Scientific Research Publishing

Open Journal of Applied Sciences, 2026, 16(3), 927-949
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

Evaluation of the Socio-Economic and Environmental Contributions of the Improved Artisanal Landing Site of Kaporo in the Urban Commune of Ratoma (Republic of Guinea)

Nounténin Sidimé[1], Fatoumata Sylla[2,3], Amadou Sylla[4,5], Adama Moussa Sakho[4], Amara Kourouma[5], Karim Camara[6], Amadou Koré Bah[6], Kandet Bangoura[1]

[1]Guinea Maritime and Coastal Research Centre (CEREMAC-G), Conakry, Republic of Guinea
[2]Center for Environmental Studies and Research (CEER), Gamal Abdel Nasser University of Conakry, Conakry, Republic of Guinea
[3]Telecommunications Laboratory of the Polytechnic Institute, Gamal Abdel Nasser University of Conakry, Conakry, Republic of Guinea
[4]Department of Laboratory Technology, Higher Institute of Technology, Mamou, Republic of Guinea
[5]The Non-Governmental Organization, Guinea Ecology, Conakry, Republic of Guinea
[6]Department of Economics and Management, University of Kindia, Kindia, Republic of Guinea
Email: sidimlovesako2023@gmail.com

How to cite this paper: Sidimé, N., Sylla, F., Sylla, A., Sakho, A.M., Kourouma, A., Camara, K., Bah, A.K. and Bangoura, K. (2026) Evaluation of the Socio-Economic and Environmental Contributions of the Improved Artisanal Landing Site of Kaporo in the Urban Commune of Ratoma (Republic of Guinea). *Open Journal of Applied Sciences*, **16**, 927-949.
https://doi.org/10.4236/ojapps.2026.163055

Received: February 12, 2026
Accepted: March 20, 2026
Published: March 23, 2026

Abstract

The study conducted in this work reveals the important role that the Kaporo landing stage plays in the local economy through various income-generating activities such as fishing, sale of firewood, fish smoking, small businesses and other actors in the value chain (such as transporters, equipment suppliers, credit agents, ice sellers, retailers, etc.), despite inadequacies in infrastructure and management. However, observable environmental impacts and analysis of the physicochemical parameters of water and soil samples from the site reveal signs of environmental pressure linked to human activities, highlighting the urgent need for sustainable management and better supervision of activities. Earn without destroying the ecosystem.

Keywords

Improved Artisanal Landing Site, Kaporo, Global Impacts, Sustainability

1. Introduction

Fishing activities are an ancient practice dating back almost 40,000 years, which has become nowadays an income-generating activity for many countries While making

a significant contribution to the economy of these countries [1]-[4]. Estimation of the World Bank on production of sea products, passed from 19 million tonnes in 1950 to 179 million tonnes in 2018, compared to a slight annual decrease of 1% observed in 2019 and another slight increase of 0.2% in 2020 [5]. The landing stages in African countries, particularly the Republic of Guinea, provide immense resources to the socio-economic environment of the countries and the riparian populations, where economic and social activities intersect. However, the real concern of these developing countries would be the overexploitation of their fishery resources in certain places and in right places, the impacts caused by human activities on the natural environment namely: deforestation, water pollution, uncontrolled urbanization, growing industrial development, etc. [6]-[9]. The Republic of Guinea, a country in West Africa, is a coastal country with 300 km of Atlantic coastline with a maritime geography marked by several essential elements, namely: the Atlantic coast, ocean currents, sandy beaches, vast expanses of plains with vegetation and coastal areas covering 15% of the total area, *i.e.* 36,200 km^2 etc. 70% of this area, it has an approximate depth ranging from 0 to 40, which gives it easy access to geological resources [9]. Its climate is tropical, with rainfall varying from 1300 to 4000 mm (Upper Guinea and coastal regions) in July and August, maximum humidity of 80% to 85% with temperatures between 20˚C and 36˚C [10]. Coastal fishing in the landing stage (improved or unimproved) is one of the main and most important sectors of the national economy. Its contribution to GDP was estimated at 6% and the issuance of fishing licenses brought in more than 13 billion francs to the national economy in 2018 [9]. Its contribution to food security was estimated at 21.5 kg of average consumption Per habitat between 2009-2018. The added value generated by Guinean fishing between 2009-2018 was estimated at 3195 billions GNF, of which 2210 billion GNF was an annual average [11]. This economic potential brought by Guinea's landing stage in terms of fishing alone could be optimized if the authorities put in place strategies and actions to reorganize, in order to address or improve the needs current unmet of all landing stages located in Guinea, in order to optimize sites activities. For the present case of the improved landing stage of Kaporo, the necessary missing facilities among others are: ice production device, electric fish smoking device, water drainage systems, drinking water points, clear signage and information panels, weighing and quality control system, means of communication (telephone, internet), etc. Although commitments of modernization of all the landing stages in Conakry have been underway for several years, the beneficiaries of this program, including the Kaporo landing site, currently experiencing a shortage of essential equipment. This insufficiency of equipment can mitigate or compromise local economic development, the working conditions of users, the sanitary quality of fishery products and the sustainability of activities carried out on these landing stages [12]. Thus, this study aims to understand the functioning, the economic and social contributions made to the local population and the impact on the environment of the improved artisanal landing stage of Kaporo in the urban commune of Ratoma (Republic of Guinea). To do this, the evaluation will be carried out in the form of surveys

of users and authorities in charge of managing this landing stage with questionnaires on the environment, economic activities of the site sale of fish, processing (smoking, drying, trade in wood, small businesses namely: sale of food, equipment etc.) previously established. This assessment will help to understand the overall functioning of the site and its economic activities, in order to help public decisions in the training of stakeholders within a sustainable development framework.

2. Materials and Methods

2.1. Presentation of the Study Area

This study was conducted at the Kaporo landing stage in the urban commune of Ratoma, Conakry region (Republic of Guinea) (**Figure 1**). The commune of Ratoma is bordered to the north by the seashore, to the east by the Démoudoula River, to the south by the Leprince road, and to the west it is bordered by the sea inlet at Hamdallaye near the pier bridge. It presents a climate of type Aw according to the Köppen classification, an average annual temperature of 27.3˚C with rainfall of approximately 1429.8 mm per year [13]. A map of the site was developed using satellite images (Landsat 5 and 8) and open geographic data, georeferenced under WGS 84 (UTM zone 28N) (**Figure 1**).

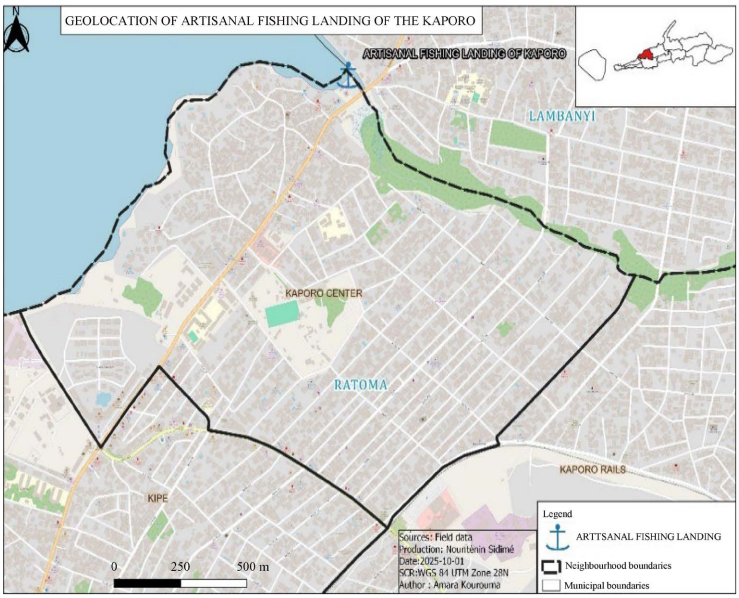


Figure 1. Shows the geolocation of the Kaporo landing stage. *Source*: *Field data*, *Production*: *Nountenin Sidimé*, *Date*: 2025-09-25; *SCR*: *WGS*84 *UTM Zone* 28 *N*, *Autor*: *Amara Kourouma*.

