberjacks. The interview with executives was the first activity in the field, it was marked by collective and individual interviews with executives of the Prefectural Directorate of Fisheries and Maritime Economy and those of the Prefectural Directorate of the Environment and Sustainable Development of Boké. These interviews focused on the types of boats and gear used, the main anthropogenic activities and the fishery resources landed. The archives of the different directorates were analyzed to know the evolution of catches and the number of boats in order to measure the extent of anthropogenic activities on the surface waters of the study area.

Through survey sheets, a total of 77 fishermen were interviewed. The questions related to the types of boats and gear used, the effective fishing effort, the techniques applied in the event of fishing net overload, the presence or absence of juveniles in the catches, the disappearance or rarity of certain species of fish, the destination of used nets, the health status of fisheries including the yield of

fishing activities and the difficulties encountered.

From a sample of 36 smokers surveyed, information relating to the quantity of fish smoked, the types, quantities and origin of wood used for smoking.

Loggers from the different study areas were individually and collectively interviewed about logging activity. From the survey sheets, 51 loggers answered questions related to the types of wood cut, the frequency of cutting, the weight and number of poles cut per day as well as the use or destination of the cut wood.

As for farmers operating along watercourses, questions relating to the area of cultivated fields, the types and duration of crops, as well as the use of phytosanitary products. These investigations concerned 29 farmers in the study area.

At the end of the field surveys, some physicochemical parameters (temperature, salinity and turbidity) of the water were determined (*in situ*), in order to highlight possible anthropogenic modifications occurring in these aquatic ecosystems.

The temperature was determined on board a boat using a depth sounder. We immersed the fishfinder in the water about 15 cm, then we pressed its single button and waited 5 to 6 seconds before removing it to read the result. This action was repeated three times at different times of the day before averaging the values found.

Salinity was measured through a refractometer and a graduated pipette. We took 2 ml of water using a graduated pipette, lifted the lid and put the water on the flattened end of the refractometer before closing it. Then we placed the eye on the eyepiece of the device before pointing it at the sun to read the results. The same method was applied at the three stations of each study site and in the same way as the temperature.

The determination of turbidity was made using a Secchi disk associated with a centimeter for taking measurements. The following technique was used, we vertically immersed the Secchi disk in the water holding it through its rope, until its white bands completely disappeared, then we removed it until their reappearance before to take measurements of the submerged portions of its rope and take their average. The metric values obtained are expressed in Nephelometric Turbidity Unit (NTU), knowing that 250 cm = 1 NTU, 158 cm = 2 NTU, 120 cm = 3 NTU, 99 cm = 4 NTU, 85 cm = 5 NTU, 53.4 cm = 10 NTU, 32 cm = 20 NTU, 21 cm = 30 NTU, 20 cm = 40 NTU, 17.9 cm = 50 NTU, 11.5 cm = 100 NTU, 7.3 cm = 200 NTU. Just like the two previous parameters, turbidity was determined at different times of the day to average the values found. Then, a summary of anthropogenic activities on water resources in the study area was made.

3. Results and Discussion

The survey of executives and analysis of archives to be revealed that the main anthropogenic activities affecting fisheries resources are enormous and pose real threats to surface water resources, **Figures 3-6** are illustration.

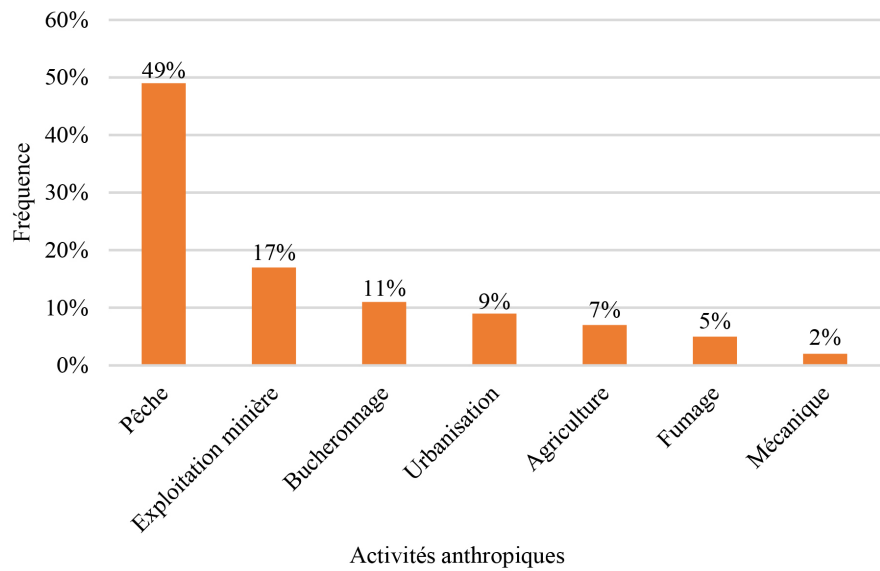


Figure 3. The main anthropogenic activities by degree of threat.

