

Assessment of traditional fish processing techniques and production systems in Bataan's backyard sector

Lizette B. TAPANG, Mydee S. QUIÑONES, Elma B. MUÑOZ-GONZALES, Madel F. DAMASO

Cite this article as:

Tapang, L.B., Quiñones, M.S., Muñoz-Gonzales, E.B., Damaso, M.F. (2026). Assessment of traditional fish processing techniques and production systems in Bataan's backyard sector. *Aquatic Research*, 9(1), 8–17. <https://doi.org/10.3153/AR26002>

Bataan Peninsula State University-Orani
Campus, Bayan, Orani, Bataan,
Philippines

ORCID IDs of the author(s):

L.B.T. 0009-0004-4647-0523
M.S.Q. 0009-0006-1949-8197
E.B.M.G. 0009-0002-1222-7344
M.F.D. 0000-0002-2756-8785

Submitted: 07.10.2025

Revision requested: 21.10.2025

Last revision received: 04.11.2025

Accepted: 04.11.2025

Published online: 09.01.2026

Correspondence:

Madel F. DAMASO

E-mail: mfdamaso@bpsu.edu.ph

ABSTRACT

Fermented fish (*Acetes sp.*), dried-salted fish (*tuyo*) and smoked fish (*tinapa*) remain as the most manufactured products in the Philippines, including Bataan, contributing to a significant livelihood and food source in the province. The study was conducted in 11 municipalities and one city in Bataan. This study aimed to assess and profile backyard processors in the province. The study employed a combination of qualitative and quantitative research designs. Qualitative data included the interview, actual observations, and Focus Group Discussions (FGDs). A semi-structured questionnaire was used to primarily collect data from the fish processors. On the other hand, data on income, years of engagement, and return on production expenses are among those that were quantitatively gathered. *Tuyo*, *tinapa*, and fish paste (bagoong alamang) emerged as the most produced products in the province. *Tinapa* was primarily produced in Balanga City, while *tuyo* processing was made in bulk in Balanga City, Abucay and Orion. Milkfish and round scads are the primary raw materials for *tinapa*, while Salinas fish for *tuyo* are purchased from fishers. Return on Production Expenses (ROPE) showed processors gained 30% income. A positive correlation between income, years of engagement and volume of production was computed. Source of raw materials, working capital and facilities and equipment top the most concerns for backyard processors. Results indicated that backyard processors have a very low awareness of food safety (98.53%).

Keywords: Mapping, Profiling, Fish processing, Smoked fish, Dried salted fish



© 2026 The Author(s)

Available online at
<http://aquatres.scientificwebjournals.com>

Introduction

One of the fastest-growing sectors providing global protein requirements is the fisheries (Vergis et al, 2021). Fisheries provide food (Arlinghaus et al, 2019), which has been extracted from the wild for centuries (Tahiluddin & Kadak, 2022) and even from commercial fishers and increasing aquaculture (Arlinghaus et al, 2019). In Asia, traditional fish processing techniques (TFPTs) are widely applied, including in the Philippines.

The Philippines is an archipelagic country endowed with fish and fishery resources (Tahiluddin & Kadak, 2022), making it one of the most common sources of food and livelihood for Filipinos. Fish production in the country was as high as 4,400,373.01 metric tons in 2020 (Philippine Statistics Authority 2021). With the fish production in the country, where extraction from the wild is a practice (Tahiluddin & Kadak, 2022) and the continuously growing aquaculture (PSA, 2021), it is not surprising that Filipinos rely on fishery products as their primary source of protein. While the world population is rapidly increasing (Tahilludin & Kadak, 2022), demand for seafood could be addressed through effective processing technology (Espejo-Hermes, 1998; Tahilludin & Kadak, 2022)

Fish processing technology in the country refers to activities used in the post-harvest processing, handling, and marketing up to the final consumption, which are primarily aimed at preventing spoilage or retard the growth of microorganisms, shortening shelf life (Espejo-Hermes, 1998; Tahiluddin & Kadak, 2022; FAO & WHO, 2021). Fish processing techniques were composed of traditional and non-traditional methods. Traditional fish preservation techniques widely used in the Philippines are smoking, drying, and fermenting, as these are inexpensive and straightforward methods (Cain, 2019; De Leon, 2020), while non-traditional methods include canning, freezing, and chilling (FAO & WHO, 2021).

Widely produced through traditional methods, dried-salted fish is one of the ethnic and important value-added fishery products in the Philippines, consumed locally and abroad (Amascual, 2020; Simora & Peralta, 2018). Moreso, smoked fish is considered one significant economic activity in the country (Bigueja, 2020) that, despite being one of the oldest processed fish products, continues its popularity. Every Filipino consumes about 37 kg year⁻¹ of fishery products per year (Tahilludin & Terzi, 2021). Moreover, most fisherfolk rely on indigenous knowledge and traditional methods; hence, most processing methods are traditionally done in backyards and sold to local consumers or dealers (Tahilludin & Kadak, 2022; Amascual et al., 2020; Irene & Abadiano, 2017).

