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Development Strategy Of Fisheries Industrialization To Promote Product Downstreaming In Badung Regency

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Abstract

This study formulates a fisheries industrialization strategy to accelerate product downstreaming in Badung Regency, a premium tourism epicenter. Using a mixed-methods descriptive-exploratory design, data were collected through purposive surveys on 30 Joint Business Groups (KUB) and 23 HoReCa/MSME units, alongside Focus Group Discussions. Quantitative forecasting utilized the Linear Trend method to project market absorption, followed by strategy formulation using IE Matrix, TOWS, and Analytical Hierarchy Process (AHP). Results reveal a structural transition toward downstreaming, evidenced by a surge in processed product absorption from 39.14% (2019) to 52.54% (2024). Aggregate absorption is projected to reach 18,848.05 tons by 2030, while local marine catch coverage declines to 47.2%, emphasizing that downstreaming cannot rely solely on raw catch intensification. Upstream mapping indicates high-capacity disparity, with 43.3% of fishermen dependent on middlemen. The IFAS and EFAS matrices positioned the region in Cell II (Grow and Build). AHP validation confirms that "Quality and Food Safety" (0.3147) and "Supply Continuity" (0.2908) are paramount prerequisites. Consequently, primary strategic priorities must focus on communal cold chains infrastructure (0.2418), traceability legality (0.2172), and B2B partnerships between KUBs and HoReCa (0.1954), operationalized into a three-phase roadmap (2026–2035) to ensure sustainable economic growth.

Keywords: Analytical Hierarchy Process, Cold Chain, Fisheries Industrialization, Product Downstreaming, Supply Chain.

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INTRODUCTION

Badung Regency is a tourism epicenter with a strategic coastal area that serves as a hub for fisheries activities. The geographical proximity between fish landing centers and tourism zones creates a massive captive market demanding fishery product for households, MSMEs, and premium sectors such as Hotels, Restaurants, and Cafes (HoReCa). However, the creation of value-added in this sector is not directly proportional to mere increases in catch volume. The extraction of economic value heavily relies on the efficiency of supply chain interactions, among fishermen, processors, suppliers, and buyers, as well as the system's capability to maintain quality and supply continuity from the moment the fish are landed until they reach the consumer's table.

The discourse on fisheries downstreaming and industrialization has been widely examined from various dimensions. Previous studies (Nainggolan et al., 2019; Anam & Prihatini, 2022) confirm that limitations in cold chain infrastructure, capital access, and raw material supply deficits are the main bottlenecks triggering inefficiency in both regional and national fisheries processing industries. From a value chain perspective, literature emphasizes the urgency of partnership governance and market information transparency (Prayoga et al., 2017), risk management in the cold chain (Wibowo et al., 2024), and product design upgrading in small-scale fisheries (Rosales et al., 2017). On the demand side, macro-projection modeling (Tran et al., 2017) and food service market preferences (Lawley & Howieson, 2015) prove that quality consistency and supply continuity are absolute variables for professional chefs when making seafood purchasing decisions.

Although these literatures lay a strong theoretical foundation, each study still focuses on fragmented commodities, locations, or variables. A significant empirical research gap exists when these concepts are confronted with the characteristics of the Badung ecosystem, which is highly driven by the tourism industry. Empirical data shows that the absorption of fishery products in Badung surged from 12,213.66 tons (2019) to 16,482.40 tons (2024), during which the share of processed commodities skyrocketed from 39.14% to a dominant 52.54% (Ministry of Marine Affairs and Fisheries, 2026; Study Team, 2026). Ironically, amidst this downstream absorption surge, the upstream sector is left behind. A preliminary survey of 30 Joint Business Groups (*Kelompok Usaha Bersama*/KUB) revealed extreme disparities in catch capacity, with 13 KUBs being highly dependent on and exclusively distributing all their catches to middlemen. Simultaneously, HoReCa buyers prefer to secure their raw materials from external distributors or central markets. There is a missing link between the massive tourism market opportunities and the bargaining power of local fishermen.

