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**Original Article**

# Characterization of the shrimp industry in the Nakanbe and Mouhoun watersheds in Burkina Faso

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**Abstract**
Limited information is available on the shrimp industry in Burkina Faso, hindering its characterization and development. This study aimed to characterize the shrimp sector by examining the sociodemographic and organizational profiles of stakeholders, production and processing technologies, production and marketing volumes, and the contribution of shrimp-related activities to stakeholder incomes. Data were collected between February and July 2024 through surveys of 74 shrimp fishermen and 122 female shrimp processors/traders across 16 sites in the Mouhoun and Nakanbé basins using respondent-driven sampling. Most respondents were Burkinabè, representing 70.4% of fishermen and 98.0% of processors/traders. Young people (<35 years) accounted for 22.2% of fishermen and 30.0% of processors/traders, while school enrollment rates were low in both groups. Shrimp fishing relied mainly on traps, gillnets, and trammel nets, with corn bran serving as the primary bait. Fishing activities occurred from November to June. Mean daily shrimp catch was 6.54±3.76 kg per fisherman. Fresh shrimp prices ranged from 1400 to 2625 CFA francs $kg^{-1}$ at the fisher level and from 1750 to 5000 CFA francs $kg^{-1}$ at the processor/trader level. Frying was the predominant processing method, with firewood as the main energy source. Annual gross incomes ranged from 216000 to 2132480 CFA francs for fishermen and from 168000 to 6819120 CFA francs for processors/traders. Shrimp activities were primarily conducted as byproducts of fishing, processing, and fish marketing operations. These findings provide the first comprehensive characterization of the shrimp sector in Burkina Faso and establish a baseline for its future development and management.

**Keywords:** Burkina Faso; female processors; shrimp catching; shrimp marketing; shrimp processing

## 1 | INTRODUCTION

Burkina Faso is a landlocked Sahelian country whose water system consists primarily of natural and artificial lakes, rivers, and streams (Bado *et al.* 2007). These water sources have led to the development of various types of activities, including fisheries production. The main fishery resources harvested and/or produced in Burkina Faso include, among others, fish with more than 100 species (Ouédraogo *et al.* 2018) and a national supply of 276348 tons in 2025, of which imports account for approximately 79% (DGRH 2025), crustaceans, consisting mainly of shrimp (Fofana 2010; Ouédraogo 2020), mollusks (mussels and oysters), and amphibians (MRAH 2018). The shrimp consumed come from domestic fisheries and imports. The available data on the domestic supply of shrimp pertain solely to imports, which are estimated to average 100000 tons per year from 2015 to 2025, with an average monetary value of over 36.33 million CFA francs

(DGRH 2025), corresponding to approximately $62.049 USD.

Compared to the fish sector, where data are fairly well-structured due to the existence of formal organizations at various levels (cooperatives, provincial unions, regional unions, and interprofessional associations), aside from the work of Fofana (2010) and Ouédraogo (2020), there is no specific information on the structured shrimp sector in Burkina Faso. Hence the significance of this study, which aims primarily to characterize the various segments of the shrimp industry in the context of Burkina Faso.

## 2 | METHODOLOGY

### 2.1 Study sites

The study was conducted at sixteen (16) sites spread across the Mouhoun and Nakanbé watersheds (Figure 1). These sites include Koubri/Nabazana and Tanghin in the Central Region; Ouèra, Savilly, Salbisgho, Nabadogo, and Koudougou in the Central-West Region; Mogtédo in the Central Plateau Region; Bion in the South-Central Region; Toécé, Tilgui, Berenga, Pougyango, and Dourou in the North Region; and Bama and Makognadougou in the Hauts-Bassins Region (Table 1). These sites were selected because shrimp fishing and/or processing and marketing activities are fairly well developed there.

Data collection from fishermen took place at the sites of Bion, Berenga, Tilgui, Mogtédo, Ouèra, Savilly, Salbisgho, Toécé, Makognadougou and Nabazana. Data collection from stakeholders involved in shrimp processing and marketing took place at the sites of Koubri, Berenga, Dourou, Mogtédo, Nabadogo, Koudougou, Tilgui, Pougyango, Tanghin and Bama.