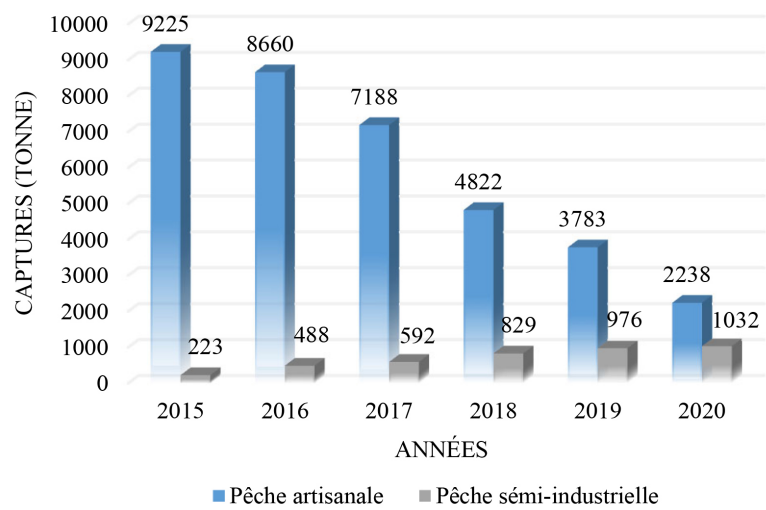


Figure 4. Evolution of catch rates (2015-2020).

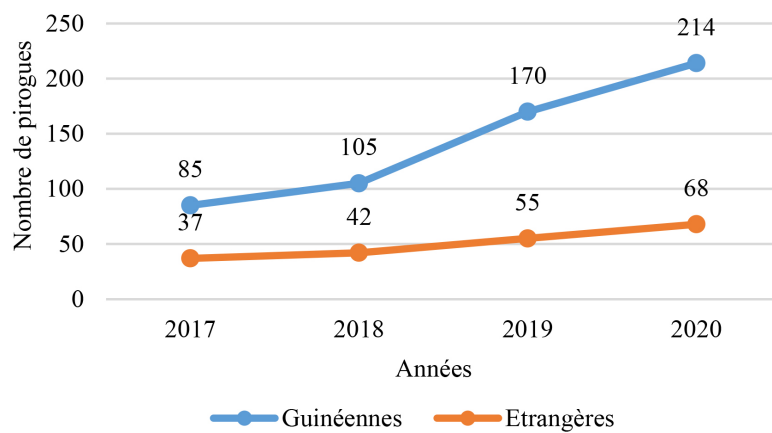


Figure 5. Evolution of the canoe fleet (2017-2020).