2.2. Description Methods of Use Lands between 1994 and 2025

Types of land use were analyzed from Landsat 5 (1994) and Landsat 8 (2024) satellite images, in using QGIS software and coupled with classification supervised by the Orfeo toolbox [14]. Four classes were defined: built-up area, vegetation, water body, and bare soil. Using a confusion matrix and field data collected by

GPS, the classification accuracy was evaluated and resulted in an overall accuracy rate of 87%. This made it possible to identify the evolution of deforestation and the expansion of urban areas around the artisanal landing stage, represented by the figure (Figure 2). Some activity points practiced within the landing stage are shown in Figure 2 and Figure 3.

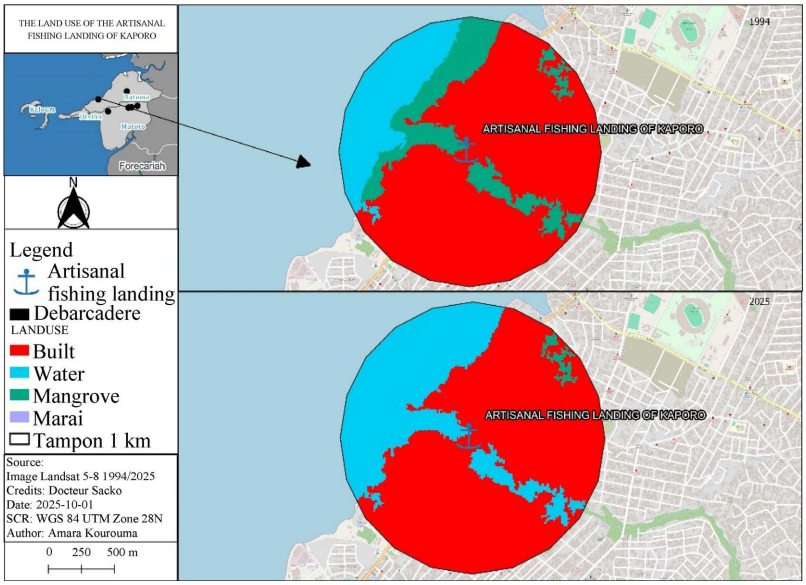


Figure 2. Shows destruction of the mangrove around of landing stage of Kaporo between 1994 and 2025.

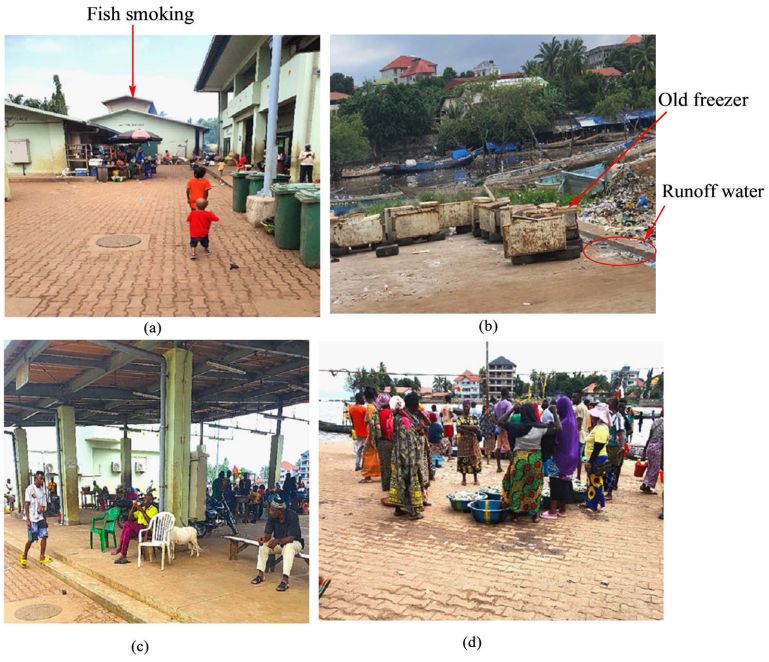


Figure 3. Showing (a) fish smoking; (b) old freezer and runoff water; (c) sheds intended for the repair of fishing nets and other small fishing equipment, with the frequent presence of motorcycles and animals and (d) manipulation and marketing of seafood products in the Kaporo landing stage.

2.3. Survey Data Collection Methods

A total of 90 people were surveyed using questionnaires defined. These respondents, came from different groups (fisher, fishmongers, traders, transporters, local authorities and administrative, households, elderly people, users or local economic actors, passers-by, visitors, quantitative sampling of 90 respondents), were selected using a purposive sampling method, making it possible to target the main actors involved in the site's activities Fishermen represented 80%, followed by wood merchants (10%), Women smokers fish (5%) and small business (5%). In addition, semi-structured interviews were conducted with local authorities and community leaders. Direct observation of the site made it possible to assess the state of the infrastructure, environmental practices and socio-economic dynamics. Data collection on the improved artisanal landing stage of Kaporo in the urban commune of Ratoma was carried out between May and August 2025, focusing on three main types of evaluation:

➢ ***Ecological assessment***

Based on the observation and identification of types of pollution on natural resources, water quality, soil and biodiversity.

- Methodes used:
- Direct observations of environmental practices (discharges, waste, etc.)

❖ ***Physico-chemical analyses of seawater and soil sample***

(*allow to better understand the environmental state of the landing stage, in order to ensure on the quality of fishery products which is one of the determining factors in the commercial value of fishery products and provided support for the sustainable management of the site.*)

- **Methods used**

A total of six (6) soil samples (3) and water samples (3) were collected on three sites and carefully stored in polyethylene zip-lock bags (soil samples) for the following parameters: (pH, COD, NPK, heavy metals (Pb, Cd, Hg, etc.), temperature, conductivity, turbidity, BOD) and (texture, structure, moisture content, organic matter for soil), CEC, as well as in sterilised 500 mL polyethylene bottles (water samples), then kept in an insulated cooler equipped with a control thermometer and convey to the laboratory. Transport did not exceed six hours to ensure the integrity of the analysed parameters. The geographical coordinates of the sites were recorded using a portable GPS device (accuracy ± 3 m).

➢ ***Water sample***: water sampling at a depth varying between 20 and 30 cm below the surface, away from visible sources of pollution.

***Site* 1.** Landing points for seafood products: Latitude: 9.616316; Longitude: 13.644168.

***Site* 2:** (E2) Canoe parking dock (9.616244˚N, 13.641855˚W).

***Site* 3.** 50 metres from the quay: Latitude: 9.61586; Longitude: 13.643577.

➢ ***Soil samples***: collected at a depth of 10 to 20 cm in staggered using a trowel.

Site 1. (E1) Woods storage: Latitude: 9.615824; Longitude: 13.641966.

***Site* 2. (E2)** *Canoe parking dock:* Latitude: 9.616244; Longitude: 13.641855.

***Site* 3. (E3)** At 50 metres from the landing stage: Latitude: 9.615801; Longitude:

−13.64293.