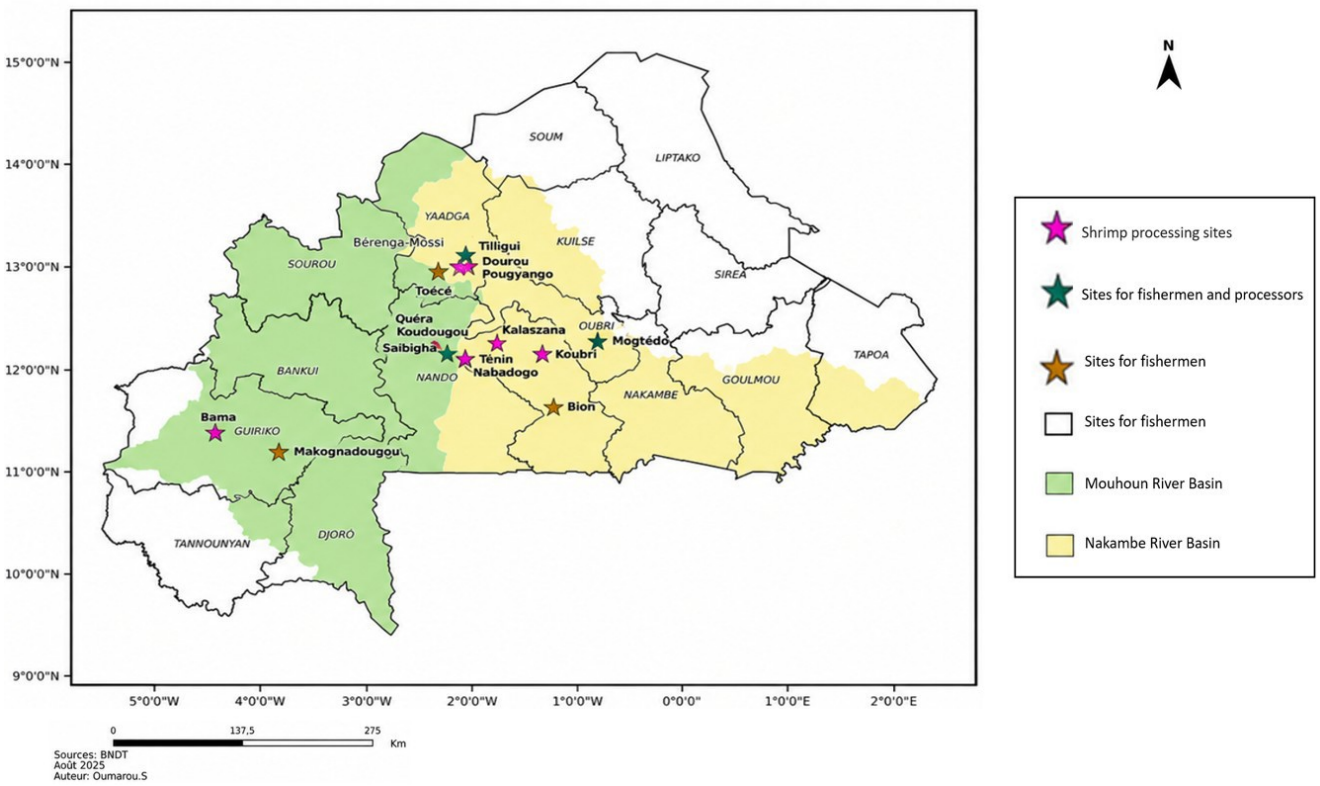



**FIGURE 1** Map showing the locations of the study sites in Burkina Faso.

### 2.2 Data Collection and processing

Data were collected using the respondent-driven sampling method employed by Heckathorn and Cameron (2017). This method is particularly well-suited for hard-to-reach populations or those for which a comprehensive sampling frame does not exist as is the case with shrimp farming stakeholders in Burkina Faso where comprehensive data are virtually unavailable.

The sampling methodology consisted of:

- identifying entry points that is a few key stakeholders in the shrimp industry at each sampling site in collaboration with the decentralized technical services responsible for fishery resources and local authorities;
- initial recruitment through interviews with key stakeholders to establish the initial sample for each

site;
- referrals to other stakeholders in the shrimp industry by those already interviewed;
- expanding the sample: this process was repeated until data saturation was reached or a sufficient number of stakeholders were covered to represent the diversity of the industry.

**TABLE 1** Geographic coordinates of the study sites.

| Sites | Latitude | Longitude |
|---|---|---|
| Koubri | 12°10′ 03″ | 1°21′20″ |
| Savilly | 12°6'0" | 2°1'60" |
| Salbisgho | 12°20'14" | 2°13'25" |
| Bion | 11°39'0" | 1°13'60" |
| Toécé | 12°59′43″ | 2°05′05″ |
| Ouèra | 12°26′58″ | 2°20′13″ |
| Nabadogo | 12°08′00″ | 2°04′00″ |
| Koudougou | 12°15′04″ | 2°22′28″ |
| Mogtégo | 12°17′04″ | 0°50′ 14″ |
| Tilgui | 13°03′46″ | 2°04′45″ |
| Berenga | 13°06′41″ | 2°07′32″ |
| Pougyango | 12°58′46″ | 2°09′04″ |
| Dourou | 12°59′34″ | 2°02′59″ |
| Bama | 11°22′26″ | 4°24′48″ |
| Makognadougou | 11°12′17″ | 3°49′39″ |
| Tanghin | 2°23′18″ | 1°30′07″ |

The final sample size was not predetermined but was determined by data saturation (that is, when there were no longer any new shrimp fishermen and/or processors/sellers at the study sites from whom data could be collected) and the study's logistical constraints. This sample included a diverse range of stakeholders in terms of their roles in the supply chain (fishermen, processors, retailers), geographic location, age and gender.

It is important to note that this sampling method, while allowing access to a hard-to-reach population has certain limitations. In particular, it can introduce selection bias, as individuals who have already been surveyed tend to refer people who are similar to them or whom they know well. To mitigate this bias, efforts were made to diversify the sources of participants as much as possible.

Data collection was preceded by a pilot test of the questionnaire with a sample of five fishermen and five female processors in Nabazana in the rural commune of Koubri. Participants in the test sample were not included in the final study sample. The marketing stage of the shrimp supply chain was not included due to the absence of actors specifically dedicated to it. The same stakeholders involved in the processing stage also handle the marketing stage. This phase made it possible to assess the clarity and relevance of the questions, identify any potential comprehension difficulties and estimate the time required to complete each questionnaire in order to adjust them before using them on a larger scale.

Data were collected from February through July 2024 and focused on:
- the sociodemographic variables of the participants (gender, age, nationality, ethnicity, educational level, marital status, household size, number of years of experience in the shrimp farming industry);
- the organization of fishing activities (number of fishermen engaged in shrimp fishing, level of organization, fishing gear and types of bait used, optimal fishing periods, number of fishing days per week, quantity of shrimp caught per day, uses of the shrimp);
- the organization of shrimp storage and processing activities (storage methods and equipment types of materials/equipment and processing methods, level of organization, other products sold, shrimp suppliers, relationships with suppliers, origin of the shrimp, storage methods, energy sources used for processing);
- shrimp marketing (purchasing and sales methods, purchase and sales prices, sales conditions quantities sold and customer origins).

All of this data was collected from 196 stakeholders, including 74 fishermen and 122 shrimp processors and sellers.

### 2.3 Data analysis

The collected data were entered into an Excel 2019 spreadsheet which was also used to process them. The parameters determined primarily concerned means for quantitative variables (the age of the participants quantities of shrimp caught and sold income number of fishing days) and proportions for qualitative variables (ethnic groups level of education level of organization among participants, and types of gear/equipment used processing methods energy sources used for processing). One-way ANOVA was used to compare group means at a 5% significance level. The Tukey test was used to identify the means of the variables that were significantly different.

## 3 | RESULTS

### 3.1 Sociodemographic characterization of stakeholders

**3.1.1 Stakeholders in the production sector:** Shrimp production consists solely of catching shrimp in natural bodies of water by fishermen all of whom are male, 70.4% are Burkinabé nationals and 29.6% are Malian nationals. They are predominantly of the Mossi ethnic group (59.3%) followed by the Dozos (22.2%) and the Senoufos (7.4%). The other ethnic groups encountered (Bambara, Marka, and Dafing) each account for 3.7% of those surveyed (Figure

2a). According to the breakdown by age group young people aged 35 or younger account for only 22.22% of the fishermen surveyed. However fishermen in the 36–50 age group are the most heavily represented among the respondents at 48.15% (Figure 2b).

