



How Can SNI (Indonesian National Standard) Certification Improve the Quality of Processed Fishery Products in Bone Regency, South Sulawesi, Indonesia?

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ABSTRACT

In 2024, Indonesia's marine and fisheries sector was projected to contribute approximately 65% of the country's total domestic animal protein intake. The implementation of a quality assurance system is guided by Law No. 18 of 2012 on Food Safety Standards and Quality. This study aimed to analyze hedonic product quality and conduct a cost-benefit analysis to formulate a strategy for SNI (Indonesian National Standard) certification that would improve product quality. The research findings indicate that SNI certification enhances organoleptic quality through the application of Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP). The Benefit-to-Cost (B/C) ratio for SNI-certified shredded fish products was 2.85, compared to 1.28 for non-certified products. For fish meatball products, the B/C ratio was 1.07 for certified products and 1.04 for non-certified ones. In contrast, certified presto milkfish products had a B/C ratio of 1.21, while the ratio for non-certified counterparts was slightly higher at 1.38. A SWOT analysis of SNI certification revealed several opportunities, including the development of local regulations supported by strict quality control enforcement, the potential for establishing joint ventures with investors to improve premium product quality, and the promotion of quality-assured products in broader markets. In conclusion, SNI certification has been shown to effectively enhance the quality of premium fishery products and to achieve a B/C ratio exceeding 1, making it economically viable. Recommended policy strategies to support certification include the formulation and implementation of local regulations for certification oversight, the establishment of joint ventures to boost product quality, and the promotion of certified products to strengthen their market presence.

INTRODUCTION

In 2024, Indonesia's marine and fisheries sector was projected to contribute approximately 65% of the nation's total domestic animal protein intake. To support national food security and nutrition, the government is actively working to increase per capita fish consumption. One of the key initiatives involves ensuring the availability of fishery products in sufficient quantities and at

affordable prices, thereby fostering a positive perception of these commodities among the public (Gibson *et al.*, 2020; Maire *et al.*, 2021).

A national framework for food safety and quality standards is established under Law No. 18 of 2012 on Food, which serves as the legal foundation for protecting food products circulated within the domestic market. Article 86, paragraphs 1 to 6, outlines the implementation of food safety and quality assurance policies. Specifically, paragraph 4 states that "the government and/or certification bodies accredited by the government may issue food safety and quality assurance certificates." Some provisions of Law No. 18 of 2012 have been revised through Government Regulation No. 86 of 2019 and Law No. 11 of 2020 on Job Creation.

In the Bone District, a total of 87 small and medium-sized enterprises are engaged in processing various fishery products. SNI (Indonesian National Standard) certification plays a critical role in providing quality assurance for fishery products circulated in the domestic market (Vianna *et al.*, 2020; Rozi *et al.*, 2023). The effectiveness of SNI certification is influenced by several factors, including policy facilitators, primary and supporting stakeholders, and the characteristics of the target groups within the SNI certification policy framework (Wieczorek *et al.*, 2021; Elegbede *et al.*, 2023).

Based on the background and problem identification described above, the objectives of this study were as follows:

1. To analyze product quality through hedonic quality testing on SNI-certified fishery products.
2. To evaluate the cost-benefit aspects of the SNI certification policy on fishery products.
3. To formulate a strategic approach to SNI certification in order to enhance the quality of fishery products.

MATERIALS AND METHODS

1. Time and place

The research was conducted over a period of four months, from January to April 2024. It was carried out at small-scale fish processing units in Bone District, South Sulawesi.

2. Sampling data collection method

This study employed hedonic quality organoleptic testing, cost-benefit analysis and SWOT analysis of certification policy strategies. Primary data were obtained through direct observation of 33 groups engaged in processing fish floss, fish meatballs and steamed milkfish. Secondary data were obtained from legal documents, government regulations, the Central Statistics Agency, the Bone District Fisheries and Marine Affairs Office, the Health Office and the Industry and Trade Office.