The samples were collected on Monday, 25 August 2025, during the heavy rainy season, taking into account their exposure to anthropogenic pollution sources and tidal conditions, which depend on the height and strength of the water current at a given time, in order to ensure the comparability of measurements and assess environmental conditions. The tide levels recorded were: low tide at 02:57 (0.67 m), high tide at 09:01 (3.80 m), low tide at 15:19 (0.65 m) and high tide at 21:19 (3.55 m). Data from replicated samples were expressed as mean ± standard deviation, and variability between sites was assessed using appropriate statistical analyses, with a significance threshold set at $p < 0.05$. The results of the physicochemical analysis of the water sample were expressed as mean ± standard deviation with three samples ($n = 3$) in order to assess the dispersion of the measurements around the mean and to find analytically consistent results.

- ***Sampling* (*water and soil*)**
- *Materials used*

- Sterile bottles (500 ml).
- Gloves, labels, cooler containing a thermometer.
- Stainless steel trowel and a crowbar for digging the ground.
- Polyethylene zip bags.

- *Protocol* (*water sampling*)

Collect between 20 and 30 cm below the surface of the water, away from the visible source of pollution.

- Rinse the bottle twice with the water to be sampled.
- Seal tightly and label with: (place, date, time).
- Keep cool (4˚C) and then transport to the laboratory within 6 hours.

- *Protocol* (*soil sampling*)

- Scrape the first 2 - 5 cm.
- Sampling at a depth of 10 - 20 cm.
- Staggered sampling or composite (mixing several points).
- Air dry or analysed immediately.

❖ ***Assessment of the physical condition and functioning of existing infrastructure and equipment.***

- **Methods used**

Direct observation of the presence of buildings, ice manufacturing unit (preserving fish products), docks, conveyors, cranes, toilets, latrines, rubbish bins, store or warehouse for the storage of fishing equipment, garage for maintaining propulsion engines for dugout canoes, Water supply or access to drinking water, availability of equipment such as gloves, tables, hairnets, etc.

- ***Socio-economic assessment***
- *Objectives*

Identify economic agents (fishermen, women fish smokers, wood sellers, small businesses, etc.); measure income and value added by the activities of the landing stage; measure the effects on living conditions, employment, income, food security and methods of handling seafood products, access to infrastructure, etc. To

do so, questionnaires in the form of very specific interviews have been raised to the respondents, the different groups of users who are: (fishermen, fishmongers, traders, transporters, local and administrative authorities etc.) according to a reasoned sampling method on: Collection, method of perception and analysis of income and prices of fish. Fishermen were the most numerous, that is: 80% of the sample, followed by wood sellers (10%), women fish smokers (5%), and other small traders (5%). The visit, based on direct observation of the site, allowed us to assess the existence and condition of infrastructure, environmental practices, and socioeconomic dynamics.

3. Results and Discussion

3.1. Results

Observations of the improved landing stage of Kaporo in the urban commune of Ratoma (Republic of Guinea) showed the following results:

3.1.1. Current State of the Kaporo Landing Site

❖ *Ecological assessment*

Sources of pollution have been observed as: direct discharge of all types of solid or liquid waste (polystyrene frequently found in packaging such as food trays, plastic cups, etc.). Expanded polystyrene (EPS) or polystyrene foam, also known as Styropor or Styrofoam, are melted by fishermen to be used in the restoration of canoes, maintenance of canoe outboard motors and other fishing equipment (nets), the rest is directly dumped into the water, contributing to the degradation of marine habitats [11] [12]. Greenhouse gas emissions (carbon dioxide CO_2) linked to traditional fish smoking using combustible wood has been observed within the improved Kaporo landing stage (**Figure 3(a)**) sustainable practice observed is very low, Old visible refrigerators (**Figure 3(b)**), visible presence of animals (**Figure 3(c)**), seafood products are handled on bare ground (**Figure 3(d)**), old flies abandoned, etc., sale of wood on site, repair of fishing nets and other fishing tools on the ground outside the designated shed **Figure 3(c)**, etc.

❖ *Electronic waste: a growing environmental threat on the site*

The increasing use of electronic devices (mobile phones, solar lamps, freezers, batteries, chargers, radios, etc.) by users in their daily activities at the landing site is beginning to produce another type of electronic waste, such as old solar lamps, mobile phones, out of use refrigerators displayed at the site (**Figure 3(b)**), etc. These out-of-use items are abandoned or thrown away without proper treatment, due to the lack of a suitable collection or recycling system, can constitute a high ecological risk to soil quality, runoff water flowing into the sea (**Figure 3(b)**), and the health of users through the toxic substances they contain. Thus, the need to integrate specific management of sorting, collection and recycling of this waste could be an alternative for protecting the local environment, while creating new economic opportunities in the locality.

❖ *Trend of Attendance and circulation within the landing stage*

Daily observation of the operation of the Kaporo landing stage shows a high

level of activity, with nearly 150 pirogues on average docking each day and a constant flow of economic actors (fishermen, women smokers, wood sellers, small traders, etc.). This movement causes heavy traffic of fish products, firewood and various goods, transported mainly on foot, by motorcycle or using tricycles. During peak hours, the saturation of spaces is visible, slightly slowing down the activities of unloading, smoking fish and marketing. This observation demonstrates the insufficiency of the reception infrastructure and highlights the need to rethink the site's layout to ensure fluidity and sustainable operation of the site.

- ***Assessment of the physical condition and functioning of existing infrastructure and equipment***

Buildings for administration, sheds for repairing fishing equipment, area and traditional fish smoking sheds using firewood by women smokers, garbage disposal shed (Figure 3 and Figure 4), outboard motor maintenance garage, pay toilet, quays, access ramp for canoes, the circulation area in the landing site is fitted with a floor covering made of modular tiles laid on stabilized ground is present. Electric smoking units, ice-making or storage devices for preserving fish products, conveyors, cranes, cold rooms for seafood preservation, signage boards, hygienic processing tables or equipment, shops or warehouses, sales halls, kiosks or retail markets, weighing and packaging equipment, etc., are absent.

Figure 4. Showing the shed designated for waste disposal.

- ***Policies and regulations*** (navigation laws): to hold a fishing license, ban on fishing certain species during the breeding season, strict regulation on the types of nets allowed to prevent overfishing, safety and hygiene at work, and fair access for all stakeholders to equitably use the infrastructures, collective maintenance of the landing stage, specific regulations on opening hours and disembarkation, prohibition of certain practices: waste discharge into water,

regulations on collective maintenance of transformation areas, sale of wood, parking of pirogues, small businesses with penalties for non-compliance, participatory management involving users, Presence of regulatory documents, without real application or impact.

❖ ***Management model of the landing site or governance***

The management model observed at this landing site is an administrative management model or passive fiscal management. The governance of the landing stage is centralized on taxation and ensured by administrative structures of the Guinean state, namely: ministry of Fisheries and maritime economy and the maritime navigation agency, represented by a directorate composed of a Director, a Deputy Director General and a port responsible. The state acts as a fiscal regulator, without any real coordination or direct involvement in the operational management of the landing stage, or support for local stakeholders, development, maintenance, or sustainability of the site. It is limited only to the collection of taxes on: (navigation permits, driving licenses and fishing operation manifests) which is a mandatory administrative document for the authorization to exploit fishery resources in a designated fishing area for fishermen. Obtaining it is conditional upon the payment of a tax.