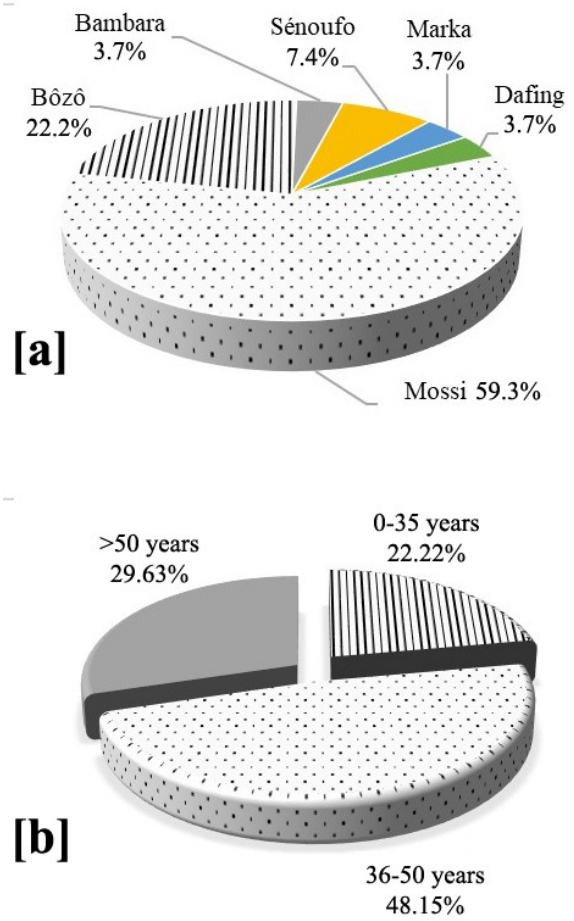



**FIGURE 2** Ethnic groups (a) and age groups (b) of the fishermen surveyed.

The mean age of the fishermen surveyed varies from one site to another: 26±1.41 years in Toécé, 27 years in Savilly, 29±2.83 years in Berenga. The majority of the fishermen surveyed are young (average age ≤ 35 years) (Table 1). One-way ANOVA at the 5% significance level showed no significant difference ($p > 0.05$) between the average ages of fishermen at the Toécé, Savilly and Berenga sites. However, the average ages of fishermen at the Tilgui, Mogtédo and Ouéra sites were significantly different ($p < 0.05$) from those at the other sites with the exception of Makognadougou and Nabazana (Table 2).

The overall enrollment rate among the fishermen surveyed was 13.6±18.93%. It ranged from 0% at the Tilgui, Ouèra, Savilly, Salbisgho, Toécé and Makognadougou sites to 50% at the Berenga site with a maximum of a secondary education (Figure 3a). At the Bion and Nabazana sites. 33% of the fishermen surveyed had a secondary education and at the Mogtédo site, 20% had only a primary education.

The highest average number of years of experience (40 years) was observed among fishermen at the Ouèra site and the lowest average number of years of experience was among those at the Toécé site at 14.5±4.95 years (Figure 3b).

**TABLE 2** Average ages of fishermen by survey site in Burkina Faso.

| Sampling sites | Mean age (years) |
|---|---|
| Bion | 44±11.53[b] |
| Berenga | 29±2.83[c] |
| Tilgui | 55±0.00[a] |
| Mogtédo | 52.2±9.20[a] |
| Ouèra | 51±0.00[a] |
| Savilly | 27±0.00[c] |
| Salbisgho | 47±0.00[b] |
| Toece | 26±1.41[c] |
| Makognadougou | 48.5±4.65[ab] |
| Nabazana | 48.5±7.18[ab] |

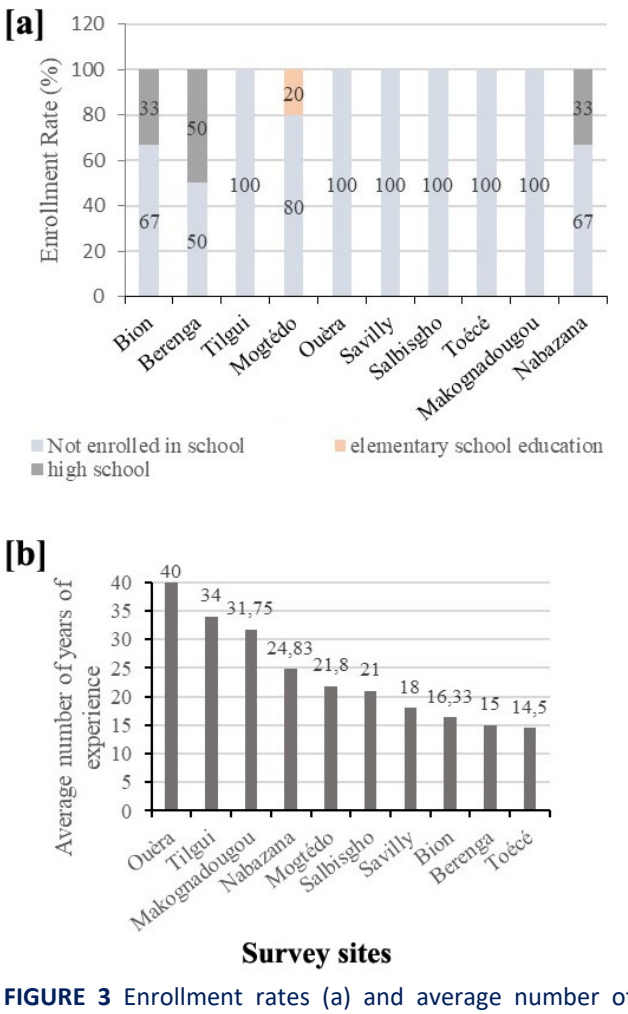



**FIGURE 3** Enrollment rates (a) and average number of years of experience among fishermen by site.

### 3.1.2 Stakeholders in the processing and marketing sectors

According to the data collected, the shrimp processing and marketing sectors are managed by the same stakeholders, all of whom are women. Among these stakeholders, 98% are Burkinabé nationals, while 2% are Malian. The Mossi constitute the predominant ethnic group, representing 92% of the respondents, followed by the Gourounsi, who account for 4% of those surveyed (Figure 4a). The breakdown by age group shows that young people aged 35 or younger account for only 30% of the female processors surveyed (Figure 4b).