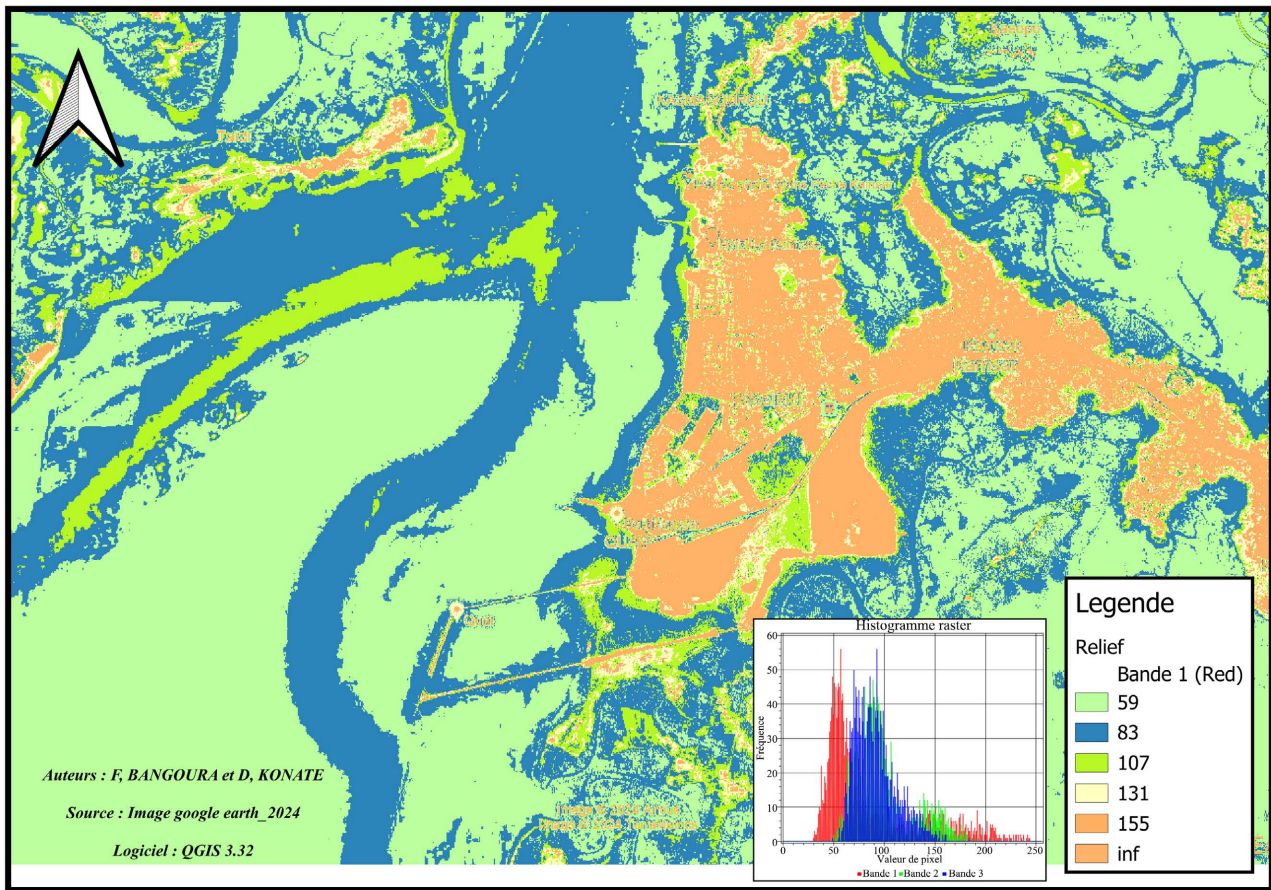


Figure 6. Maps of the decrease in vegetation cover in Kamsar over recent decades.

The analysis of these figures reveals a clear evolution of the Kamsar pirogue fleet, the number increased from 85 in 2017 to 214 in 2020 for Guinean boats and from 37 in 2017 to 68 in 2020 for foreign boats, making 776 boats. Our results are different from those found on the Guinean national scale by the CNSHB in 2005, from 2000 boats in 1993 to 3636 in 2003.

During this archival analysis, a sharp decrease in plant cover in the Kamsar Sub-prefecture was noted. The illustrative figures of this reduction are mentioned in **Figure 6**.

The stakeholder survey

Our surveys with the various stakeholders revealed that in Kamsar, fishing activities take place in the coastal zone and offshore. The results obtained are shown in **Figures 7-12**.

Determination of some physicochemical parameters of water

We notice from **Figure 13** that the temperature varies from 28.5°C to 21.3°C in the waters of Kamsar. These figures are below the WHO standard of 30°C. Our results are different from those obtained in France by Maelle, R in 2008, which varies from 15.22°C to 17.20°C and those obtained at Lake Nokoué by (Akotossode et al., 2018), varying from 25.9°C to 17.20°C. 26.4°C. This dissimilarity in our results would be due to the presence in our study area of mining

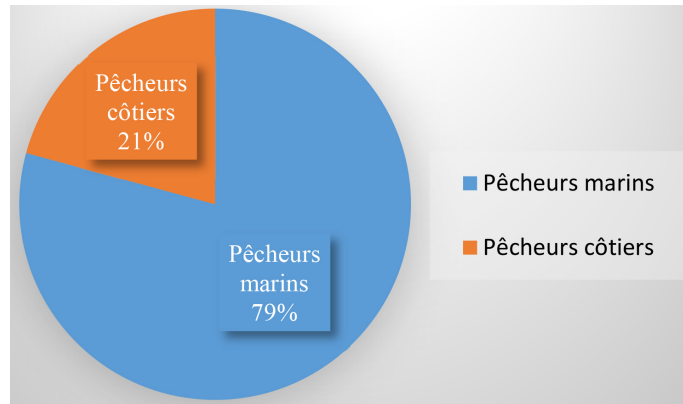


Figure 7. Distribution of fishermen according to fishing zone.