❖ ***Governance***

- Presence of a landing stage management committee composed of a representative of the landing stage users, and the general management of the landing stage.
- Internal regulations or code of conduct, absent.
- Stakeholder participation in decision-making is absent.
- Lack of transparency in revenue and infrastructure management.
- Presence of a youth structure responsible for resolving conflicts.
- Implementation of national fisheries policies, absent (site at risk in terms of resource sustainability). This can encourage overexploitation, environmental degradation, or illegal fishing.

✓ ***Type of tax collection observed at this landing site***

- Annual tax collection.

✓ ***Economic aspects***

❖ ***Taxed activities***

- Navigation permits, pirogue driving permits, and fishing operation manifests.
- Taxes on the fish smoking area at the landing stage.
- Taxes on the transit and sales areas of firewood.
- Taxes on service recipes (such as toilets, showers, rental of space for catering, other small businesses, etc.).

❖ ***Who is responsible for tax collection*?**

- Collection agents from the Ministry of Fisheries and Maritime Economy and the Maritime Navigation Agency (ANAM).

❖ ***Mode of perception***

- Direct payment by operators (fishermen, smokers, shopkeepers, toilets, show-

ers, etc.) with payment receipt.

❖ ***Is there any revenue sharing or retrocession from the Ministry of Fisheries and Maritime Economy or the Maritime Navigation Agency (ANAM) after tax payments?***

- No retrocession from the Ministry of Fisheries and Maritime Economy or the Maritime Navigation Agency (ANAM) after payment of taxes. Retrocession planned for the maintenance or development of landing stages (cleaning, safety, repairs, infrastructure construction).

3.1.2. Socio-Economic Contribution of Activities or Simulation of the Local Trade Balance

The results of our socio-economic assessment surveys showed that the improved artisanal landing site of Kaporo, in the urban municipality of Ratoma, contributes significantly to the creation of direct and indirect jobs in the municipality, with an average of 150 canoes available and 25 days of activity per canoe. The 75 local stakeholders (qualitative group) of 75 stakeholders (key economic actors: fishermen, women fish smokers, small traders, wood sellers) were selected based on their decision-making role, along with representatives of local institutions: youth offices, women's offices, the local landfall management structure, etc. Each was selected according to distinct inclusion criteria to confirm the relevance of the data collected, surveyed stated that nearly 70% of the people living around the landing site derive their income, either directly or indirectly, from activities related to the site. The fishermen report a variation in the average daily unit selling prices of fresh fish per day (Table 1). A value based on the median was found (Table 1), wood sellers, 800 units of wood per day, or 3000 GNF/stere, smoked fish in 25 days based on the weighted average estimated weights of smoked fish (13.51 kg) (Table 2). Approximately 250 direct jobs have been identified (fishermen, fish smokers, fishmongers, etc.), and approximately 100 indirect jobs related to related activities: timber sales (Table 3), small businesses, transport, catering, etc. This dynamic can assign a role of local economic leverage to the Kaporo landing site by reducing unemployment and stabilizing community incomes.

❖ ***Economic estimation methodology***

In this study, estimated economic values were obtained from realistic approximations based on field observations, supplemented by structured questionnaire surveys, semi-structured interviews with economic actors at the landing site (fishermen, fish smokers, traders, etc.), and references from the local market. The monetary and physical estimates are based on locally practiced average prices (for example, the average price of a heap of smoked fish), combined with approximate weightings used to convert informal units (heaps, pieces) into standardized quantities (kg). The data were verified by triangulation, through cross-checking respondents' statements, analysing available records and calculating averages to reduce reporting biases. This methodological approach makes it possible to produce economically consistent results, despite the absence of precise accounting data, and ensures greater reliability of the economic indicators analysed.

- ***Method for estimating economic indicators***

The trade balance that will be calculated in this study corresponds well to the gross sales value achieved by the economic actors surveyed during a specific time interval. The evaluation of surplus is assessed based on a calculation of net income, obtained after subtracting direct production and marketing costs, including labour, transport, market expenses, etc. Furthermore, fixed capital amortization charges and opportunity costs are not included in the calculation.

❖ ***Average daily fresh fish sales estimate per canoe based on the median in GNF/day***

To estimate a value of daily fish sales, we examined the variable selling prices of fish (from 50,000 to 40,000,000 GNF/fishing) declared by fishermen. Given the significant growth in the declared amounts, a median was used based on the six reported values, specifically the 3rd and 4th values, as an indicator to limit the influence of extreme values. The different amounts are recorded in Table 1.

Table 1. Shows the variation in average daily unit selling prices of fresh fish/day based on the median.

N°	Daily sales of declared fresh fish (GNF)/Kg
1	50,000
2	100,000
3	300,000
4	3,000,000
5	10,000,000
6	40,000,000
Either: median	=(3e + 4e value) ÷ 2 = (300,000 + 3,000,000) ÷ 2 = 1,650,000 GNF

❖ ***Weighted average weight estimation of smoked fish***

The average weight per unit was estimated to be around 400 g (0.4 kg) as precise data were not available. This value comes from an estimate by weighing a sample (realistic technical basis). For the sale of smoked fish, we used the weighted average method by assigning weights (Table 2).

Table 2. Showing the estimated average weighted means weights of smoked fish according to size and frequency of sale.

Type	Small weight (Kg)	Price (GNF)	Quantity sold per day
Small fish	0.25	15.000	10
Medium fish	0.4	25.000	20
Large fish	0.6	40.000	5
Weight average weighted		≈0.386 kg ≈ 0.4 kg	

That is: Calculation of the weighted average weight: Weighted average (MP) = (Weight 1 × Quantity 1 + Weight 2 × Quantity 2 + Weight 3 × Quantity 3) ÷ Total quantities = (0.25 × 10 + 0.4 × 20 + 0.6 × 5) ÷ (10 + 20 + 5) = (2.5 + 8 + 3) ÷ 35 = 13.5 ÷ 35 ≈ 0.386 kg ≈ 0.4 kg; Weighted average weight ≈ 386 g.

❖ ***Legend***: *ou* 3000 steres *of wood* = 3000 m^3 *of stacked wood*; 1,600,000 *sale/canoe* × 150 *numbers of/canoe* × 25 *days of activities* = 6.000.000.000 *GNF* = *Total sale of fresh fish from* 150 *canoes. smoke women:* 35 *units* × 0.386 *g weighted average weight* (Table 2) = 13.5 *kg* (Table 3) = *Average quantity sold in kg/day. Daily sale of smoked fish* (*GNF/day*)/(*smoke women*) = 13.5 *kg* × 40.000 *Average selling price per kg*) = 540.400 *GNF/jour. Thus, for the daily sale of* 5 *smoking women* = 540.400 *Daily sale of GNF/day* × 5 *nombers of smoke women* × 25 *days of activities* = 67.550.000 *GNF*; 2,400,000 *daily sale GNF/day* × 25 *days of activities* × 5 *number of timber sellers* = 300.000.000 *GNF Daily sales of the* 5 *firewood sellers*; 3000/*passage* × 100 *nombers of passage* = 300.000 *GNF toilet recipe.*

Table 3. Showing the estimated unit economic revenues (inputs).