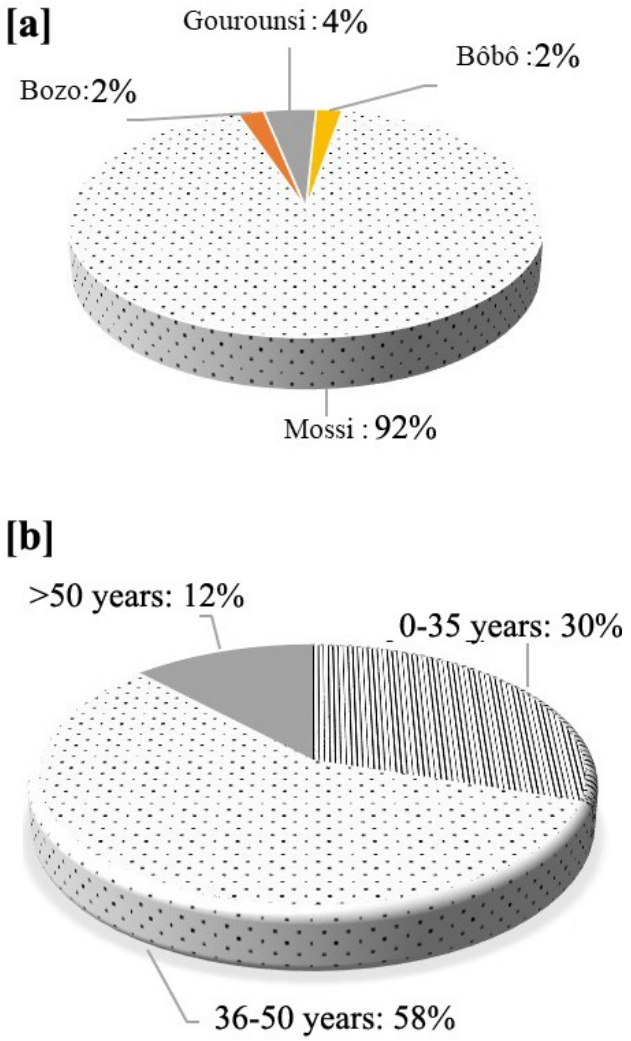



**FIGURE 4** Ethnic groups (a) and age groups (b) of female food processors and vendors.

In terms of age, female shrimp processors at the Berenga site had the lowest mean age (25 years), followed by those at the Nabadogo site, with a mean age of 32.8±7.85 years (Table 3). In contrast, female shrimp processors at the Koudougou site had the highest mean age (49.5±4.12 years), followed by those at the Tanghin site (45.0±7.07 years) and the Mogtédo site (45.17±20.23 years). The mean ages of female shrimp processors at the Mogtédo, Koudougou, Pougyango, and Tanghin sites did not differ significantly (one-way ANOVA, $p = 0.070$). However, these mean ages differed significantly ($p < 0.05$) from those observed at the other study sites, with the exception of the Bama site.

**TABLE 3** Mean age of female processors by survey sites.

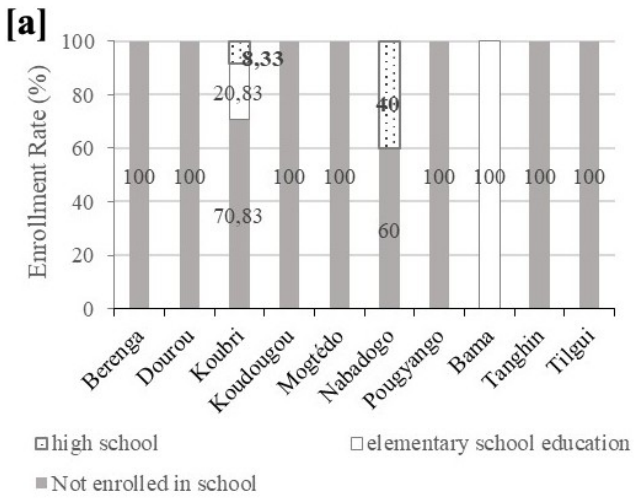
| Sites | *n* | Mean age (year) |
|---|---|---|
| Koubri | 25 | $38.5\pm6.57^{b}$ |
| Berenga | 14 | $25\pm0.007^{c}$ |
| Dourou | 11 | $37\pm0.004^{b}$ |
| Mogtédo | 6 | $45.17\pm20.23^{a}$ |
| Nabadogo | 8 | $32.8\pm7.85^{b}$ |
| Koudougou | 10 | $49.5\pm4.12^{a}$ |
| Tilgui | 12 | $36\pm8.49^{b}$ |
| Pougyango | 13 | $42.33\pm2.52^{a}$ |
| Tanghin | 8 | $45\pm7.07^{a}$ |
| Bama | 5 | $40\pm0.01^{ab}$ |

The superscript letters a, b and c shown in the column indicate significant differences across sites.

The overall enrollment rate among individuals involved in shrimp processing and marketing was 16.91±32.64%. This rate ranged from 0% at the Berenga, Dourou, Koudougou, Mogtédo, Pougyangou, Samendéni, Tanghin, and Tilgui sites to 40% at the Nabadogo site, where participants had completed secondary education (Figure 5a). The highest mean number of years of experience (24.16±15.94 years) was recorded among female processors at the Mogtédo site in the Central Plateau Region, whereas the lowest mean number of years of experience (14.5±4.95 years) was observed among female processors at the Tilgui site in the Northern Region (Figure 5b).

### 3.2 Level of organization among stakeholders

Analysis of the data revealed that 37% of the fishermen and 84% of the female fish processors surveyed were members of professional organizations (POs) for fishermen and female fish processors, respectively. Across the study sites, POs for fishermen were present in only 40% of the locations (Berenga, Mogtédo, Nabazana, and Tilgui), whereas professional organizations for female fish processors were found in 80% of the sites (Dourou, Koubri, Mogtédo, Nabadogo, Pougyango, Bama, Tanghin, and Tilgui) (Table 4). However, in localities where professional organizations existed, their level of functioning was generally low, as evidenced by irregular statutory general meetings, low membership fee contributions, and the infrequent renewal of executive committees.