This study was conducted to assess and provide the current profile and status of backyard fish processing in Bataan province. Backyard processors in this study were those producing and manufacturing smoked and dried-salted fish on a small scale, do not require a business permit and operate in small areas adjacent to their homes. This aimed to assess processing activity in each municipality or city and species utilised and produced products, and profile backyard fish processing in terms of years in processing engagement, source of capital, source of raw materials, marketing channel, annual production, and cost and return analysis.

The results of this study aimed to increase awareness on the proper management of fisheries resources towards environmental, social and economic sustainability. Environmental sustainability is hoped to be achieved through minimising waste by implementing value addition and implementing an effective waste management system to prevent pollution and minimise environmental impact. Further, social sustainability was deemed necessary through ensuring a safe working environment and fair labour practices, specifically for marginalised sectors, while providing safe and healthy products to consumers. Moreso, this is to ensure that backyard fish processing contributes to local economic development and adapts to the changing consumer demands.

Materials and Methods

Locale of the Study

The study was conducted in 11 municipalities and one city in Bataan. The province is a peninsula facing the South China Sea to the west and Subic Bay to the northwest and encloses Manila Bay to the east. It is located at 14°41'06"N 120°25'55"E. Bataan is a peninsula and is considered one of the significant sources of fish and fish products in Luzon, which include good-quality tilapia, *bangus* (milkfish), tiger prawns, mud crabs, and bivalves such as mussels, oysters, and *kapiz*.

Respondents

There were 68 backyard fish processors surveyed in the study. Respondents were fish processors from 11 municipalities and one city in Bataan province. The number of respondents was determined upon coordination with the provincial Department of Trade and Industry (DTI) and the Local Government Unit (LGU). Processors conducting various processing methods, traditional or non-traditional, were considered in the study. Respondents were categorised into two

groups: those with permits and those who were entirely implementing backyard methods.

Sample Size

Thirty percent (30%) of fish processors of all types in each municipality were considered in this study and estimated using Slovin's formula as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = Number of samples,

N = Total population and

e = Error tolerance (level).

Sampling Technique

The number of fish processors was determined based on the data from DTI and LGUs. A random sampling of fish processors was implemented, giving each member of the population an equal chance of being selected as the subject. In the case that the selected respondent was not available, the non-probability convenience or voluntary sampling method was employed.

Research Instrument

Structured and semi-structured questionnaires were used to collect data from the fish processors, following primarily and modifying models of Ansari et al (2013), Oluwafemi et al (2013), and Vergis et al (2021). The research instrument was subjected to validity and reliability assessment by experts in the field.

Data Gathering Procedures

For the survey part, Key Informant Interview (KII) and Focus Discussion Group (FGD) were implemented to collect information from a wide range of processors. All data were recorded. Direct observation during the production and marketing activities was done to validate the survey data. Secondary data were collected from published articles, the Philippine Statistics Authority (PSA), and Local Government Units (LGUs) for further verification.

Data Analysis and Procedure

Both qualitative and quantitative analyses were used in treating the collected data for this study. Qualitative data were encoded and analysed using Microsoft Excel. Qualitative data

were prepared, organised, and reduced to themes and will be represented in tables, charts, and graphs as part of the discussion. Quantitative analyses were run using SPSS. Various statistical tools, including correlation, the chi-square test, and analysis of variance, applying the Posthoc Tukey's test, were utilised. The margin of error was considered at $e=0.05$.

Results and Discussion

Mapping of Fish Processing Engagement

Various fish processing activities in the province, including smoking, drying, fermenting, bottling, and steaming of crabs, are presented in Table 1. Fish processing in the province showed three primary activities: smoking, drying, and fermenting. The most common species processed for smoking was milkfish, while the drying process was mainly produced using salinas fish (*halubaybay*). Fermented/salted product was processed using *Acetes* sp. or *alamang*.

Engagement in smoking fish was observed in central locations in the province, with 91.67%, while drying is practised in eight towns and a city, with 75% of engagement. On the other hand, fermentation is recorded to be implemented in 25% of the areas. The milkfish species emerged as the top species used for smoked processing. This can be attributed to the aquaculture engagement area of the province, where milkfish becomes available at all times for smoked fish processing. Milkfish is the second top-produced cultured species in the Philippines (BFAR, 2019), and Region III, where Bataan is situated, was the second-highest milkfish-producing region in the country (PSA, 2023). Further, Salinas fish *Sardinella fimbriata* and *Acetes* sp. *alamang* are among the common fish species caught in major fishing areas of the province. Shrimp paste is an important fermented commodity in the Philippines (Pilapil et al., 2016). While bottling has been recorded, bottling of tuna was observed in only one town, while bottling of window pane or *kapiz* meat was observed in another town. One of the activities gaining popularity in the province is the processing of blue swimming crabs, where crabs are subjected to steaming as a post-harvest technique, which was observed in Orion, Orani, and Pilar.