3. Tools and materials

The tools used for data collection included a checklist for hedonic quality organoleptic testing. The hedonic quality test analysis was conducted by six trained panelists, who were selected for their expertise in this area. A questionnaire was used to collect data on the cost-benefit analysis and the determination of SNI certification policies in the Bone District.

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Respondents consisted of 33 fish processing business groups and 13 individuals who were involved in the determination of policy options using the SWOT method.

RESULTS

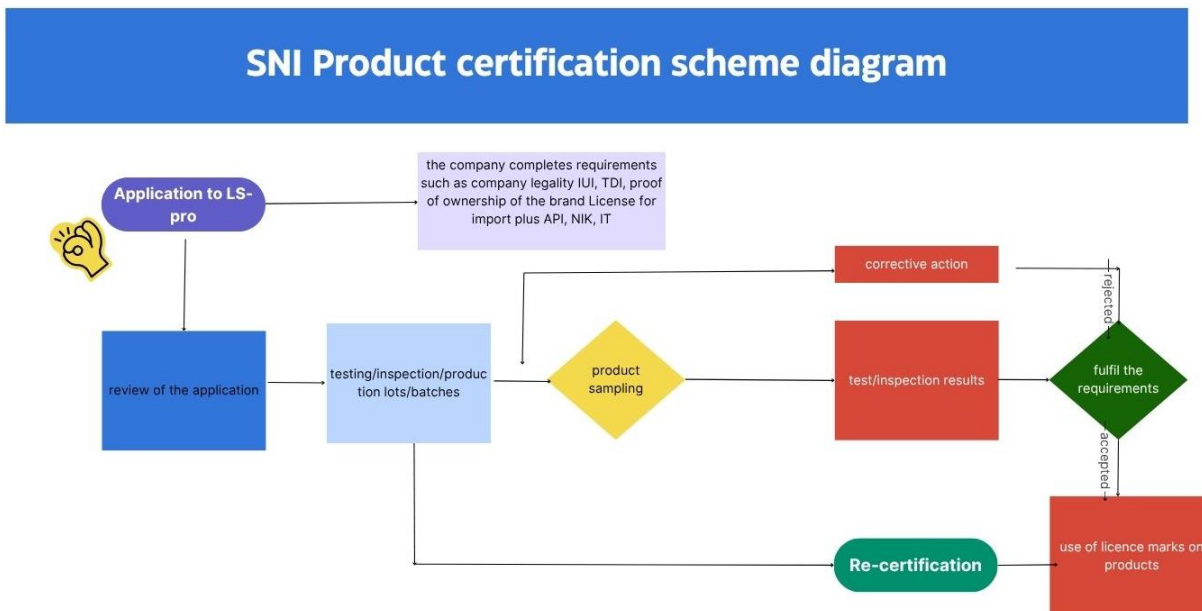


Fig. 1. Illustration of SNI product certification

1. Hedonic quality analysis

Hedonic quality testing is a test applied to determine the level of panelists' liking for SNI certified and non-certified products. Hedonic quality testing includes the appearance, aroma, taste, and texture of the commodity (Torrico *et al.*, 2019; Aguiar *et al.*, 2020).

1.1 Hedonic quality of shredded fish

The comparison of the organoleptic hedonic quality scores of certified and non-certified shredded fish products is shown in the graph below.