Products	Number of days of activity	Average quantity sold in Kg	Average unit price at Kg	Daily sales GNF/day	Number of economic actors at the landing stage	Total estimated sale in GNF
Fresh fish (canoes)	25	40	40.000	40 × 40.000 = 1.600.000	150 (canoes)	1.600.000 × 150 × 25 = 6.000.000.000
Smoked fish (smoke women)	25	35 units × 0.386 = 13.51 kg	40. 000 (Average selling price per kg)	13,51 × 40.000 = 540.400	5 (smoke women)	540.400 × 5 × 25 = 67.550.000
Wood	25	800 units of product sold (st.)	3000/steres	800 steres × 3.000 GNF = 2.400.000 GNF/day	5 (wood seller)	2.400.000 × 25 × 5 = 300.000.000
Public toilets		100 passages	3000	300.000	100 passages	300.000
Total				**4.840.400 GNF**		

❖ **Trade balance in receipts (BCR) for the 25 days:**

It shows the landing site's capacity to generate income inflows from outside (sum of the landing stage exports = total value of products (fresh and smoked fish, wood, services, etc.) sold to markets outside the commune, regardless of expenses related to imports).

✓ **BCR = ∑Vext:** Total amount of sales (fresh or smoked fish, wood, small businesses catering to external clients (other municipalities, regions…) or ∑Vext = (V_P + V_F + V_B + V_{PC} + R_T) or,

- V_P = *Total daily revenue from fresh fish of the* 150 *canoes, for* 25 *days of activity* = 6.000.000.000 *GNF* (6 *billion*),
- V_F= *Total daily revenue from smoked fish by* 5 *fish-smoking women over* 25 *days* = 67.550.000 *GNF* (67.550 *million*),

- V_B = *Total daily revenue from the* 5 *wood vendors over* 25 *days* = 300.000.000 *GNF* (300 *million*),
- V_{PC} = *Small businesses turnover of products sold, estimated average* = 2.600.000 *GNF* × 25 *days of activity* = 65.000.000 *GNF* (65 *million*).

✓ R_T = *Public toilets* = 300.000 *GNF*

❖ **BCR = ∑Vext** = (V_P + V_F+ V_B + V_{PC} + R_T) = 6.000.000.000 + 67.550.000 + 300.000.000 + 65.000.000 + 300.000 = 6.432.850.000 GNF.

❖ **Calculation of the trade balance (expenditure or imports) (BCD)**

This corresponds to the import trade balance, which includes the sum of expenditures or purchases ($\sum D_{Purchases}$) made from suppliers or service providers outside the landing stage (inputs: fuel or equipment, fishing exploitation, etc.) (Table 4). It helps to assess the level of economic dependence of the landing stage on the outside, where part of the inputs essential for the operation of the landing stage activities (fuel, material, etc.) which is supplied by other localities outside the site because a disruption observed in external supply could negatively influence the productivity and economic stability of the landing stage and is included in the calculation of the net trade balance.

Table 4. Showing the estimated expenses economic by day.

Expenses	Amount/unitary/day	Amount total unit in GNF
Fuel (liters)/fishing canoe	15 liter × 12.000 GNF/liter	180.000
Fishing exploitation permit	5000/day	5000/day
Maintenance or repair of nets and fishing equipment (hooks) after each fishing trip	5000/day	5000/day
Total daily expenses per fishing canoe		190.000 GNF
Maintenance of the dock	Voluntary	00
Navigation license	250.000/year	250.000
Driving license	250.000/year	250.000
Taxes on the transit area and sale of firewood	50.000	50.000
Taxes on the fish smoking area	5000/fish smoking	5000
Timber transport to the sales area	100.000/transport	100.000
Total expenditure		690.000 GNF

✓ **BCD =** $\sum D_{Purchases}$: Total daily expenses for the 150 canoes (fuel purchase, ice, hook, etc.) + total expenses (taxes on the transit and firewood sales area, taxes on the fish smoking area) + Total expenses (purchase of navigation permits, driver's licenses, fishing operation manifest) and expenses carried out with external suppliers *vendors of rice*, *coffee*, *drinks*, *sales of miscellaneous items* (*phone top-ups*, *nets*, *hooks*, *plastics*, *ice*) *or* $\sum Dext = (D_{JP} + D_{Tax} + D_P + D_{PC})$;

- D_{JP} = *Total daily expenses of the* 150 *canoes* = 190.000 *GNF/canoes* × 150 *ca-*

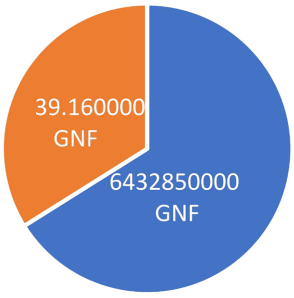
noes = 28.500.000 *GNF DT*;

- D_{Tax} = *Total expenses* (*Taxes on the transit area and sale of firewood, Taxes on*
- *Fish smoking area, transport on the sales area*) = 50.000 + 5.000 + 100.000 = 155.000 *GNF*;
- D_P = *Total expenses* (*Navigation permit, driving license/year, Fishing operation manifest*) = 250.000 + 250.000 + 5000 = 505.000 *GNF*;
- D_{PC} = *Total estimated expenses for small businesses* (*Vendors selling rice, coffee, and drinks; selling various items like: phone top-ups, nets, fishing hooks, plastics, ice*) = 10.000.000 *GNF*.

❖ **BCD =** ($\sum D_{Purchases}$ = (D_{JP} + D_{Tax} + D_P + D_{PC}) = 28.500.000 **+** 155.000 +505.000 + 10.000.000 GNF = 39.160.000 GNF.

Surplus balance is: 6,353,690,000 *GNF/month.*

Figure 5 *Trade balance.*



■ Trade balance of receipts for the 25 days ■ Trade balance of expenses

Figure 5. Showing the improved artisanal landing site of Kaporo, the trade balance, approximate monthly expenses et the surplus balance per month of the 150 canoes.

❖ **Final calculation of the net trade balance (FCNB).**

❖ **FCNB** = $\sum Vext - \sum D_{Achats}$ = 6.432.850.000 GNF − 39.160.000 = 6.393.690.000 GNF.

✓ The surplus balance is: 6.393.690.000 GNF per month beneficial to local economy.

✓ **Analysis of the trade balance by activity**

The trade balance histogram (**Figure 6** and **Table 5**) shows the trade balance by economic activity in the Kaporo landing stage, expressed in GNF. It appears that fishermen clearly dominate other economic actors with a trade balance of 5,971,500,000 GNF. So, the main generator of wealth, showing a significantly higher bar compared to others on the histogram, followed by wood sellers, women smokers, and small businesses. The difference between the two other activities (Fish-smoking women and small shops) would be 12,395,000 GNF. (*Source*: *Python program*).

3.2. Physicochemical Analysis of Water and Soil Samples of Improved Kaporo Landing Stage

The results of the analysis and interpretation are shown in (**Table 6**).

Table 5. Showing the economic balances of the landing stage activities per day.

1	Fishermen	5.971.500.000 around: 6.000.000.000
2	Timber sellers	299.845.000
3	Women smokers	67.395.000
4	Small shops	55.000.000

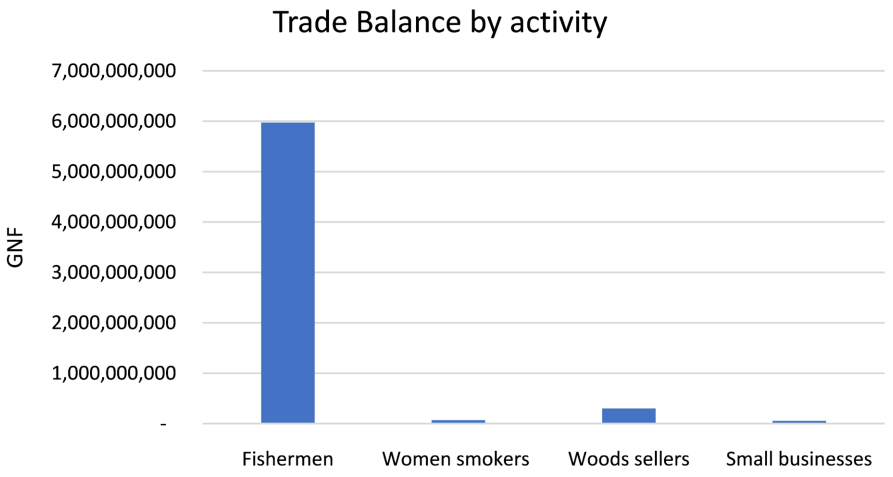


Figure 6. Showing the histogram of the trade balance analysis by activity of the improved artisanal landing stage of Kaporo.