The use of traditional fish processing techniques has been practised in the country for several decades (Tahiluddin & Kadak, 2022) because the Philippines has rich and diverse aquatic resources that Filipinos utilise for food and livelihood. Production of these primary activities in Bataan was reported by Morata (2007), suggesting that fish processing activities have been long practised in the region, catering to fish processors' source of income. Data in this study suggests that fish processing activities in the province provide livelihood and income to around 300 workers, dominated by

women. Men were observed to be dominated in the processing of crabs, as the activity requires more physical work, such as hauling big boxes for transport. Morata (2007) also reported that there were more women than men in fish processing in Region III, particularly in Bataan. The same finding was also reported by Damaso (2023), where laborious/productive activities were perceived to be men’s sphere, while less laborious and financial aspects were for women. De Leon (2020) further reported that despite the introduction of freezing and canning techniques, drying and

smoking remain the top-most engaged fish processing activities in the province, as these offer easy and inexpensive methods of fish preservation.

Non-traditional fish processing in the Philippines, specifically the canning of the tuna industry, has been an important source of protein for many households, as tuna ranked the highest among fish products consumed locally at 4.35 kilograms of consumption per capita per year in 2014 (Llanto et al., 2018).

Table 1. Fish Processing Production in Bataan

Municipality/City	Products Manufactured	Fish Species
Dinalupihan	Smoked Fish	Milkfish; Round scad
Hermosa	Smoked Fish	Milkfish; Round scad
Orani*	Fermented*	Small shrimp (<i>alamang</i>) <i>Acetes sp</i>
	Smoked	Milkfish, tilapia, round scad, Sardine fish (<i>tamban</i>)
	Dried	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i> , anchovies
	Steamed swimming crab	Blue swimming crab
Samal	Bottled	River swimming crab (<i>Talangka</i>), Window pane (<i>kapiz</i>)
	Smoked	Milkfish, tilapia, round scad, <i>tamban</i>
Abucay*	Salted/Fermented	Small shrimp (<i>alamang</i>) <i>Acetes sp</i>
	Dried*	Milkfish, tilapia, round scad, <i>tamban</i>
	Smoked	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i> , anchovies
Balanga City*	Smoked*	Milkfish, tilapia, round scad, <i>tamban</i>
	Dried*	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
		Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
Pilar	Fermented*	Small shrimp (<i>alamang</i>) <i>Acetes sp</i> .
	Bottled	Tuna
	Steamed crabs	Blue swimming crabs
	Dried	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i> , anchovies
	Smoked	Milkfish, Sardine fish (<i>tamban</i>), scad
Orion*	Steamed crabs	Blue swimming crabs
	Dried*	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
	Smoked	Milkfish, <i>tamban</i> , scad
	Fermented	Small shrimp (<i>alamang</i>) <i>Acetes sp</i>
Limay	Dried	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
	Smoked	Milkfish, Sardine fish (<i>tamban</i>), scad
Mariveles		Sapsap, Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i> , anchovies, squid
	Dried	
Morong	Dried (Acquired)	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
	Smoked (Acquired)	Milkfish, Sardine fish (<i>tamban</i>), scad
Bagac	Dried	Salinas fish (<i>Halubaybay</i>) <i>Sardinella fimbriata</i>
	Smoked	Milkfish, Sardine fish (<i>tamban</i>), scad

Legend: * Major producers of fish processed products in Bataan

Fish Processing Profile

Bataan province has been known for its traditionally produced fish products, including fermented fish, dry-salted fish, and smoked fish. As stated, this became a significant source of food and livelihood in the province. The general profile of the fish processing industry in the province is presented in Figures 2-8.

Fish processors have been engaged in fish processing for several years. The majority of the processors have been processing for several years (Figure 1). The activity was primarily inherited from the family business and continuously managed and operated over the generations. On the other hand, those who were engaged between 6 and 10 years include those in bottling and swimming crab processing. Fish processing has long been known in the Philippines. The smoked fish production has a lengthy and illustrious history in Rosario, Cavite (Mendoza & Abug, 2025), while dried salted fish is a traditional product of the Philippines (Gabriel & Alano-Budiao, 2015), suggesting a long history of processing activity in the country.

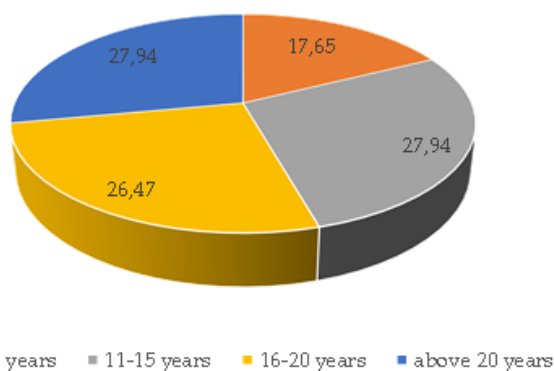


Figure 1. Years of engagement in Fish Processing

Backyard processors operate the enterprise relying on their personal savings and loans (Figure 2). Personal savings include the salary of the husbands and other sources of income, while loans from lending companies, specifically the “5-6”, were the primary option. According to the fish processors, saving money was a difficult task, specifically when starting out a business, which was also reported by Adbi & Natarajan (2023). Apart from savings, loans from banks and lending companies were also an option. Despite difficulties such as physically going to the banks and a high fee when dealing with the banks (Apat, 2024), most fish processors resorted to these lending institutions and banks. At the same time, some asked the family/relatives for loans, while others preferred to have it on their own to avoid family conflicts. Some further stated that interest can be paid much more easily over “utang