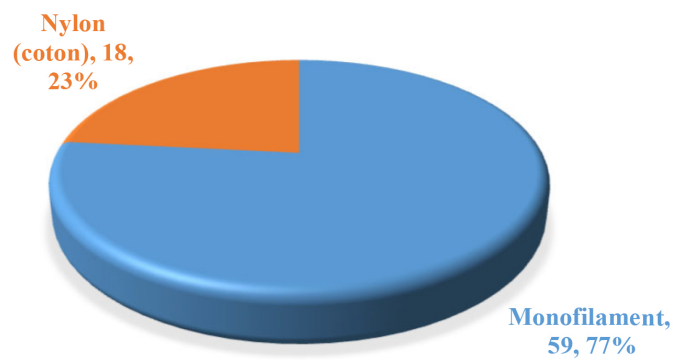
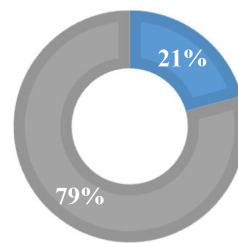


Figure 8. Types of net depending on composition.



■ Transfert du filet ■ Coupure et rejet en mer

Figure 9. Technique used in case of fishing net overload.

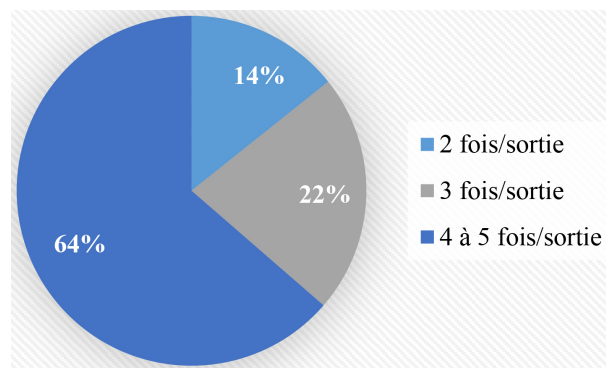


Figure 10. Destination of worn threads.

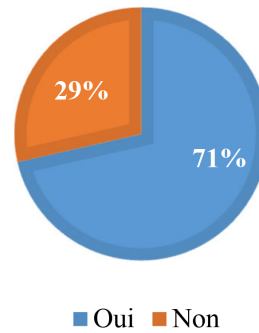


Figure 11. Presence of juveniles in the captures.

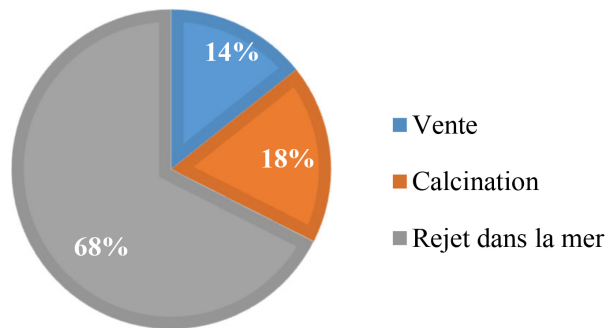


Figure 12. Analysis of effective fishing effort.

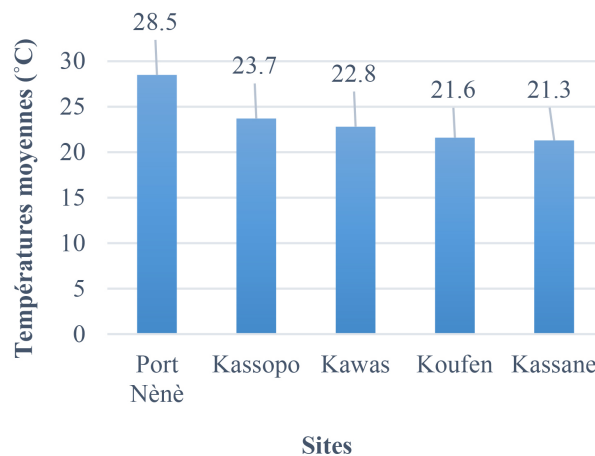


Figure 13. Temperature variation.

companies, discharging hot water from bauxite leaching activities in the processing plants. However, a huge fluctuation in temperature could negatively affect the biotic factors (feeding, reproduction, etc.) of living fisheries resources, which are conditioned by it.