Table 6. Showing the average of the physicochemical parameters of water of the landing stage and interpretation.

Sample	Potential impact parameters	Values found	Unit	Method of analysis	Recommended limit values	Interpretation
Sea water	pH	6.86 ± 0.05	Without unity	Potentiometry	6.5 - 8.5	Located in the neutrality interval, favorable to the stability of chemical balances and the viability of aquatic life.
	Temperature	24.8 ± 0.3	˚C	Thermometer	≤30	The temperature of 24.8˚C, well below the critical threshold of 30˚C, limits the risks of heat stress for marine fauna.
	Conductivity	3999 ± 120	µS/cm	Conductivity meter	<50,000	The electrical conductivity (3999 µS/cm) found is significantly lower than the criterion. Less of dissolved mineral salts as ions: (Na^+, Ca^+, K^+, Mg^{2+}, Cl^- etc.). Weakly ionised water, suggesting significant dilution by water inputs, probably of river origin, rainwater, river, fresh water, runoff, etc. around the landing stage (there are small lakes around the Kaporo landing stage that flow directly into the sea of the landing stage) with possible intrusion of polluted or chemical water.
	Turbidity	14.8 ± 1.1	FUT	Turbidity meter	<150	The measured turbidity value indicates relatively clear water lightly loaded of suspended solids, which is favourable for light penetration and photosynthesis in autotrophic organisms.

Continued

Sea water	Nitrates	2.8 ± 0.2	mg/L	Spectrophotometer	≤50	Dissolved nutrients (nitrates, phosphates, total iron, ammonium) remain at low levels, ruling out any significant eutrophication or metal contamination.
	Phosphates	0.21 ± 0.01			≤0.5	
	Total iron	0.12 ± 0.01	mg/L)		≤0.3	
	Ammonium	0.05 ± 0.005	mg/L		≤0.5	
	Chemical oxygen demand (COD)	27.6 ± 1.5	mg O_2/L	DCO reactor coupled with a spectrophotometer.	≤75	Organic pollution indicators, namely DBO_5 and DCO, are significantly inferior to regulatory thresholds, reflecting moderate organic load and good oxidative water quality.
	BOD_5 (Biological oxygen demand)	4.2 ± 0.4	mg/L	DBO incubator	≤10	
	Dissolved salt content	3033.41 ± 85	mg/L	Conductivity meter	≥33,000	In relation with measured electrical conductivity, the dissolved salt content was interpreted, because conductivity is an indirect indicator of mineralization and is strongly linked to salinity. It emerges a low concentration of dissolved salts indicates that the water contains fewer mineral ions such as: Na^+, Cl^-, SO_4^{2-}, K^+, Mg^+ ions, etc. This conductivity value is approximately close to that of a salinity between 20 and 30 PSU (according to standard empirical which link conductivity and salinity at 25˚C which is lower than that of oceanic seawater which is (≈35 PSU with a conductivity ≈ 50,000 - 60,000 µS/cm). But also higher than the thresholds for fresh water. The origin of this influence may be due to: rainwater, river or spring water, runoff, groundwater, decrease in dissolved salts, human activities, etc. Based on these elements, the sample can probably be considered as brackish water with a strong marine influence, or coastal water diluted by inputs (runoff, river inputs). Thus, this interpretation can be considered understandable in a context of sampling carried out in a coastal area with exchanges between marine water masses (with large volumes of ocean water) and river inputs. However, salinity was not directly measured; it was estimated from electrical conductivity, a method commonly used in environmental studies when temperature conditions are controlled.

The analysis of physicochemical parameters was carried out according to standardized international methods: ISO 10523:2008 (for pH), ISO 6060:1989 (for COD), ISO 5815-1:2003 (for BOD_5), and ISO 7890-3 (for nitrates). Heavy metals (Pb, Hg) in the soils after acid digestion were determined and analyzed by ICP-

MS in accordance with ISO 17294-2:2016. Calibration was performed using a multipoint curve ($R^2 \geq 0.995$) according to the reference standards to verify viability. The limits of detection and quantification were calculated as 3σ and 10σ of the blank, respectively. The quality control composed of blanks, duplicates and certified reference materials as well as the recuperations included between 80 and 120%. The results were compared to the World Health Organization's recommendations for drinking water and the EPA's international guideline value for soils, in the absence of specific detailed standards in the Republic of Guinea. **Figure 2** shows the level of environmental degradation around the Kaporo landing stage caused by human activities, mainly dominated by housing construction, between 1994 and 2025. Before 2025, the extent of the mangrove is very visible in the middle of which was the landing stage on the map. However, by 2025, this area has disappeared, leaving space for water in the center of the landing stage on the map (**Figure 2**). In tropical regions, the contribution brought by mangroves to the local community through several ecological, economic and social functions is enormous because in these regions, the mangrove is a resource for subsistence by providing them with firewood (the main source of domestic energy in these localities), shipbuilding materials, dwellings, fences, traditional medicinal plants, hunting grounds, fishing, livestock farming, nurseries for many species, shell collecting, beekeeping, potential ecotourism, coastal protection, natural water filtration, carbon storage by mitigating the effects of climate change, local climate and hydrological regulation, etc., although some of these activities are often uncontrolled by administrative authorities [15] [16]. It covers nearly 75% of the coasts with an estimated area of between 14 and 23 millions hectares worldwide for an average global productivity of USD 28,662 per hectare per year [16]-[18]. In the Republic of Guinea, it is estimated to be 60% degraded [14]. This deforestation of mangroves is observed across all the coastal villages of before, and by destruction of this mangrove, they are today considered like of the city of Conakry in Guinea who are: (Kaporo, Boulbinet, Dixinn Port, Teminetaye, Bonfi, Lansébounyi) due to the intensive use of wood for smoking fish and in shipbuilding and housing. This has contributed significantly to the reduction even the disappearance of mangrove areas in these coastal zones such as the Kaporo coastal zone (**Figure 2**) who going in disfavor of the artisanal fishing for those who understand the importance of mangroves in the aquatic ecosystem This analysis would be consistent with national trends observed by the FAO (Food and Agriculture Organisation of the United Nations) estimated at nearly 1.04 million hectares of decrease of the mangrove area between 1990 and 2020 [14].

- ***Analysis of the management model and the excessive trade balance***

The economy of communities is fundamentally based on their available resources and its capacity operating and management of these resources [19]. Thus, the economic, administrative, and local institutions of these communities are responsible for organizing, managing and providing services or products deemed essential in order to support their economies [19]. However, the management model observed in the improved Kaporo landing stage is an administrative or pas-

sive fiscal management model. The state limits itself solely to taxation, Collection is assured out by administrative structures of the Guinean state, namely: Ministry of Fisheries, Maritime Economy and Maritime Navigation Agency. However, trade balance study of this improved artisanal landing site to show a significant surplus of: 6.393.690.000 GNF in just 25 days of activity (**Figure 5**).