na loob”. *Utang na loob* was described by Gavino et al. (2023) as a Filipino way of showing gratitude for a favour granted. Apart from the obligation to pay the financial debt, the receiver is morally obligated to have a debt of gratitude. Gavino et al. (2023) further reported that, in failure of the receiver to pay for the debt, the receiver can be tagged as having no integrity, which could lead to severed ties between the giver and receiver. In terms of source of raw materials (Figure 3), some fish processors collect their raw materials as they have their boats specifically for drying. Further, all processors rely on purchasing to acquire raw materials. For smoke processing, milkfish and tilapia are supplied from the province and nearby provinces, including Bulacan and Pampanga. Region 3 was reported as the top 4 highest producing fisheries production, topping the tilapia production, while second on milkfish production in 2022 (PSA, 2023). Other smoking raw materials, including mullet fish (kapak) and sardine (tamban), are captured in the waters of Bataan, while the round scad was bought from other fish landing areas. The Salinas fish, or halubaybay, as the primary raw material used for dried-salted fish (tuyo), are collected from the waters of Bataan. Salinas fish were typically abundant in the coastal waters of Bataan, specifically in Limay and Orion, making the areas the leading suppliers of raw materials in the community (PEMSEA and Provincial Government of Bataan, 2017). Its abundance could be attributed to the environment, which was described by Whitehead (1985) as a marine or brackishwater area, favouring the growth and reproduction of the species. In the absence of local availability, raw material is purchased from Cavite and Bulacan.

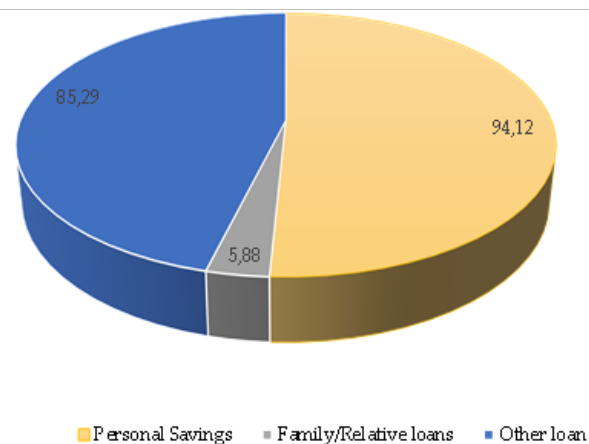


Figure 2. Source of Capital for Fish Processing

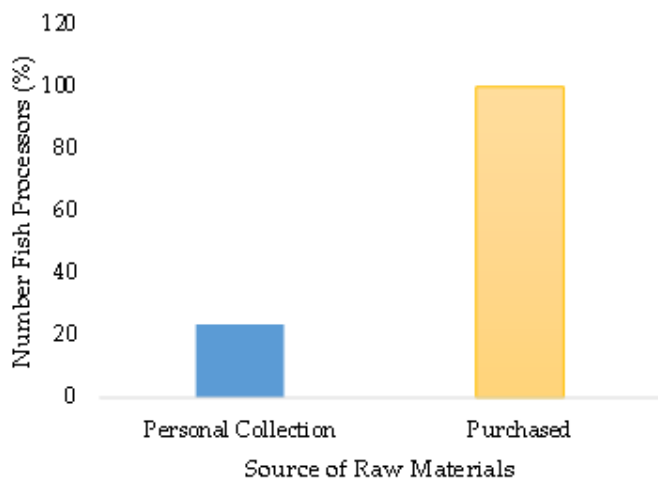


Figure 3. Source of raw material. For Fish Processing

Fish processors distribute their finished products in multiple types of marketing channels (Figures 4 and 5). Most smoked fish producers in the study also engaged in dried fish production, diversifying their product offerings. Additionally, processors utilised multiple marketing channels, tailoring their distribution strategies to the volume of production. Findings reveal that the marketing channels of *tuyo* and *tinapa* are almost similar. Figure 4 shows that for smoked fish, tailored distribution channels were identified as producer to consumer (P-C: 92.42%), producer-retailer-consumer (P-R-C: 3.03%) and producer-wholesaler/retailer-consumer (P-W-C: 4.55%). A direct channel between producer and consumer appeared to be the most commonly practised, with 92.42%. This was attributed to the volume of the production method applied. Backyard production of smoked fish typically yields small batches, around 10 kilograms or less per production. Backyard producers produce small volumes; hence, the distribution channel is mainly through direct selling to the consumers. Some processors have their own resellers who acquire their final product at a lower price than they sell the product in the market, community and house-to-house. Producer-wholesaler-retailer-consumer is applied especially during peak seasons for smoked fish, where production is high. The highest marketing channel for *tuyo* was observed through producer-wholesaler-retailer-consumer (Figure 5) with 66.27%, followed by producer-retailer-consumer with 14.46%. Producer-consumer and producer-wholesaler-consumer channels both recorded 9.64%, respectively. De Leon's (2020) study focused on the city of Balanga and reported that for *tuyo*, 67% of the production is supplied to 20 retailers at the Balanga City Public Market, while the remaining 33% go to retailers in the other provinces of Luzon, such as Zambales, Pampanga, Tarlac, Laguna, and Quezon. This finding is consistent with the study's results, where most *tuyo* wholesalers