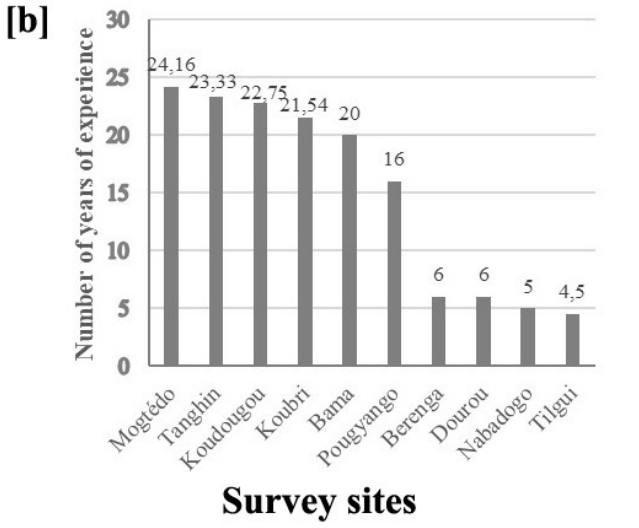




**FIGURE 5** Enrollment rates (a) and average number of years of experience (b) among female fish processors.

**TABLE 4** Level of organization among stakeholders.

| Parameters | Fishermen (%) | Food processors/retailers (%) |
|---|---|---|
| Members of a PO | 37 | 84 |
| Not a member of a PO | 63 | 16 |
| Sites where there is at least one PO | 40 | 80 |
| Sites where there is no PO | 60 | 20 |

PO: professional organization

### 3.3 Relationships among stakeholders

The relationship between fishermen and female processors was predominantly professional. Female processors often supported fishermen by providing fishing gear and equipment. In exchange, fishermen prioritized the sale of their catch to the women who supplied the equipment, thereby fulfilling their obligations. Beyond these professional interactions, familial and marital relationships also occurred. Within marital relationships, fishermen generally gave priority to supplying their catch to their wives when the latter were involved in fish processing or marketing activities.

### 3.4 Characterization of fishing gear and shrimp catches

**3.4.1 Fishing gear:** The principal fishing gears used, in descending order of prevalence, are fishing traps (FT), cast nets (CN), and gill nets (GN). These gears were often used in combination with other fishing gears. Table 5 summarizes the fishing gears employed and the various gear combinations observed at the surveyed sites.

Some fishermen used canoes to facilitate access to deeper waters, while others used bait to increase their catch. Corn bran was the most commonly used bait, reported by 65.22% of respondents. In addition to corn bran, other types of bait were also used, including millet bran and cereal flours (Figure 6).

**TABLE 5** Types of fishing gear used in different survey sites.

| Sites | Proportions of fishing gear use (%) | | | | |
|---|---|---|---|---|---|
| | FT | CN | CN+FT | GN | GN+FT |
| Berenga | 100 | - | - | - | - |
| Ouèra | 100 | - | - | - | - |
| Salbisgho | 100 | - | - | - | - |
| Savili | 100 | - | - | - | - |
| Tilgui | 100 | - | - | - | - |
| Toécé | 100 | - | - | - | - |
| Bion | - | - | 100 | - | - |
| Makognandougou | - | - | - | 75 | 25 |
| Mogtédo | - | 80 | 20 | - | - |
| Nabazana | - | 50 | 50 | - | - |

FT: fishing traps; CN: cast net; GN: gill nets; CN+FT: cast net + fishing traps and GN+FT: gill nets + fishing traps.

**3.4.2 Shrimp harvesting:** The shrimp harvesting season extended from November to June (Figure 7). Its duration varied from three months at the Bion (February–April), Berenga and Ouèra (March–May), Salbisgho (January–March), and Toécé (April–June) sites to seven months at the Mogtédo (December–June) and Nabazana (November–May) sites.

The mean daily shrimp catch per site was 6.54±3.76 kg. The Ouèra site recorded the highest mean daily catch (10.0 kg), followed by the Bion site (9.67±5.51 kg) and the Mogtédo site (8.0±4.47 kg) (Table 6). However, a one-way ANOVA conducted at the 5% significance level indicated no significant differences among the mean daily catches recorded at these three sites. A similar pattern was observed for the Berenga, Tilgui, and Savilly sites. In contrast, the mean daily catches recorded at the Salbisgho

and Nabazana sites differed significantly from those of the other sites ($p$ = 0.030).

Shrimp fishing was conducted daily at the Bion, Berenga, and Ouèra sites. In contrast, fishermen at the Salbisgho site engaged in shrimp fishing on an average of three days per week (Table 5). The price received by fishermen for fresh shrimp ranged from 1400 CFA francs $kg^{-1}$ at the Mogtédo site to 2625 CFA francs $kg^{-1}$ at the Nabazana site (Table 6).