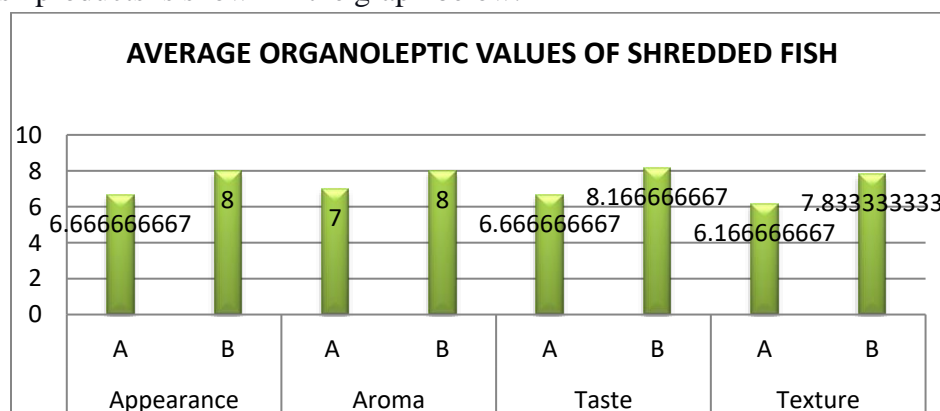


Fig. 2. Hedonic quality value graph for shredded fish. Note: A = Product not yet certified by SNI certification; B = SNI certified product.

1.2 Hedonic quality of fish meatballs

The results of the comparison of the organoleptic hedonic quality values of certified and non-SNI certification-certified fish meatballs are shown in Fig. (3).

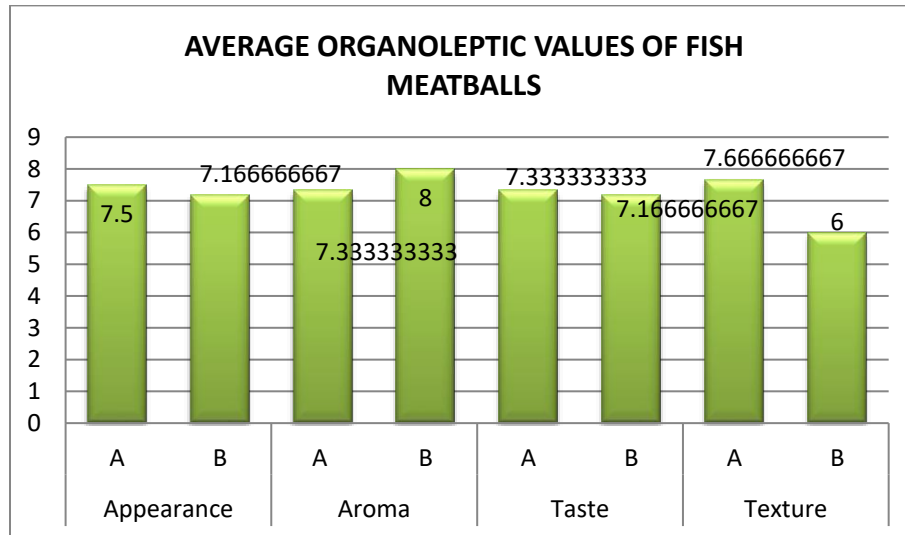


Fig. 3. Hedonic quality value graph of fish meatballs

Note: A = product not yet certified by SNI certification; B = product certified by SNI certification

A comparison between the hedonic organoleptic values of SNI-certified and those of the uncertified fish meatball products shows mixed results. In terms of appearance, uncertified products received higher scores than certified ones. However, for aroma, SNI-certified products were rated more favorably. Regarding taste and texture, uncertified products again received higher values than their certified counterparts.

1.3 Hedonic quality of presto milkfish product

The organoleptic hedonic quality scores of certified and uncertified SNI presto milkfish product products are shown in Fig. (4).