place orders for specific volumes prior to production through the "*suki*" method. The products are then distributed to nearby provinces, including Pampanga, Tarlac, and Nueva Ecija (Figure 6), with some even reaching major markets in Baguio City and Manila.

In addition to *tuyo* and *tinapa*, the recent emerging blue swimming crab processing exhibits a Producer-Wholesaler-Processor/Exporter-Retailer-Consumer. Processing through steaming takes place in the province, hauled and transported to wholesalers in the Bicol Region, supplied to Processors or Exporters and are then distributed in restaurants, local and abroad. Currently, the Bicol Region is the only area with high demand for processed blue swimming crab. Mascariñas et al. (2017) reported that blue swimming crab (*Portunus pelagicus*) is one of the processed fishery products exported by the Philippines in the global market, sourced from a few well-integrated players which extend to other parts of Luzon, including Bataan, and the Visayas.

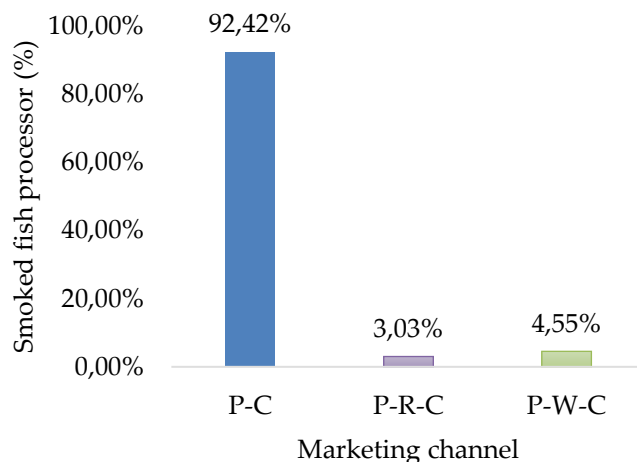


Figure 4. Marketing channel of smoked fish

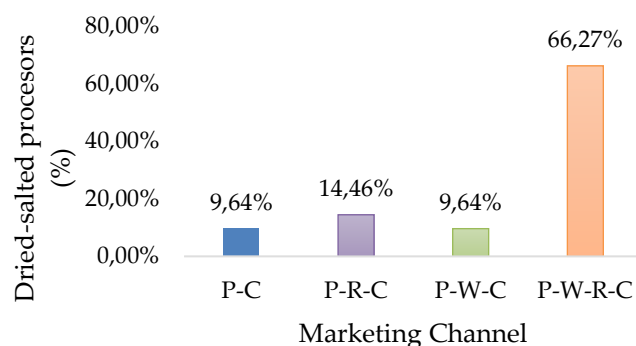


Figure 5. Marketing channel of dried-salted *tuyo* fish

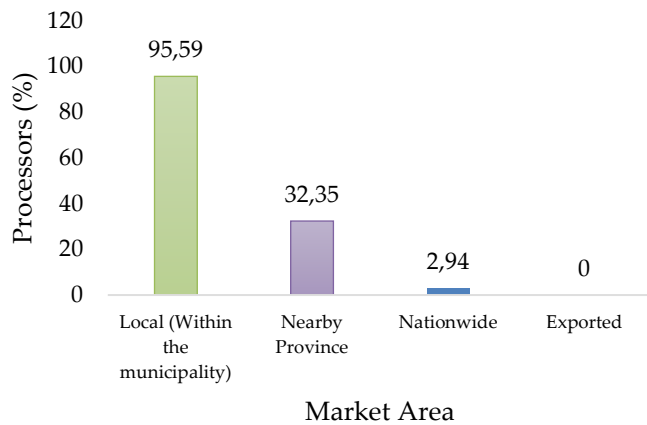


Figure 6. Market area of processed products produced through backyard production in Bataan

Most of the smoked fish products and dried products are marketed within the province. Major producing areas, including Balanga City and Orion, supply the product to the municipalities that do not produce tuyo and tinapa, including Dinalupihan, Hermosa, Bagac and Morong.