- ***Visual comparison and analysis of the trade balance of landing stage activities***

The histogram of economic activities (**Figure 6**) shows that fishermen are the main generators of wealth and economic contributors to the landing site that they don't spend, with a very high trade balance. However, other activities (wood sellers, women smoking fish, and small businesses) contribute less, ranging from 55 to 300 million, but are overall important for the functioning and value chain of the landing stage. According to [4], global per capita fish consumption was 14.4 kg in 2005. The fishing sector in Africa contributes much more to the product (GDP), it would even be the second most important economic sector after agriculture [4]. This analysis has identified the key players in wealth creation and shows the need to support different activities according to their economic weight, while providing assistances to other actors less-performing to integrate in a meaningful way within the local dynamic. To date, improved artisanal landing stage in Guinea remains an underdeveloped sector, due in particular to the under-equipped and defective nature of its port infrastructure. According to [20], landing and sales sites for artisanal or industrial fishing products need adequate infrastructure and constant maintenance. Because they can determine the commercial value of the landed products through related quality. The artisanal landing stages, as in most African countries, necessarily need to be modernized or equipped for their operationalization and sustainable resource management. Despite the important role these landing stages play in local and national economies, compared to other areas of food production, this sector is still struggling.

- ***Abiotic or physicochemical parameters influencing the fishing environment***

The study of these abiotic or physicochemical parameters (such as temperature, pH, dissolved oxygen, salinity, conductivity, turbidity, etc.) is necessary in small-scale fishing for the following reasons: Water and soil quality (**Table 6** and **Table 7**), habitat of species, safety alimentary and public health, sustainability of the activity, helping with decision-making, etc. Variations in these parameters (**Table 6** and **Table 7**) can cause species migration, their mortality, decline of their reproduction, contamination with health risks, biases the commercial value of the products, loss of buyer confidence and their eventual withdrawal or rejection from the market. Thus, knowledge of these parameters makes it possible to predict the environmental impacts on fishing in order to implement sustainable management measures for the landing stage and resources. Analysis of soil samples and seawater made it possible to assess possible sources of pollution. To do this, the results found are acceptable but fragile, indicating that the environment is vulnerable to future pollution. Parameters such as pH, COD, nitrates, heavy metals, etc., are approximately within recommended limits, which indicates a satisfactory cur-

rent environmental condition. A low concentration of dissolved salts indicates that the water contains fewer mineral ions such as: Na^+, Cl^-, SO_4^{2-}, K^+, Mg^+, etc. The origin of this influence may be due to rainwater, river or spring water, runoff, tablecloths, decrease in dissolved salts, human activities etc. (Table 6). The organic matter content in the soil sample is high, which promotes soil structuring, biological activity and nutrient retention (Table 7). This variability may be due to the intensity of human pressures and the ecological resilience or the capacity of the site's ecosystem to resist climatic disturbances, overexploitation, pollution.

Table 7. Showing the physicochemical parameters of the soil samples of the landing stage and interpretation.

Parameters	Land (timber storage area) E1	Land (canoe parking area) E2	Land (50 m from the landing stage) E3	Criteria	Interpretation
Texture	Sandy silty-clay	Sandy silt	Clayey sand	-	The soil results for the timber sales area show a sandy loam-clay texture, indicating good water retention capacity while maintaining a certain degree of permeability.
Structure	Slightly compact	Weakly lumpy	Stable lumpy	-	The slightly compact structure suggests moderate porosity, which may limit aeration and root activity, but this can be compensated for by regular organic inputs.
Moisture content (%)	2.23	16.51	17.12		Values close to normal.
pH	8.52	7.35	7.99	6.5 - 8.5	Although the pH is at the upper limit of the recommended values, it shows an alkaline tendency that may alter the bioavailability of certain essential micronutrients such as iron (Fe) and zinc (Zn). Regular monitoring of pH is therefore recommended to prevent possible deficiencies.
Organic matter (%)	3.2	2.78	2.8	>2	The organic matter content is high, which promotes soil structure, biological activity and nutrient retention. The concentrations of nitrogen, available phosphorus and exchangeable potassium (NPK) all comply with agronomic standards, indicating satisfactory chemical fertility. NPK (nitrogen, phosphorus and potassium), the main nutrients in the soil, are within the recommended ranges for all four samples, indicating that the soil is nutritionally balanced.
Total nitrogen (%)	0.22	0.15	0.18	0.1 - 0.3	
Phosphorus (P_2O_5) (mg/kg)	31.6	25	25.4	15 - 40	
Potassium (K_2O) (mg/kg)	162.9	85	135.7	80 - 200	
Lead (Pb) (mg/kg)	28.1	22	22.3	<70	The heavy metal content (Pb, Cd, Hg) remains well below the critical thresholds defined for uncontaminated soil, ruling out any immediate risk of metal pollution or environmental toxicity.
Cadmium (Cd) (mg/kg)	0.58	0.32	0.42	<3	
Mercury (Hg) (mg/kg)	0.09	0.09	0.07	<1	
CEC (cmol(+)/kg) (cation exchange capacity)	21.3	13	18.6	10 - 25	Cation exchange capacity (CEC) indicates good soil buffering capacity and a high ability to retain nutrients in cationic form, which is beneficial for plant nutrition.

- ***Limitations and sensitivity analysis***

This study reveals several sources of uncertainty. Firstly, the data on prices and quantities have been obtained partially from the declarations of the people investigated. Secondly, seasonal instability in fish catches and prices is only partially taken into account due to the short observation period. Thirdly, lean on a reasoned sampling limits the generalisation of results. To assess the robustness of the estimates, a simple sensitivity test based on recalculating the surplus was carried out using low, median and high fish prices. The results show that while the absolute level varies, as in the case of the price retained, overall trends and orders of magnitude remain unchanged or stable. This confirms the consistency of the conclusions.

4. Conclusion

Study of the socio-economic and environmental impacts of the improved artisanal landing stage of Kaporo in the urban commune of Ratoma (Conakry) shows his capital role in local dynamics. It constitutes an important source of income for many groups of actors: fishermen, women smokers, wood sellers, small traders and service providers in economic terms. The value chain produced by these activities contributes significantly to the local economy. However, the site's governance is of a deficient type, showing weaknesses or breaches. This translates as, poor coordination, lack of clear rules and transparency, less of control on the activities, flexibility of the responsible authorities, with an administrative management model or passive tax management, based on taxation and collected by Guinean state administrative bodies, namely: the Ministry of Fisheries and Maritime Economy and the Maritime Navigation Agency, or the state, is only concerned with collecting taxes on: navigation permits, canoe driving, fishing operation manifests, taxes on fish smoking areas, sale of firewood, service revenue (such as toilets, showers, space rental of artisanal restoration, other small businesses, etc.).

There is no retrocession or return of funds from the structures collecting these taxes for the maintenance or development of the landing stages (cleaning, security, repairs, construction of infrastructure etc.). The trade balance study reveals a profitability of the landing stage with a high surplus of 6,353,690,000 GNF/month in just 25 days of activity. According to the results obtained, artisanal fishing is the main economic activity generated at this landing site, followed by timber vendors, women fish smokers, and small businesses, all of which contribute to the local economy with differentiated but complementary added value. The operation of the landing stage reveals a high level of attendance. An average of 150 pirogues on average dock every day. The traffic is permanent causing heavy circulation during peak hours, causing a slight slowdown in unloading, fish smoking, and sales activities. This observation reveals insufficient infrastructure reception facilities, hence the need to rethink the layout of the site to ensure its smooth and sustainable operation. In environmental terms, the perception of environmental impacts has been visible on the deforestation for years, because the ancient villages of Conakry have now become neighbourhoods of the city of Conakry following

deforestation and the construction of buildings by local residents. Thus, analysis of the physicochemical parameters of the water and soil obtained showed signs of disturbance, as the values found are within acceptable limits. This may be linked to human activity, in particular the lack of sustainable waste management, pressure on natural resources and the gradual degradation of the immediate environment.