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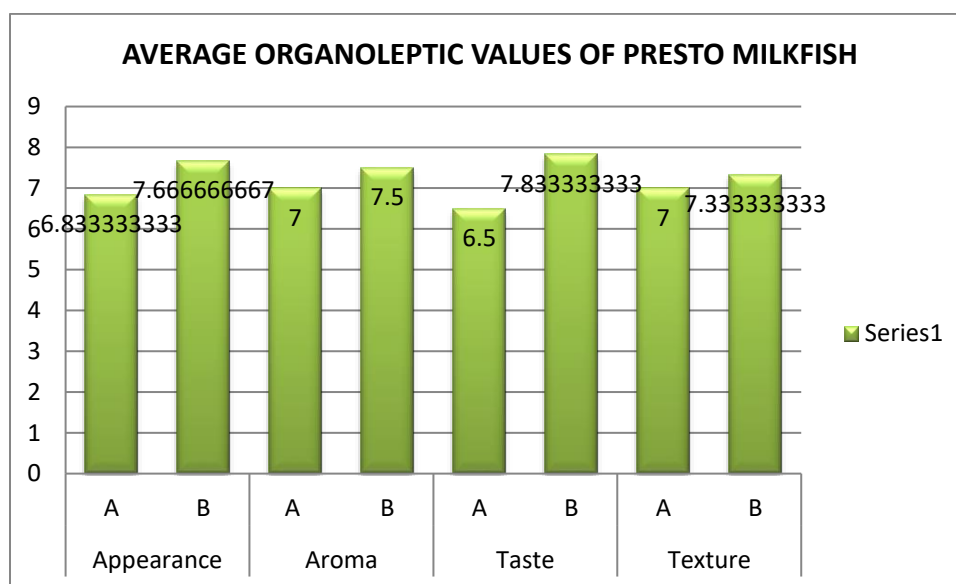


Fig. 4. Hedonic quality value graph of presto milkfish. Note: A = Product not yet certified by SNI certification; B = Product certified by SNI certification

Fig. (4) shows that the hedonic quality value of certified presto milkfish is higher than that of uncertified products in terms of appearance, aroma, taste, and texture.

2. Financial analysis (Cost-benefit)

A financial analysis was conducted to assess the feasibility of the business and to determine whether SNI certification has an impact on production sustainability. Based on a comparison between SNI-certified and non-certified products, the following data presented in Table (1) were obtained.

Table 1. Comparison of financial analysis of SNI and non-SNI products

Product analysis	Fish shredded		Fish ball		Presto fish milk	
	SNI	Non SNI	SNI	Non SNI	SNI	Non SNI
Before Financing						
NPV	4.802.631.170,35	2.454.711.709,72	1.790.266.321,91	1.411.226.310,79	2.014.682.563,77	2.292.238.390,85
IRR	231 %	163 %	120%	119%	155%	177%
B/C	2.58	1.28	1.07	1.04	1.21	1.38
TNB	6.915.000.000,00	3.597.400.000,00	2.686.000.000,00	2.120.000.000,00	2.961.900.000,00	3.343.400.000,00
After Financing						
NPV	4.787.278.331,88	2.447.035.290,48	1.788.731.038,06	1.409.691.026,94	1.999.329.725,30	2.291.470.748,92
IRR	267 %	178 %	122 %	121 %	194 %	179 %
B/C	2.50	1.26	1.06	1.03	1.16	1.38
TNB	6.855.000.000,00	3.567.400.000,00	2.680.000.000,00	2.114.000.000,00	2.901.900.000,00	3.340.400.000,00

Description: TNB = Total Net Benefit; SSNI= certification of household industry products

Based on Table (1), the comparison of the Benefit-to-Cost (B/C) ratio between SNI-certified and non-certified fishery products does not show a consistent pattern. The differences fluctuate and are not directly attributable to the influence of SNI certification. The cost of obtaining SNI certification for fishery products includes a certificate issuance fee of IDR 4,540,000, a product user certificate fee of IDR 465,000, and surveillance costs of IDR 2,000,000—resulting in a total certification cost of IDR 7,005,000 per product.

The B/C ratio is primarily influenced by a business's net profit and total outflow, rather than certification status. For example, non-certified presto milkfish products show a higher B/C ratio than their certified counterparts. In contrast, certified fish meatball products have a slightly higher B/C ratio compared to non-certified ones. Similarly, shredded fish products also exhibit a higher B/C ratio in certified products than in uncertified ones.

These findings suggest that SNI certification does not consistently affect the B/C ratio. This is likely because SNI certification does not significantly influence the product's selling price, but rather determines the market segment it can access. Certification adds value through market positioning and consumer perception, rather than through direct cost-profit dynamics.