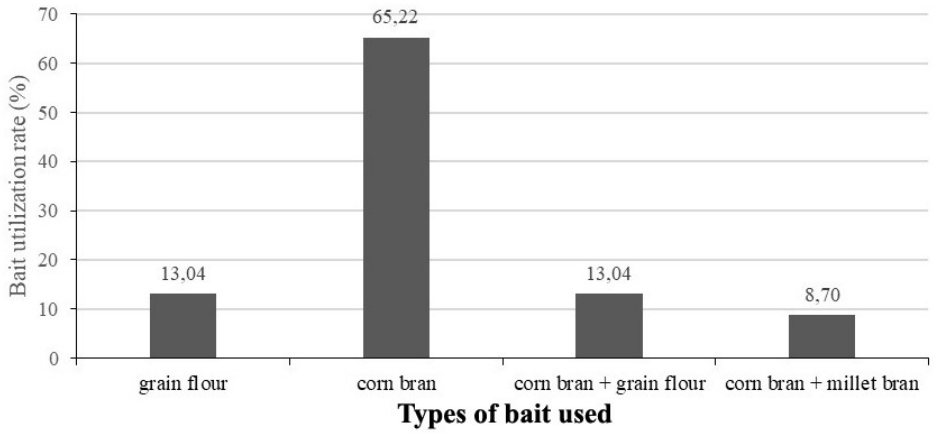



**FIGURE 6** Types of bait used by the fishermen.

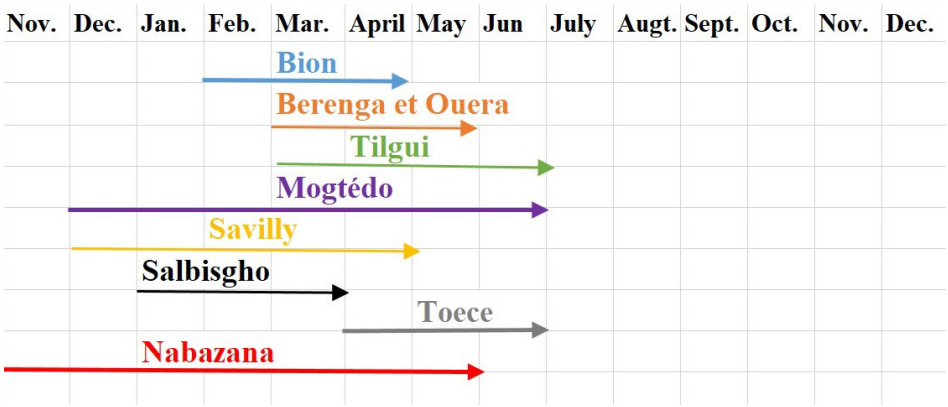



**FIGURE 7** Shrimp catch periods by study sites in Burkina Faso.

**TABLE 6** Average daily quantities of shrimp caught and average number of fishing days per week.

| Sites | Mean daily catch (kg) | Average number of days spent catching shrimp | Selling price per Kg by fishermen (francs CFA) |
|---|---|---|---|
| Bion | 9.67±5.51$^{a}$ | 7±0.00$^{a}$ | 2040 |
| Berenga | 7.5±3.54$^{ab}$ | 7±0.00$^{a}$ | 1875 |
| Tilgui | 7.5±3.54$^{ab}$ | 5±2.8$^{ab}$ | 1750 |
| Mogtedo | 8±4.47$^{a}$ | 6.8±0.4$^{ab}$ | 1400 |
| Ouèra | 10±0.00$^{a}$ | 7±0.00$^{a}$ | 2250 |
| Savilly | 7±0.00$^{ab}$ | 5±0.00$^{ab}$ | 2000 |
| Salbisgho | 3±0.00$^{c}$ | 3±0.00$^{b}$ | 2000 |
| Toece | 6.5±0.71$^{b}$ | 4±0.00$^{b}$ | 1750 |
| Nabazana | 3.08±0.97$^{c}$ | 5.5±1.6$^{ab}$ | 2625 |

The letters a, b, and c appearing in the same column indicate significant differences between the quantities.

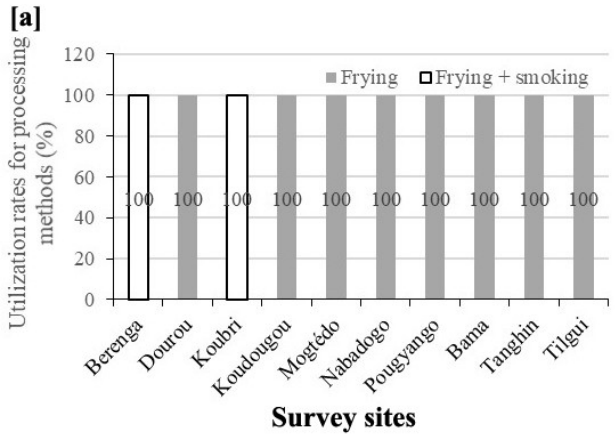
**3.4.3 Equipment and materials for transporting and storing shrimp:** Several types of containers are used to package fresh shrimp. The most common are fiber bags, baskets, trays, and buckets. The shrimp are packed with ice and transported using two-wheeled vehicles (motorcycles, bicycles) or three-wheeled vehicles (tricycles). Once at their destination, they are transferred to insulated boxes containing ice (Figure 8) or, at times, to refrigerators or freezers, depending on the resources available to each stakeholder.



**FIGURE 8** Fresh shrimp in a cooler filled with ice.

### 3.5 Shrimp processing methods and equipment

The primary shrimp-processing method observed was frying, which was practiced by women at all study sites (Figure 9a). This method serves as a common preservation technique among female processors. To carry out the process, processors used basic equipment, including frying pans, basins, and plates. In addition to frying, processors at the Berenga and Koubri sites also smoked shrimp in response to specific consumer demand. Wood was the primary energy source used for shrimp processing, being reported by 58% of the female processors surveyed (Figure 9b). In contrast, butane gas was used by only 4% of the respondents.



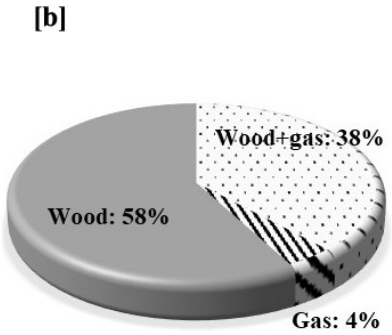




**FIGURE 9** Transformation modes (a) and energy sources used (b) for shrimp processing.

**3.5.1 Shrimp marketing:** The minimum and maximum mean daily quantities of shrimp sold by processors are presented in Table 7. A one-way ANOVA conducted at the 5% significance level indicated no significant difference ($p$ = 0.200) between the mean quantities of shrimp sold by processors at the Berenga and Tanghin sites. Similarly, no significant differences were observed among the Koubri, Koudougou, and Nabadogo sites ($p$ = 0.060). However, the quantities sold at the Berenga and Tanghin sites differed significantly from those recorded at the Koubri, Koudougou, and Nabadogo sites (Table 7).

**TABLE 7** Average daily quantities of shrimp sold by female processors by survey site in Burkina Faso.

| Sites | Quantity sold per day (kg) | | |
|---|---|---|---|
| | Minimum | Maximum | Average |
| Berenga | 6±0.00$^{a}$ | 50±0.00$^{a}$ | 28.0±31.11$^{a}$ |
| Dourou | 0.5±0.00$^{d}$ | 2±0.00$^{d}$ | 1.25±1.06$^{d}$ |
| Koubri | 2.65±1.23$^{bc}$ | 10.88±7.20$^{c}$ | 6.77±5.82$^{b}$ |
| Koudougou | 2.13±1.93$^{bc}$ | 13±5.72$^{c}$ | 7.57±7.69$^{b}$ |
| Nabadogo | 2.4±2.61$^{bc}$ | 9±6.52$^{c}$ | 5.70±4.67$^{bc}$ |
| Mogtédo | 1.5±0.84$^{c}$ | 4.67±1.37$^{c}$ | 3.09±2.24$^{c}$ |
| Pougyango | 3±2$^{b}$ | 10.83±5$^{c}$ | 6.92±5.54$^{b}$ |
| Tanghin | 7±5.2$^{a}$ | 40.67±52.17$^{b}$ | 23.84±23.81$^{a}$ |
| Tilgui | 0.5±0.00$^{d}$ | 1.25±0.35$^{d}$ | 0.88±0.53$^{d}$ |

The letters a, b, c and d appearing in the same column indicate significant differences between the quantities.