Stemming from these gaps, there is an urgent need to integrate actor capacity mapping, product absorption trends, future demand projections, and the formulation of

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policy interventions into a single holistic analysis. This study introduces novelty by combining qualitative analysis of KUB/HoReCa conditions, forecasting modeling of absorption trends, and the determination of strategy priorities using a SWOT matrix and Analytical Hierarchy Process (AHP) based on stakeholder assessments. The primary objective of this research is to formulate the priorities for fisheries industrialization strategies and to construct a downstreaming development roadmap that is adaptive to tourism market specifications while remaining responsive to the actual readiness of local actors in Badung Regency.

METHODS

Design and Data Sources

This research used a mixed-methods approach with a descriptive-exploratory design (Creswell, 2014). The quantitative approach was employed to map production capacity and analyze the projected absorption of fishery products quantifiably. Meanwhile, the qualitative approach was applied to explore supply chain conditions, operational constraints, and market needs, as well as to formulate development strategies collaboratively with stakeholders.

Primary data were collected through field observations, surveys, in-depth interviews, focus group discussions (FGD), and expert judgments. Respondents were decided using purposive sampling (Sugiyono, 2019) to represent the Quadruple Helix elements (government, academia, business actors, and society). The existing condition survey covered a population of 30 joint business groups (*Kelompok Usaha Bersama*/KUB) in fisheries, alongside 23 Micro, Small, and Medium Enterprises (MSMEs) and Hotel, Restaurant, and Cafe (HoReCa) sector units in Badung Regency. Secondary data were compiled from publications by Statistics Indonesia (BPS), the One Data Portal of the Ministry of Marine Affairs and Fisheries (KKP), Badung One Data, and the database of the Badung Regency Fisheries Office.

Absorption Analysis and Supply Scenarios

The development of fishery product absorption (fresh, processed, and total) was analysed separately using time-series data from 2019–2024. Projections for the 2026–2030 period were calculated using the Linear Trend/Least Squares forecasting method with the assistance of POM-QM for Windows software. The forecasting model equation is formulated as follows (Heizer et al., 2020):

$$P_t = a + bt$$

where P_t is the projected absorption value in period t, a is the intercept, b is the trend coefficient (slope), and t is the time index. The model's performance was evaluated using

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the Mean Absolute Deviation (MAD), Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE), and the coefficient of determination (R^2) (Heizer et al., 2020).

The HoReCa segment analysis was modeled separately, involving 44 units comprising 19 hotels/accommodations and 25 restaurants/cafes. This separation was conducted to avoid double counting, considering that HoReCa needs may have already been partially covered in the aggregate absorption data; thus, the results of this segment analysis were not directly added to the main projection. The projection of HoReCa needs was formulated based on three scenarios: a low scenario (0% growth in units and intensity), a moderate scenario (9.60% hotel growth and a 3% increase in intensity), and a high scenario (15.97% hotel growth and a 5% increase in intensity). These assumptions serve purely as analytical scenario parameters, not as the results of regression or extrapolation of the entire HoReCa population in Badung Regency.

Local marine capture production was projected using three analytical scenarios (low, status quo, and high) based on the minimum, average, and maximum production values from 2022–2024, which were then kept constant throughout the 2026–2030 period. The coverage of local marine capture production against the projected absorption was calculated using the following equation:

$$C_t = \frac{P_t}{D_t} \times 100\%$$

where C_t is the coverage percentage, P_t is the local marine capture production according to the scenario, and D_t is the total projected absorption. This coverage value specifically represents the relative position of local supply and is not treated as an absolute deficit or self-sufficiency balance, as it has not integrated aquaculture production, inter-regional product flows, inventory movements, and depreciation within a closed system.