Estimating Return on Production Expenses (ROPE) is a crucial step in marketing tuyo and tinapa, as it determines the relationship between input costs and output revenue, informing business decisions. Our findings show that most processors earn a high income, with an ROPE of over 30% (Figure 7). Notably, the ROPE remains relatively consistent across different production levels, despite variations in production volume and activities. *Tuyo* processors, who typically process around 20 kg of raw materials per day, tend to earn higher incomes compared to *tinapa* processors, who produce at lower volumes (5-15 kg of raw materials per day). Statistical analysis revealed a significant positive correlation ($p < 0.05$) between income and years of production, as well as volume of production, suggesting that increased production volume can lead to higher income. In addition, the chi-square test revealed that months significantly affect the income of the processors, specifically the *tuyo* processors ($p < 0.001$). Wet months or rainy months (e.g. June, July, August, September) significantly increase the rejected *tuyo* products, while higher income was significantly higher during summer months (February, March, April, May). Fitri et al. (2022) suggested that for the fish to be dried effectively, the temperature, drying environment, and time need to be considered. Drying fish is one way of preserving fish by reducing the water content of fish so that the activity of microorganisms can be reduced (Rani et al., 2022). Hence, wet months prevent this activity, which could significantly affect the quality of the products, leading to poor quality output.

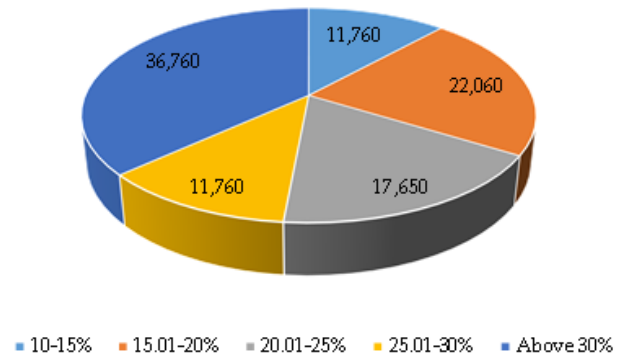


Figure 7. Return on production expenses of backyard fish processing

For *tinapa* processors, production is constrained by the shelf life of the product, which deteriorates more rapidly (Espejo-Hermes, 1998) than salted products. While the fish smoking and drying process reduces moisture, resulting in reduced water activity (Mondo et al., 2020), smoked fish typically contains higher moisture content than salted and dried fish. Francisca et al. (2010) suggested that a well-smoked fish with a low water activity of less than 0.50 and a moisture content between 15 and 25% could inhibit the growth of pathogenic microorganisms in the products. Moreso, a cold storage area is needed to keep the product's shelf life longer. In addition, a more limited market for *tinapa* is observed in the province compared to that of *tuyo*. The number of years a processor has been in the business significantly impacts their income, mainly due to the patronage or "*suki*" system. This system relies on trust and loyalty built over time between processors and buyers, favouring those with longer business histories. As Totanan et al. (2021) noted, small businesses worldwide struggle to survive, but the patronage system can be a key factor in their success. By fostering repeat business through established relationships, processors can increase their marketing sales and ultimately, their profitability (Ajara, 2017; Totanan et al., 2021).

Issues and Concerns on Backyard Fish Processing

This study's findings indicate that despite the Philippines' long-standing fish processing industry, most small to medium-sized fisheries continue to rely on traditional methods, including salting, drying, and smoking. According to Cabugao (2024), the processing, production, and marketing of fish products are crucial components of the seafood industry, despite the challenges they face.

Source of raw materials, working capital and facilities and equipment were the most common concerns and issues limiting the production and expansion. Source of raw materials

topped the processors' concern at 98.53%, followed by working capital at 92.65%. Facilities and equipment ranked 3rd with 80.88%. For dried-salted fish (*tuyo*), the abundance of the raw materials is affected by the season and the weather conditions. According to the fishers, gale warnings during the rainy season prevent them from fishing, thereby reducing the availability of raw materials and affecting production. For smoked fish, while milkfish is considered abundant in the province and nearby provinces, price fluctuations are often an issue affecting the working capital, hence reducing the potential income. Table 2 presents that months with the highest prices (Php 230-250) were October, November, and December, which are not significantly different from each other (letter "a"). Months with moderate prices (Php 207.50-217.50) were February and September, which are mostly not significantly different from each other (letters "b" and "bc"). Further, January, February, and March have prices that were not significantly different from those of both the higher price groups (letters "ab"). Lowest prices (Php 185.00-197.50) were in May, June, July, Jul and August, which were considered significantly lower among the groups (letter "d"). The price trend suggests a seasonal pattern, with higher prices towards the end of the year and lower prices in the middle of the year. High prices during the abovementioned months are attributed to occasions and local celebrations, including New Year's Eve, Christmas Celebration, Chinese New Year, among others.

Furthermore, adequate facilities and equipment, particularly storage areas, are crucial for effective *tuyo* and *tinapa* processing in the province. According to De Leon (2020), proper facilities and storage can extend the shelf life of processed fish products, thereby enhancing their quality and safety.