The analysis of Figure 14 shows us respective average turbidity values of 21.3 to 16.7 NTU which are all higher than the standard accepted by the WHO which is 4 NTU. Our results are lower than those found in the same area of Kamsar by (Kane, 2014) varying from 11.4 to 30.4 NTU and significantly higher than those obtained in the lagoon of Porto-Novo and Nokoué by Vodougnon, M in 2015,

mentioning 0.1 to 0.26 NTU and 0.2 to 0.6 NTU. This dissimilarity in our results could be explained by the presence in our study of ore transport boats frequently dumping bauxite during transport, and coastal pollution due to the absence of dumpsites. However, high turbidities are accompanied by low light penetration, and therefore a reduction in the quantity of oxygen, which can negatively affect surface water resources.

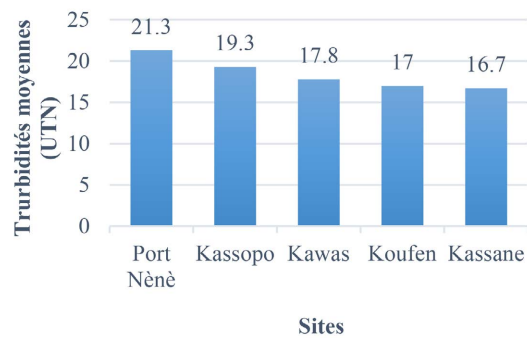


Figure 14. Variation of turbidity.

It appears in **Figure 15** that the salinity varies from 26.9‰ to 15‰, which is lower than the standard accepted by the WHO, which is 35.8‰. Our results are mostly higher than those found at Lake Nokoué and Porto Novo by (Akotossode et al., 2018) which are 2.3‰ to 16‰ and 2‰ to 3‰. This dissimilarity of our results would be due to the nature of the study environments including both the marine and continental environments in our case. The high salinity observed in the waters of Port Nènè could be explained by the presence of warm waters with a high capacity for dissolving salt thanks to their high temperatures. However, a strong variation in salinity has consequences on the life of fish species, particularly “stenohaline” species incapable of withstanding high salinities.

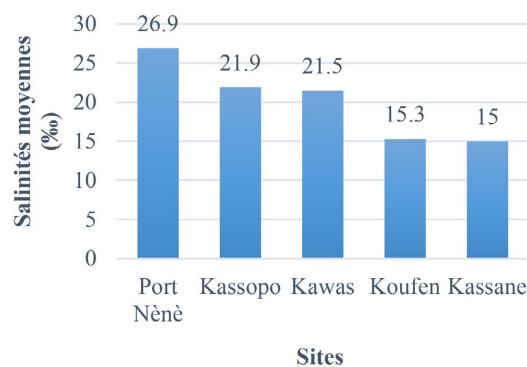


Figure 15. Variation of salinity.

Recapitulation anthropogenic activities carried out in Kamsar

To better highlight the anthropogenic influences on the water resources of the Kamsar Sub-prefecture, we have summarized the main anthropogenic activities and their effects on aquatic fauna. Details of this activity are shown in **Figure 16**.