Recommendations

The resulting histogram shows a concentration of economic value around fishermen. It can guide decision-makers to: Strengthen assistance: to fishermen, not forgetting the valorization of other links in the chain (wood sales, fish smoking) for sustainable economic balance, strengthen and modernise existing infrastructure, easy access to financing enabling them to modernise their work equipment (anoes, nets, improved ovens…), organise and support technical training for those involved in activity management, hygiene, processing, safety at sea and conservation, improving local governance by setting up a participatory management committee that includes economic stakeholders (fishermen, smokers, traders, local authorities and transport operators) and strengthen of the committee capacity to act, establishment of internal site regulations and enforce them, establish a monitoring and evaluation system (continuously collect data on income, flows, water and soil quality), establish sustainable fishing practices, respect of sizes, seasons, etc., raise awareness among users about the preservation of natural resources (water, soil, mangroves, etc.), promote social equity by encouraging women and young people to participate in decision-making, create spaces for exchange between actors to strengthen cohesion and resolve conflicts, and establish of a device Sustainable electronic equipment management, in introducing the sorting system, collection and recycling. This can be a method of reducing the risks of pollution, creation of new revenue streams through their valorization for the actors of the site. The implementation of these recommendations may be an alternative to improving the durability and operation of the landing stage.

Conflicts of Interest

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

References

[1] Daffay, M. and Ali Mohamed, E. (2021) Determinant of Fishing Performance in Comoros. *Journal of Human Resource and Sustainability Studies*, **9**, 630-639. https://doi.org/10.4236/jhrss.2021.94040

[2] Subnawin, S. and Singchai, A. (2024) Network Construction Food Security of Local Fishing Community in Thailand. *Open Journal of Social Sciences*, **12**, 449-460. https://doi.org/10.4236/jss.2024.122026

[3] Saytarkon, D.O., Kathambi, B. and Kibugi, R. (2025) Pathway for Climate Change Adaptation Strategies through Local Knowledge by Small-Scale Fisheries in Liberia. *American Journal of Climate Change*, **14**, 1-21.

https://doi.org/10.4236/ajcc.2025.141001

[4] Mohamed, E.A. and Amir, N. (2023) Factors Contribute the Existence of Fishing in Comoros. *Journal of Human Resource and Sustainability Studies*, **11**, 290-297. https://doi.org/10.4236/jhrss.2023.112018

[5] (2022) Organisation des Nations Unies pour l'alimentation et l'agriculture. https://openknowledge.fao.org/server/api/core/bitstreams/00f1704f-b092-492c-84da-63c2a88923e2/content/sofia/2022/world-fisheries-aquaculture-production.html

[6] Failler, P., Pan, H., Thorpe, A. and Tokrisna, R. (2014) On Macroeconomic Impact of Fishing Effort Regulation: Measuring Bottom-Up Fish Harvesters' Economy-Wide Contribution. *Natural Resources*, **5**, 269-281. https://doi.org/10.4236/nr.2014.57025

[7] Les scandales en série du secteur de la pêche. https://www.ndarinfo.com/Les-scandales-en-serie-du-secteur-de-la-peche_a28783.html

[8] Sossoukpe, E., Hoto, G., Djidohokpin, G. and Fiogbe, E.D. (2022) Fishing of the Flat Sardinella (*Sardinella maderensis*, Pisces, Lowe 1838) in Benin (West Africa) Nearshore Waters: Production, Typology of Fishing Gear and Current Status of Its Stock. *Agricultural Sciences*, **13**, 1136-1150. https://doi.org/10.4236/as.2022.1310070

[9] Dolo, O., Camara, R.H., Kondiano, S.G., Diallo, I., Sangare, A. and Traore, L. (2025) Assessment of the Presence of Trace Metal Elements (Hg, Pb, Cd) in Six Species of Fish Landed at the Artisanal Fishing Port of Boulbinet Republic of Guinea. *Journal of Water Resource and Protection*, **17**, 145-158. https://doi.org/10.4236/jwarp.2025.173008

[10] Annuaire Des Statistiques Forestières 2004-2013. https://www.stat-guinee.org/images/Documents/Publications/SSN/meef/MEEF_statistiques_forestieres_2004_2013.pdf

[11] Moustapha, D., El hadj, B.D., Pierre, M.S. and Youssouf, H.C. (2023) La contribution de la pêche à l'économie guinéenne: Une évaluation à partir de l'élaboration d'un cadre d'indicateurs économiques clés Belgeo Revue belge de Géographie Édition électronique. https://journals.openedition.org/belgeo/62026

[12] (2025) À Boffa, la pêche artisanale face au défi de la preservation. https://france-volontaires.org/mag/a-boffa-la-peche-artisanale-face-au-defi-de-la-preservation/

[13] https://fr.wikipedia.org/wiki/Ratoma

[14] Sidimé, N., Camara, S., Sakho, A.M., Kourouma, A., Bah, A.K. and Bangoura, K. (2025) Assessment of the Socio-Economic and Environmental Impacts of the Artisanal Landing Stage at Yimbaya Kinssi in the Urban Commune of Gbessia (1994-2024). *Journal of Environmental Protection*, **16**, 852-866. https://doi.org/10.4236/jep.2025.169045

[15] Costa, L.d. and Branco, A.F. (2025) Economic Valuation of the Mangrove Forest in Metinaro Coastal, Timor-Leste. *Journal of Geoscience and Environment Protection*, **13**, 269-283. https://doi.org/10.4236/gep.2025.133014

[16] Tran, T.T., Takahashi, K., Nishikawa, H., Nguyen, V.H.T., Hoang, T.T., Nguyen, T.H.T., *et al.* (2023) Evaluation of Mangrove Ecosystem Importance for Local Livelihoods in Different Landscapes: A Case Study of the Hau and Hoang Mai River Estuaries in Nghe An, North-Central Vietnam. *Sustainability*, **15**, Article No. 3843. https://doi.org/10.3390/su15043843

[17] Rakotomavo, A. (2018) The Mangroves of the East of Madagascar: Ecological Potentials and Pressures. *Open Journal of Ecology*, **8**, 447-458.

https://doi.org/10.4236/oje.2018.88027

[18] Bimrah, K., Dasgupta, R., Hashimoto, S., Saizen, I. and Dhyani, S. (2022) Ecosystem Services of Mangroves: A Systematic Review and Synthesis of Contemporary Scientific Literature. *Sustainability*, **14**, Article No. 12051. https://doi.org/10.3390/su141912051

[19] Amu-Mensah, M.A., Amu-Mensah, F.K. and Obirih-Opareh, N. (2014) Perspective of the Economy Situation in the Fishing Industry of the Volta Basin in Ghana: Case Study of Dzemeni and Kpando-Torkor. *Sociology Mind*, **4**, 93-106. https://doi.org/10.4236/sm.2014.42012

[20] Bignoumba, G., Lembe-Bekale, A.J. and Bolé-Baïzoumi, S. (2022) Enjeux et défis de la modernisation des sites de débarquement des produits issus de la pêche maritime artisanale à Owendo (Gabon). *Cahiers de Géographie du Québec*, **67**, 71-87. https://doi.org/10.7202/1112470ar