Lastly, low awareness of the adoption of good manufacturing practices was also recorded at 98.53%. While the government

offers various production technologies, very limited ones were offered for food safety. In addition, attending seminars and training was deemed a challenge to backyard processors as this stops the daily production, hence reducing the possible income.

Conclusion

The study's findings underscore the critical role of fish processing as a primary source of livelihood for backyard processors in Bataan Province, engaging both men and women, with fermented fish (*Acetes* sp.), dried-salted fish (*tuyo*), and smoked fish (*tinapa*) identified as the most commonly practised processing methods. Given the dominance of these traditional products, targeted support from local government units and relevant agencies is recommended to enhance processing techniques, strengthen marketing strategies, and improve market access in order to increase processors' income and ensure the sustainability and competitiveness of the sector. Analysis of raw material price trends indicates a clear seasonal pattern, highlighting the importance of strategic purchasing, inventory management, and capital planning. Furthermore, limited access to raw materials, insufficient working capital, and inadequate facilities and equipment were identified as the main constraints to production and expansion, emphasising the need for policies that ensure a secure and sustainable supply of raw materials, improved access to affordable credit and financial assistance, particularly for small-scale processors and the upgrading of facilities and equipment to enhance efficiency and productivity. Despite long-term engagement in fish processing activities, awareness of Good Manufacturing Practices (GMP) and food safety remains low, underscoring the necessity for institutional support in product development and comprehensive training programs on GMP and food safety standards.

Table 2. Farm gate price of milkfish for smoked fish processing

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Price (Php)	232.50 ^a	217.50 ^{ab}	212.50 ^{abc}	197.50 ^{cd}	192.50 ^d	185.00 ^d	185.00 ^d	185.00 ^d	207.50 ^{bc}	230.00 ^a	245.00 ^a	250.00 ^a
Std. Dev	9.57	9.57	9.57	9.57	9.57	5.77	5.77	5.77	9.57	8.16	10.00	11.55

Significant at the 0.05 level of confidence.

Means with the same letter are not significantly different. Means with different letters are significantly different.

Compliance with Ethical Standards

Conflict of interest: The author declares no actual, potential, or perceived conflict of interest for this article.

Ethics committee approval: All respondents expressed voluntary participation and provided informed consent in the use and publication of the data collected.

Data availability: The data will be made available upon request from the author.

Funding disclosure: The author extends gratitude to the BPSU and RDO managements for the funding of the project.

Acknowledgements: The cooperation of staff from Local Government Units (LGUs) in the province is highly appreciated. The help and assistance of DOST Region 3 and the DOST Provincial office are likewise acknowledged.

Disclosure: -

References

- Ajara, R. (2017).** The analysis of buying motives in purchase decision of virtual goods in online game. *Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi*, 5(1), 1-13.
- Amascual, R.H., Panganoron, H.O., Irene, E.A., & Pajarillo, N.D. (2020).** Histamine profile of dried-salted fish sold in local supermarkets of Samar, Philippines. *Italian Journal of Food Safety*, 9(1), 8322. <https://doi.org/10.4081/ijfs.2020.8322>
- Ansari, M., Kumar, V., Singh, & Shukla, V. (2013).** Studies on food safety management and it's significance in maximizing the profit for food industry. *Internet Journal of Food Safety*, 15, 20–28.
- Arlinghaus, R., Abbott, J.K., Fenichel, E.P., Carpenter, S.R., Hunt, L. M., Alós, J., ... Jensen, O.P. (2019).** Opinion: Governing the recreational dimension of global fisheries. *Proceedings of the National Academy of Sciences*, 116(12), 5209–5213. <https://doi.org/10.1073/pnas.1902796116>
- BFAR (2019).** Philippine fisheries profile 2018.
- Bigueja, M.C. (2020).** Adoption of Good Manufacturing Practices of Small and Medium Smoked Fish Enterprise (SMSFE) in Bicol Region, Philippines.
- Cain, M.L. (2019).** The Philippines: Fish Preservation Techniques. In *Appropriate Technology for Development* (pp. 343–357). Routledge. <https://doi.org/10.4324/9780429051418-19>
- Cabugao, I. (2024).** Challenges in the processing, production, and marketing of the dried fish industry. *IARJSET*, 11, 1-10. <https://doi.org/10.17148/IARJSET.2024.11501>
- Damaso, M.F. (2023).** Production and marketing practices of the mangrove crab industry towards sustainability in Bataan, Philippines. *Aquatic Research*, 6(1), 26–42. <https://doi.org/10.3153/AR23004>
- De Leon, P.C. (2020).** Processing and marketing of salinas tuyo and tinapa in Balanga City, Bataan. *Journal of Management and Development Studies*, 9(1), 18–29.
- Espejo-Hermes, J. (1998).** Fish processing technology in the tropics. Tawid Publications.
- FAO and WHO (2021).** Microbiological risk assessment - Guidance for food. Microbiological Risk Assessment Series No. 36. Rome.
- Fitri, N., Chan, S.X.Y., Che Lah, N.H., Jam, F.A., Misnan, N.M., Kamal, N., ... Abas, F. (2022).** A Comprehensive Review on the processing of dried fish and the associated chemical and nutritional changes. *Foods*, 11(19), 2938. <https://doi.org/10.3390/foods11192938>
- Irene, E.A., & Abadiano, M. (2017).** Exploring indigenous knowledge, community resilience and belief systems in typhoon-prone areas of Samar, Philippines. *Journal of Academic Research*, 2, 1–15.
- Llanto, G.M., Ortiz, M.K.P., & Madriaga, C.A.D. (2018).** The Philippines' Tuna Industry. In *Reducing Unnecessary Regulatory Burdens in ASEAN: Country Studies* (pp. 210–238). ERIA. <https://doi.org/10.62986/dp2017.13>
- Mascarinas, A.M., Torres, E.E., Cortez, C.V., & Gaveria, L.M.A. (2017).** Value Chain Analysis of Blue Swimming Crab in the Bicol Region, Philippines.
- Mendoza, X.L., & Abug, N. (2025).** Tinapa production: An analysis of current practices, challenges, and potential for enhancement in the province of Cavite. *International Journal of Multidisciplinary Educational Research and Innovation*, 3(2), 1–13.