Processors sold fresh shrimp at prices ranging from 4000 to 5000 CFA francs kg$^{-1}$ in Koubri, 3000 to 4000 CFA francs kg$^{-1}$ in Mogtédo, 3000 to 3250 CFA francs kg$^{-1}$ in Tanghin, 2500 CFA francs kg$^{-1}$ in Koudougou, and 1750 to 2000 CFA francs kg$^{-1}$ in Pougyango. Fried shrimp were sold in piles using lids of various sizes as measuring units. The price per pile ranged from 500 to 1000 CFA francs, depending on the size of the lid. This practice was common across all study sites. Most processors used lids from Blue Band butter containers for piles sold at 1000 CFA francs, whereas lids from 1-kg cans of sweetened condensed milk were commonly used for piles sold at 500 CFA francs. Field measurements indicated that, on average, six piles sold at 1000 CFA francs each were equivalent to 1 kg of fried shrimp.

**3.5.2 Contribution of the shrimp Industry to stakeholders' income:** In terms of mean annual gross income per fisherman, the Mogtédo site recorded the highest value, at 2132480 CFA francs, followed by the Ouèra site, at 1890000 CFA francs. In contrast, the Salbisgho site recorded the lowest mean annual gross income, at 216000 CFA francs (Table 8). No significant difference ($p$ > 0.05) was observed between the mean annual incomes of fishermen at the Mogtédo and Ouèra sites. Similarly, no significant differences were found between the incomes of fishermen at the Bion and Savilly sites, among the Berenga, Tilgui, and Nabazana sites, or between the Toécé and Salbisgho sites.

In terms of mean annual gross income per processor, the Koubri site recorded the highest value, at 6819120 CFA francs, followed by the Tanghin site, at 4200000 CFA francs (Table 9). A one-way ANOVA con-

ducted at the 5% significance level indicated no significant differences ($p$ = 0.070) between the mean annual incomes of processors at the Tanghin and Berenga sites, the Koudougou and Mogtédo sites, the Nabadogo and Pougyango sites, and the Dourou and Tilgui sites. However, the mean annual income recorded at the Koubri site differed significantly from those observed at the other sites ($p$ = 0.030).

**TABLE 8** Annual gross incomes of fishermen by survey site in Burkina Faso.

| Sites | Annual gross income (F CFA) |
|---|---|
| Bion | 1657051[b] |
| Berenga | 1181250[c] |
| Tilgui | 1050000[c] |
| Mogtédo | 2132480[a] |
| Ouèra | 1890000[a] |
| Savilly | 1400000[b] |
| Salbisgho | 216000[d] |
| Toece | 546000[d] |
| Nabazana | 1245090[c] |

1 USD = 584.5 F CFA. The letters a, b and c in the same column indicate significant differences in income.

**TABLE 9** Annual gross income of female processors/traders by survey site in Burkina Faso.

| Sites | Annual gross income (F CFA) |
|---|---|
| Berenga | 4032000[b] |
| Dourou | 180000[e] |
| Koubri | 6819120[a] |
| Koudougou | 3268080[c] |
| Mogtédo | 3830400[c] |
| Nabadogo | 999540[d] |
| Pougyango | 995760[d] |
| Tanghin | 4200000[b] |
| Tiligui | 168000[e] |

1 USD = 584.5 F CFA. The letters a, b and c in the same column indicate significant differences in income.

## 4 | DISCUSSION

In Burkina Faso, shrimp production through aquaculture is virtually nonexistent. The shrimp available in markets come partly from capture fisheries in certain national water bodies and partly from imports. This situation highlights the country's dependence on external sources and on climatic uncertainties that regularly affect the level of fishery production in these water bodies.

The sociodemographic profile of stakeholders in the shrimp sector reveals a gender-based division of roles, with men predominating in fishing and women in processing, preservation, and marketing. This division of roles is consistent with observations made in other West African countries. Mahyao *et al.* (2014), and Roland *et al.* (2001) noted a similar trend in Senegal, Côte d'Ivoire, and Benin, respectively, where women constitute the majority in post-harvest activities within the fisheries sectors. This division of labor often reflects deeply entrenched cultural and social norms, but it can also limit economic opportunities for women in certain segments of the sector.

The dominance of local residents in shrimp fishing, processing, and marketing corroborates the findings reported by Boguhe *et al.* (2011); Kadjo *et al.* (2016), who noted that Ivorians constituted the majority of shrimp fishermen operating on the Bandama River (64%) and the Bia River (94%). Furthermore, the ethnic diversity observed among shrimp fishermen and processors/traders was noted by Kadjo *et al.* (2016) and Roland *et al.* (2001) in Côte d'Ivoire and Benin, respectively. The diversity of nationalities and ethnic groups across all sectors of activity reflects a sign of integration among peoples and cultural mixing, even if this is often a source of tension between communities.

The low proportion of young people among shrimp fishermen corroborates the findings of Boguhe *et al.* (2011), who observed that young people under the age of 30 accounted for 25% of fishermen on the Bandama River. According to Kadjo *et al.* (2016), shrimp fishing is primarily carried out by older fishermen and the most experienced adults. This situation may be explained by the fact that young people are more inclined toward other types of activities, such as trade, gold panning, schooling, etc., and engage in fishing only on a part-time basis. However, young people are fairly well represented in shrimp processing and marketing activities. In most cases, the young women encountered in this sector were involved because they were assisting their mothers. This shows that the development of the shrimp industry in Burkina Faso could contribute to job creation and income generation for young people and help reduce their unemployment rate. The presence of all age groups in the shrimp industry is a positive indicator of the transmission of know-how from one generation to the next.

In general, the level of education among the stakeholders surveyed is low. This could pose an obstacle to the genuine professionalization of the sector's activities. However, the development of initiatives similar to those in the fish sector such as the agropastoral and fisheries initiative (2023–2025) could encourage young graduates to take an interest in the shrimp sector as an opportunity for job creation and income generation, provided that aquaculture production is successfully mastered.

The low level of organization among fishermen, in contrast to that of processors and traders, is a factor that limits their ability to defend their interests, sustainably manage the resources they exploit, and benefit from support from the government and its partners in the context of their fishing activities. According to Béné *et al.* (2009), organizing fishermen into associations or cooperatives

can improve their bargaining power and facilitate the adoption of sustainable practices. However, the low level of organization observed in certain study areas could hinder the sector's sustainable development. Unlike fishermen, fish processors are well organized. This situation makes it easier for them to obtain support from the government and its development partners.