3. SWOT analysis

A SWOT analysis was conducted through structured interviews with key policy implementers and stakeholders, including the Food and Drug Monitoring Agency (BPOM) (2 respondents), the Bone District Health Office (4 respondents), the Bone District Marine and Fisheries Office (3 respondents), the Bone District Industry and Trade Office (2 respondents), and Fisheries Product Quality Supervisors (2 respondents).

The SWOT framework identifies four strategic dimensions—Strengths, Weaknesses, Opportunities, and Threats—to support problem-solving and to create effective conditions for implementing SNI certification policies (Wang & Wang, 2020; Wang *et al.*, 2020).

3.1 Internal and external factors (IFAS and EFAS)

The implementation of SNI certification policies in small and medium-sized enterprises (SMEs) involves both Internal Factors (IFAS) and External Factors (EFAS). The integration of these factors supports the development of strategic responses to challenges and opportunities. The resulting matrix will generate strategic alternatives, including:

- **SO Strategy** (leveraging Strengths to exploit Opportunities),
- **WO Strategy** (addressing Weaknesses through Opportunities),
- **ST Strategy** (using Strengths to mitigate Threats), and
- **WT Strategy** (minimizing Weaknesses and avoiding Threats)

(Wang & Wang, 2020; Kankya *et al.*, 2025).

The successful implementation of the SNI certification program requires active support from government agencies, entrepreneurs, quality supervisors, non-governmental organizations, consumers, and other stakeholders.

Key issues in implementing SNI certification include:

1. Ensuring broad-based support for fishery product safety—including business, economic, socio-political, and technical aspects.

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2. Enhancing the effectiveness of supervisory institutions and the capacity of target groups.
3. Ensuring that policy outputs translate into meaningful outcomes for both consumers and certified business operators (**Donner *et al.*, 2022; Nijamdeen *et al.*, 2023; Provensi *et al.*, 2024**).

An analysis of internal factors (IFAS) will be conducted by assigning weights and ratings to each relevant factor, forming the basis for strategic planning and policy refinement.

Table 2. Weighted values of internal strategies

Internal strategy factors (IFAS)	Score	Rating	Score x Rating	Notes
Strengths				
• Authority of SNI certification implementers	0.15	4	0.60	The quality of supervision is key to the effectiveness of product certification.
• Capabilities of SNI certification implementers	0.15	4	0.60	
• Understanding of SNI certification implementers	0.15	4	0.60	
• Desire/willingness of SNI certification implementers and business actors to pursue independent certification	0.10	3	0.30	
• Technical skills of business actors	0.10	3	0.30	
Weaknesses:				
• Continuous instability in production and processing	0.05	2	0.10	Climate change needs to be anticipated.
• Inconsistency in the number of employees and business capital	0.05	2	0.10	
• Conflict between business actors and policy implementers	0.10	2	0.20	
• Lack of processing facilities and infrastructure	0.10	2	0.20	
• Low implementation of GMP and SSOP	0.05	1	0.05	
Total	1		3.05	

These internal factors are used to determine the SNI certification policy strategy by utilizing every existing strength factor and minimizing every existing threat factor. Existing strengths must be assessed to produce new and effective strategies for developing the SNI certification policy. Meanwhile, existing weaknesses must be analyzed so that they can be minimized and new, and more effective alternative strategies can be produced. These internal factors are weighted based on the type of strength and weakness so that their weight values can be distributed, where one in this case can be said to be 100%. Next, the weighting is multiplied by the rating of the likelihood of the factor occurring; if it occurs frequently, the rating value is the highest at 4. This results in the

multiplication of the weight and rating, producing the final value for each existing factor (Lam *et al.*, 2016; Bancal *et al.*, 2018; Agnew, 2019).