Mondo, B.C., Akoll, P., & Masette, M. (2020). Water activity, microbial and sensory evaluation of smoked fish (*Mormyrus caschive* and *Oreochromis niloticus*) stored at Ambient Temperature, Terekeka, South Sudan. *International Journal of Fisheries and Aquaculture*, 12(2), 47–60.

Morata, M.S. (2007). The fish processing industry in Central Luzon and the processors' assessment of the extension program of the Department of Agriculture.

MRAG Asia Pacific (2022). The State of Fish in Nutrition Systems in the Philippines.

Oluwafemi, F., Akisanya, E., Odeniyi, K.A., Salami, W.O., & Sharomi, T. (2013). Microbiological quality of street-vended foods and ready-to-eat vegetables in some Nigerian cities. *African Journal of Biomedical Research*, 16, 163–166.

PEMSEA and Provincial Government of Bataan, Philippines. (2017). State of the Coasts of Bataan Province.

Pilapil, A.R., Neyrinck, E., Deloof, D., Bekaert, K., Robbens, J., & Raes, K. (2016). Chemical quality assessment of traditional salt-fermented shrimp paste from Northern Mindanao, Philippines. *Journal of the Science of Food and Agriculture*, 96(3), 933–938.
<https://doi.org/10.1002/jsfa.7167>

PSA (2021). Fisheries Statistics of the Philippines 2018-2020.

PSA (2023). Fisheries Statistics of the Philippines 2019-2021.

Rani, R., Sholihah, N., Mutmainah, F., Sopiha, S., Rahmi, R., Aisyah, N., & Marta, E. (2022). The impact of drying and salting on the fish resilience and quality. *International Journal of Natural Science and Engineering*, 6, 30-36.

<https://doi.org/10.23887/ijnse.v6i1.41473>

Gavino, R.M., Donato, A.M., & Panotan, G.V. (2023). The concept of utang na loob among Filipino working millennials. *Formosa Journal of Social Sciences*, 2(3), 369–396.
<https://doi.org/10.55927/fjss.v2i3.4572>

Simora, R.C., & Peralta, E.M. (2018). Occurrence of histamine and histamine-forming bacteria in Philippine traditional dried-salted fish products. *Asian Fisheries Science*, 31(1), 73–88.
<https://doi.org/10.33997/j.afs.2018.31.2.001>

Tahiluddin, A., & Kadak, A. E. (2022). Traditional Fish processing techniques applied in the Philippines and Turkey. *Menba Kastamonu Üniversitesi Su Ürünleri Fakültesi Dergisi*, 8(1), 50-58.

Tahiluddin, A., & Terzi, E. (2021). An overview of fisheries and aquaculture in the Philippines. *Journal of Anatolian Environmental and Animal Sciences*, 6(4), 475-486.
<https://doi.org/10.35229/jaes.944292>

Totanan, C., Mayapada, A.G., Yamin, N.Y., Parwati, N.M.S., & Indriasari, R. (2021). The effect of patronage buying motives on small business profitability: Evidence from Indonesia. *Innovative Marketing*, 17(1), 109–119.
[https://doi.org/10.21511/im.17\(1\).2021.09](https://doi.org/10.21511/im.17(1).2021.09)

Vergis, J., Rawool, D.B., Singh Malik, S.V., & Barbuddhe, S.B. (2021). Food safety in fisheries: Application of One Health approach. *The Indian Journal of Medical Research*, 153(3), 348–357.
https://doi.org/10.4103/ijmr.IJMR_573_21

Whitehead, P.J.P. (1985). FAO Species Catalogue. Vol. 7. Clupeoid fishes of the world (suborder Clupeoidei). An annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, shads, anchovies and wolf-herrings. FAO Fish. Synop. 125(7/1):1–303. Rome: FAO.