The provision of fishing gear and equipment to fishermen by processors in exchange for their catches is a mechanism that has the advantage of allowing fishermen who lack financial resources to obtain the tools they need to work. However, the repayment method could work to their disadvantage, as the processors who provided them with equipment often face difficulties in setting the purchase price for their catches. There are also cases where fishermen who have been provided with equipment by processors fail to honor their commitments. After a few repayment installments, they may change to landing sites that are inaccessible or supply only a portion of their catch to the processors who provided them with equipment, claiming that the catch was poor. To address these shortcomings, fishermen need access to microfinance institutions (MFIs) so they can obtain loans that will enable them to purchase the tools they need for their work and sell their products under better conditions.

The use of rudimentary fishing gear such as traps, gillnets, and gill-and-line nets, as well as the variety of baits used, reflect an adaptation to local conditions. According to Welcomme *et al.* (2010), the use of traditional fishing methods may be more sustainable in the long term, but it can also limit fishermen's productivity and income. The introduction of more modern techniques should therefore be approached with caution, taking into account potential impacts on the ecosystem and the sustainability of the resource.

Shrimp are caught primarily during the dry season, when rainfall is low to nonexistent. This could be explained by the fact that fishermen are able to devote more time to fishing once farm work is finished; according to Bado *et al.* (2007), virtually all Burkinabé fishermen are primarily farmers. Furthermore, the dry season appears to coincide with the period most favorable for shrimp development at the study sites.

Variations in average daily catches and the number of fishing days per site are thought to be linked, on the one hand, to shrimp abundance, which varies from one site to another due to differences in conditions favorable to their growth, and, on the other hand, to the level of professionalism among fishermen and the local population's interest in consuming shrimp.

Preservation and processing practices depend on the specific conditions at each site, with common constraints such as a lack of appropriate equipment and difficulties in accessing energy for the cold chain and processing. These challenges are often the cause of increased post-harvest losses in African artisanal fisheries (Akande and Diei-Ouadi 2010). Improving preservation and processing techniques could not only reduce post-harvest losses but also increase the value added of the products and the income of stakeholders in the value chain.

The prevalence of frying as a processing method and the use of wood as an energy source raise questions about energy efficiency and environmental sustainability. It is therefore necessary to encourage the use of more sustainable alternatives, such as improved stoves and renewable energy, in order to reduce carbon emissions.

The quantities of shrimp sold by processors depend on supply sources and fishermen's catches. For example, processors in Koubri and Tanhgin are generally supplied by fishermen from Bion and Nabazana; those in Koudougou by fishermen from Ouèra and Salbisgho; and those in Nabadogo by fishermen from Savilly. This demonstrates the diversity of shrimp supply sources and reflects the existence of a harmonious, albeit informal, organization between fishermen and the processors in the shrimp industry. In this structure, it is difficult to distinguish between those involved in processing and those involved in marketing shrimp, as was done by Aquilas *et al.* (2013) and Mahyao *et al.* (2014). The same women serve as both processors and traders (Sachi *et al.* 2016) after receiving their supplies from the fishermen.

The high selling prices of shrimp at the Koubri and Mogtédo sites are likely linked to strong demand at these locations due to their proximity to the city of Ouagadougou a major consumption hub and their easy accessibility. These prices are comparable to those observed by Mahyao *et al.* (2014) among retailers of freshwater shrimp from the Bandama River in Côte d'Ivoire. However, at other sites such as Pougyango, the selling price is relatively low due to its distance from major consumption centers such as Yako, Ouahigouya, Ouagadougou, etc., and its relatively difficult accessibility. In general, the selling prices of fresh or smoked shrimp are higher than those of nearly all fish species caught in Burkina Faso, with the exception of species such as *Lates niloticus* and *Gymnarchus niloticus*.

For each site, if we calculate the average monthly gross income of fishermen and fish processors based on their annual gross income, we find that it exceeds the current value of the Guaranteed Interprofessional Minimum Wage (SMIG) in Burkina Faso, which is 45000 CFA francs, with the exception of the Salbisgho site (where it is less than 20000 CFA francs). The recorded annual gross incomes at most sites are significantly higher than those determined by Mahyao *et al.* (2014) among fishermen who catch shrimp on the Bandama River in Côte d'Ivoire. This shows that shrimp fishing, although a secondary activity to fish catching in several localities in Burkina Faso, significantly improves the incomes of fishermen and female processors. The importance of shrimp is also evident

in the annual “Koulsouré” fair or “shrimp fair,” as it is known in the national Moré language organized by the Koubri Association of Fish and Shrimp Vendors.

## 5 | CONCLUSIONS

Based on this study, it is clear that the shrimp industry in Burkina Faso is characterized by the presence of stakeholders (fishermen and processors/retailers) who are predominantly Burkinabè, with a low representation of young people under 35 (22.22%), particularly in the capture fisheries sector, and an overall enrollment rate below 20% among both fishermen and processors/traders. In addition, there is a lack of specific organizations representing sector stakeholders, and a variety of fishing gear is used (traps, gillnets, entangling nets, and canoes) and baits (cereal flour, corn bran, millet bran) to facilitate shrimp catches, and variations in peak catch periods (which span November through June) depending on the location. Overall, the prices at which fishermen sell shrimp are about half those paid by processors, with gross monthly incomes exceeding the current minimum wage in Burkina Faso. Although shrimp are a specific product that generates income for industry stakeholders, it must be emphasized that, to date, it is difficult to speak of the existence of a structured shrimp industry in Burkina Faso. Stakeholders view shrimp as byproducts of fish farming. It will therefore be necessary to continue research to characterize the shrimp populations in Burkina Faso’s water bodies in order to eventually domesticate one or more species suitable for aquaculture.

## CONFLICT OF INTEREST

The author declares no conflict of interest.

## AUTHORS' CONTRIBUTION

Oumarou Sow: Data curation, Investigation, Methodology, Formal analysis, Visualization, Writing – original draft; Souleymane Sanogo: Conceptualization, Methodology, Writing – review & editing.

## AI-USE STATEMENT

AI was used in this manuscript to facilitate linguistic review and to improve grammar and readability. AI was not used for data collection, analysis, or interpretation, nor for the generation of scientific results.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on a reasonable request from the corresponding author.

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