External factors influencing the performance of the SNI certification policy in Bone District include the following:

Table 3. The weighting of external strategies

External strategic factors (EFAS)	Score	Rating	Score x Rating	Notes
Opportunities:				
• Business demands for SNI certification	0.20	4	0.80	Other product quality certifications as supporting documents
• Public/consumer demands for SNI -certified products	0.15	4	0.60	
• Favorable socio-political conditions	0.15	4	0.60	
• Promotion of quality-assured products	0.20	3	0.60	
• Investment trends (attractiveness of SNI certification) for fishery products	0.10	3	0.30	
Threats:				
• Unfavorable economic potential	0.2	2	0.04	The entry of foreign products into the domestic market
• Certain political pressures	0.05	2	0.10	
• Unfavorable social desires (preference for low-quality products)	0.05	2	0.05	
• Unfavorable fishing season, weather/climate conditions	0.05	1	0.05	
• Illegal certification fees	0.03	1	0.03	
Total	1		3.17	

These external factors serve as the foundation for determining appropriate strategies that leverage existing opportunities while minimizing potential threats. Each opportunity must be carefully evaluated to develop the most suitable strategy for advancing SNI certification policies. At the same time, threats must be analyzed to reduce their impact and to generate viable alternative strategies.

External factors are assigned weights based on the significance of the opportunities and threats identified. These weights, when totaled, must equal 100%. Each weight is then multiplied by a rating that reflects the likelihood of the factor occurring. The rating scale ranges from 1 to 4, with 4 indicating the highest likelihood or frequency of occurrence (The *et al.*, 2019; Johannese *et al.*, 2020).

3.2 SWOT matrix

The strategic factors related to the SNI certification policy are compiled using the SWOT matrix, which clearly illustrates the external opportunities and threats associated with implementing the policy, and aligns them with the existing internal strengths and weaknesses. Based on the average scores from questionnaire responses, final values are calculated for each IFAS (Internal Factors Analysis Summary) and EFAS (External Factors Analysis Summary)

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component. These values are then multiplied by their respective weights to obtain the total weighted score for each factor (Askari *et al.*, 2023).

The resulting weighted scores for internal (X-axis) and external (Y-axis) factors are then plotted within the SWOT quadrant. This positioning helps determine the most appropriate strategic posture to adopt when implementing the SNI certification policy.

Additionally, a strategy prioritization analysis is conducted to rank the strategies in order of importance. This is done by multiplying the scores of the IFAS and EFAS factors by their respective weights. The weighted values are then summed to identify the most favorable and strategic course of action (Li *et al.*, 2021).

The available strategies are clearly shown in Table (4):

Table 4. Final SWOT value matrix

		Strength	Weakness
		9.16	3.44
Opportunity	9.19	(1) Strategy SO 18.35	(2) Strategy WO 12.63
Threat	0.62	(3) Strategy ST 9.78	(4) Strategy WT 4.06

Based on the results of the above calculations, the selected strategy falls under the **Strength–Opportunity (SO)** category. This strategic position leverages internal strengths to capitalize on existing external opportunities. The recommended strategic actions are as follows:

1. Develop and enforce local regulations accompanied by strong implementation and close supervision to ensure the safety and quality of fishery products.
2. Establish joint ventures between local and non-local investors that are free from political interference to enhance product quality and market competitiveness.
3. Conduct targeted training programs focused on product introduction and quality assurance to improve knowledge, technical skills, and compliance with SNI certification standards.

DISCUSSION

1. Discussion of hedonic quality testing of shredded fish

The overall organoleptic hedonic quality score for uncertified shredded fish products was 6.625, with a standard deviation of 0.875, while SNI-certified shredded fish products received a significantly higher score of 8.00, with a standard deviation of 0.25. This suggests that certified products are more favorably perceived in terms of appearance, aroma, taste, and texture. Consequently, uncertified products that have not undergone formal training or certification processes are less able to compete with certified counterparts in consumer preference (Torrico *et al.*, 2019; Domínguez *et al.*, 2024).

A t-test was conducted to compare the mean hedonic values between certified and uncertified products. The results showed a calculated t-value of 3.97, exceeding the t-table value

of 2.45, and a *P*-value of 0.007, which is below the significance level of 0.05. Therefore, the null hypothesis (*H*₀) was rejected, indicating a statistically significant difference in hedonic quality. It can be concluded that SNI-certified shredded fish products are significantly preferred over uncertified ones.