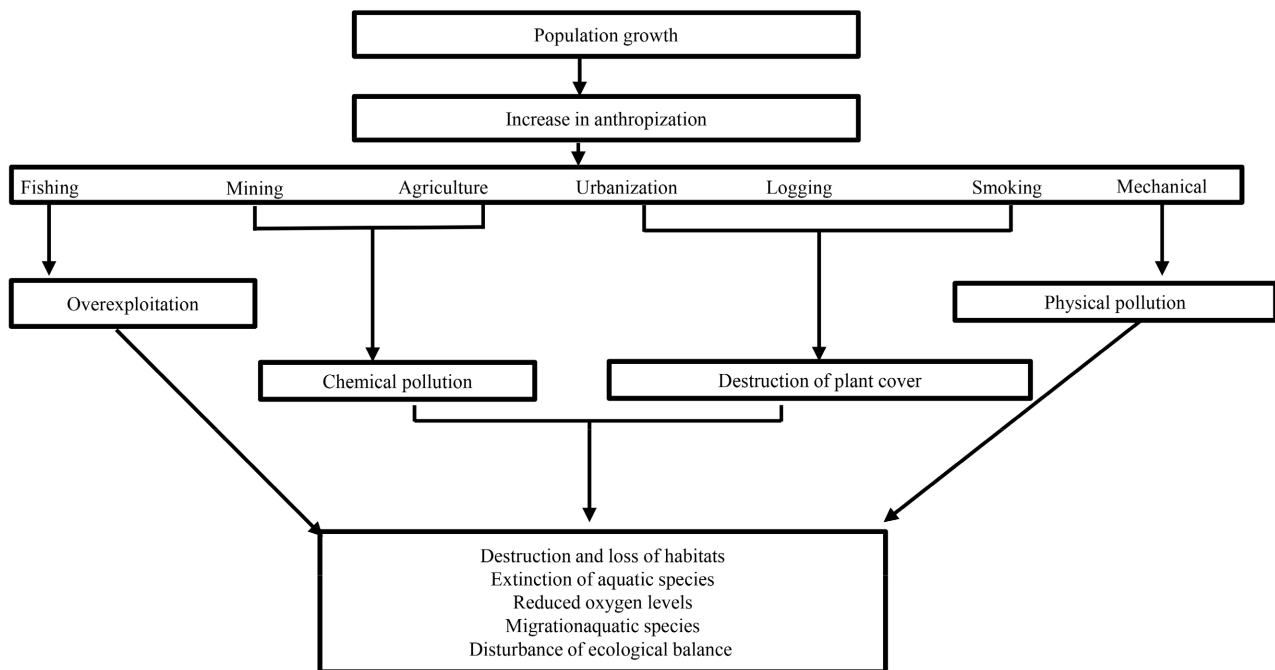


Figure 16. Summary of anthropogenic activities carried out in Kamsar.

4. Conclusion

At the end of our scientific research work on the theme “Influence of anthropogenic activities on surface water resources—case of the Sub-Prefecture of Kamsar-Boké”, the results obtained from executives revealed to us that anthropogenic activities weighing on water resources are, among other things, fishing, mining, logging, uncontrolled urbanization, agriculture, smoking and mechanics. All these activities pose real threats to surface water resources. Analysis of the archives showed a drop in catch rates in artisanal fishing, which could be, explained by destruction of spawning grounds, coastal pollution, semi-industrial fishing, and mining.

Surveys of anglers revealed that in Kamsar, fishing activities are carried out in the coastal zone and offshore with a rich and varied fishing potential, including fish, crustaceans and molluscs, most of which are reported rare, in endangered or extinct, this is the case of *Pristis*. The main net used is monofilament due to its low cost compared to cotton net and its non-biodegradability, we have also noted that a large number of fishermen pollute the sea by directly throwing away used fishing nets, which increases ghost fishing and the capture of immature individuals. The main ones Types of wood exploited are *Rhizophora mangle*, *Avicennia germinans*, *Lagunlaria racemosa* and *Mangifera indica* from mangroves, islands and humid forests. As for farmers, the use of chemical substances has been noted but at low doses. The results of the measurement show that the vast majority of individuals are captured before their first reproduction; this is the case for example *Dentex gibbosus* with a total absence of mature individuals in the sample. This clearly proves the negative effects of fishing gear on pelagic re-

sources, which collapse overnight. The determination of some physicochemical parameters of the water showed high values of temperature, salinity and turbidity for the Port Nènè area, which could be explained by the intensification of anthropogenic activities negatively affecting water resources.

To remedy this, we suggest the following mitigation measures,

✓ In the state

Raise awareness among the population about environmental protection; build garbage recycling plants; ban uncontrolled coastal construction; ensure the rational exploitation of fishery resources and ensure the responsible exploitation of bauxite to mitigate the harmful effects on water resources;

✓ To the fishermen

Avoid the use of monofilaments and other prohibited devices;

Avoid fishing activities in spawning grounds;

✓ To the local population

Avoid the discharge of domestic waste into the sea;

Avoid uncontrolled construction on the coast.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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