2. Fish meatballs

The hedonic quality score for uncertified fish meatballs was 7.45 (SD = 0.30), compared to 7.08 (SD = 0.24) for SNI-certified products. Surprisingly, the uncertified products received higher average scores. This may be due to the end consumers' preferences, as they might not differentiate quality based on certification but rather on familiar taste and texture.

A t-test was performed to assess the difference between the groups. The t-value was 2.18, which was lower than the critical value of 2.26, and the *P*-value was 0.057, exceeding the 0.05 threshold. Therefore, the null hypothesis was accepted, indicating no significant difference in hedonic quality scores between certified and uncertified fish meatballs. This result may reflect a lack of consumer awareness regarding the significance of SNI certification, suggesting a need for targeted education and marketing efforts (Starowicz *et al.*, 2018; Kallas *et al.*, 2019; Silva *et al.*, 2022; Rejman *et al.*, 2023; Sesini *et al.*, 2023).

3. Presto milkfish

Certified presto milkfish products received consistently higher organoleptic scores than uncertified ones in appearance, aroma, taste, and texture. The average score for uncertified products was 6.83 (SD = 0.4), while certified products scored 7.58 (SD = 0.31).

A t-test showed a calculated t-value of 3.37, higher than the critical value of 2.26, and a *P*-value of 0.008, confirming a statistically significant difference between certified and uncertified products. These results suggest that SNI certification enhances consumer preference for presto milkfish products (Barendse *et al.*, 2019; Wu *et al.*, 2024). The findings support the implementation of SNI certification among small-scale enterprises targeting premium markets such as supermarkets or retail chains.

4. Cost-benefit analysis

4.1 Shredded fish

The production of shredded fish uses skipjack tuna as raw material, with a cost of Rp.15,000/kg. For one production batch, 140kg is required, resulting in an annual raw material cost of Rp. 525,000,000 (based on 25 working days for 10 months). Auxiliary materials cost Rp. 63,000,000, labor costs Rp. 10,800,000, and fixed costs for buildings, equipment, and depreciation total Rp. 49,000,000. Thus, the total outflow in the first year is Rp. 647,800,000.

The inflow is calculated based on a 42.86% yield, producing 60kg of shredded fish per batch. Each 250g package sells for Rp. 32,000, resulting in a total annual inflow of Rp. 1,920,000,000.

- NPV: Rp. 1,778,572,410.87 (positive → investment is profitable)
- IRR: 122% (well above market rates → investment is viable)
- Net Benefit: Rp. 2,664,400,000
- Total Outflow: Rp. 2,534,600,000
- Net B/C Ratio: 1.05 (profitable, since >1)

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Interestingly, the non-certified shredded fish had a higher B/C ratio of 1.28, indicating slightly greater profitability despite the lower quality rating.

5. Fish meatballs

Processing 100 kg/day of raw white-fleshed fish at Rp. 15,000/kg, over 25 days for 10 months, results in a raw material cost of Rp. 375,000,000. Auxiliary materials cost Rp. 60,000,000, labor Rp. 21,600,000, and fixed investment Rp. 71,000,000.

The yield is 80%, with 160 packs/day sold at Rp. 26,000 per pack, generating Rp. 1,040,000,000 annually.

- NPV: Rp. 1,773,689,127.58
- IRR: 119%
- Net Benefit: Rp. 2,664,400,000
- Outflow: Rp. 2,535,600,000
- Net B/C Ratio: 1.07
- Non-certified B/C Ratio: 1.04

The difference between certified and uncertified B/C ratios is minimal, suggesting certification has little financial impact in this case.

6. Presto milkfish

The processing uses 80kg/ day of milkfish, totaling Rp. 360,000,000 annually. Salt costs Rp. 4,800,000, labor Rp. 28,800,000, and fixed investment Rp. 39,000,000 (with depreciation). Total outflow before financing is Rp. 432,600,000.

Inflow is based on an 80% yield, producing 240 packages/day, sold at Rp. 15,000 each, totaling Rp. 1,080,000,000 per year.

- NPV: Rp. 2,014,682,563.77
- IRR: 155%
- Net Benefit: Rp. 2,961,900,000
- Outflow: Rp. 2,438,100,000
- Net B/C Ratio: 1.21
- Non-certified B/C Ratio: 1.38

The higher B/C ratio for uncertified milkfish suggests greater financial efficiency, likely due to the additional costs associated with certification.

7. SWOT analysis

7.1 Development of local regulations and supervision

An effective SNI certification system requires robust local regulations and stringent implementation. Regulations must be enforced by local authorities, ensuring food safety, traceability, and quality compliance at all stages of the fishery product value chain (**Rahman et al., 2021; Kechagias et al., 2023**).

7.2 Joint ventures for quality improvement

Capital limitations often push processors to compromise on product safety. Joint ventures between local and non-local investors—free from political influence—can improve product quality and ensure compliance with GMP and SSOP standards. The government must play a neutral role in facilitating such collaborations (Liu *et al.*, 2020; Li *et al.*, 2021; Setyaningrum *et al.*, 2023).

7.3 Product education and training

Most fish processors lack awareness of hazardous additives and the certification process. Training and education on safe processing practices, SNI procedures, and consumer awareness are essential. Barcodes or labeling on certified products can also enhance consumer trust (Hüppe & Zander, 2021; Inguglia *et al.*, 2023; Smaoui *et al.*, 2023).

This study concludes that SNI certification improves the hedonic quality of certain fishery products and enhances consumer preference, particularly for shredded fish and presto milkfish. However, the financial advantage is not always clear, as non-certified products may still yield higher B/C ratios due to lower costs.

The study further identifies that SNI certification can enhance food safety assurance, market access, and consumer willingness to pay, particularly when accompanied by proper regulation, investment partnerships, and education initiatives. These findings contribute to the development of strategic policies for advancing the quality and sustainability of Indonesia's small-scale fishery sector.

CONCLUSION

Based on the results of the study, the following conclusions can be drawn:

1. Hedonic quality improvement

The hedonic quality tests revealed that fish floss, fish meatballs, and presto milkfish products with SNI certification demonstrated improved premium quality. Certification enhances organoleptic attributes—such as appearance, aroma, taste, and texture—primarily due to the better organization and implementation of Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP) compared to uncertified products.

2. Financial performance

From a financial perspective, the Benefit-to-Cost (B/C) ratio for shredded fish showed a significant difference between certified (2.85) and uncertified (1.28) products, favoring certification. For fish meatballs, there was no significant difference between certified (1.07) and uncertified (1.04) products, suggesting that certification had limited financial impact in this category. In the case of presto milkfish, certified products had a lower B/C ratio (1.21) compared to uncertified ones (1.38), indicating that certification may reduce financial viability in certain product categories due to additional costs.

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3. SNI policy strategy:

The SWOT analysis identified a strategy in the Strength–Opportunity (SO) quadrant, recommending the following policy approaches:

- Develop and enforce local regulations supported by strong implementation and close supervision to ensure the safety of fishery products.
- Establish joint ventures between local and non-local investors—free from political influence—to improve product quality.
- Conduct training and product awareness campaigns on quality assurance and certification standards to strengthen implementation capacity.

Recommendations

1. Further study and evaluation

Future research should focus on continuous monitoring and in-depth evaluation of fishery product quality systems. Particular attention should be given to refining and streamlining the quality assurance framework, ensuring that it effectively supports the implementation of SNI certification policies (Pedro *et al.*, 2023; Zhang *et al.*, 2023).

2. Strategic policy coordination

A coordinated strategic implementation plan is recommended to integrate and operationalize the three proposed SO strategies. This should involve collaboration among government agencies, industry stakeholders, and certification bodies to maximize the impact of SNI certification on both product quality and economic sustainability for small-scale fishery enterprises.

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