Strategy Formulation and Prioritization

Strategic factors were formulated and validated through an FGD mechanism utilizing 11 unique responses from stakeholders (one identically filled form was eliminated to prevent double counting). The validation results were mapped into the Internal Factor Analysis Summary (IFAS) matrix to evaluate strengths and weaknesses, and the External Factor Analysis Summary (EFAS) matrix to analyze responses to opportunities and threats (Rangkuti, 2016). The strategic position for development was then determined through the Internal-External (IE) Matrix, and alternative operational strategies were formulated using the TOWS Matrix (David, 2011).

Twelve strategies generated from the TOWS Matrix were subsequently synthesized into six main alternatives for evaluation using the Analytical Hierarchy Process (AHP) (Saaty, 2008). Experts assessed these six alternatives through pairwise comparisons against five criteria: (1) continuity and supply suitability; (2) quality, food

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safety, and market compliance; (3) market access and value-added enhancement; (4) implementation feasibility, institutional, and financing; and (5) social and environmental sustainability.

Expert assessments were aggregated using the Aggregation of Individual Judgments (AIJ) approach based on the geometric mean (Forman & Peniwati, 1998). The priority weights of each criterion and alternative were normalized before finally being integrated into the global strategy weight. As a requirement for validating the decision-making model, the consistency of each aggregate matrix was measured using the Consistency Ratio (CR), with an acceptable CR value of ≤ 0.10 (Saaty, 2008).

RESULTS AND DISCUSSION

Supply Chain Conditions and Local Actors' Positions

Qualitative exploration through a purposive survey mapped the multi-layered structure of the fisheries supply chain in Badung Regency, involving fishermen or joint business groups (*Kelompok Usaha Bersama*/KUB), middlemen/collectors, processors, and the HoReCa sector. Field data from 30 KUBs revealed extreme disparities in production capacity, ranging from marginal groups (45–60 kg/month) to dominant groups (16,500 kg/month). This upstream inequality significantly affects marketing dynamics: 13 KUBs (43.3%) exclusively distributed 100% of their catch through middlemen. On the downstream side, the 23 surveyed MSMEs and HoReCa units also did not transact directly with local fishermen; instead, they secured raw materials through distributors or central markets, which are heavily concentrated in the Kedonganan–Jimbaran area.

These findings prove a clear asymmetry to market access. The specification gap between traditional fishermen and premium tourism standards is accommodated by the emergence of middlemen acting as aggregators. The prominent role of these collectors does not necessarily show exploitative monopsony practices, but rather a manifestation of efficiency in bulking supplies. However, the Focus Group Discussion (FGD) emphasized the critical need to evaluate price transparency and the distribution of quality risks among actors. This multi-layered agency structure aligns with small-scale fisheries value chain theories, where socio-commercial relations strictly limit producers' penetration into upper markets (Adhuri et al., 2016; Rosales et al., 2017). Therefore, regional interventions should not be directed at cutting the role of middlemen, but rather at improving the fluidity of market information (Prayoga et al., 2017).

Furthermore, the wide coefficient of variation in catch volume shows that policy interventions cannot be uniform. Small-capacity groups urgently require the establishment of joint-collection schemes to achieve economies of scale (Nainggolan et al., 2019). Conversely, large-scale groups need injections of cold chain infrastructure to keep post-harvest quality, alongside regulatory support to ease Business-to-Business

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(B2B) partnerships with the tourism sector. This integration between quality infrastructure and supply governance serves as a crucial foundation, the priority of which will be mathematically evaluated through AHP analysis in the next stage.

Changes in Fish Absorption and Processing Trends

Time-series data analysis (2019–2024) confirms a structural shift in the utility of fishery products in Badung Regency. As illustrated in **Figure 1**, the total aggregate volume of fish absorption experienced a progressive increase of 35.0%, growing from 12,213.66 tons in 2019 to 16,482.40 tons in 2024. Interestingly, the most prominent growth occurred in its internal structure: the absorption of fresh fish components only grew marginally (from 7,433.52 tons to 7,822.38 tons), while the absorption of processed fish surged dramatically by almost twofold, from 4,780.14 tons to 8,660.02 tons.

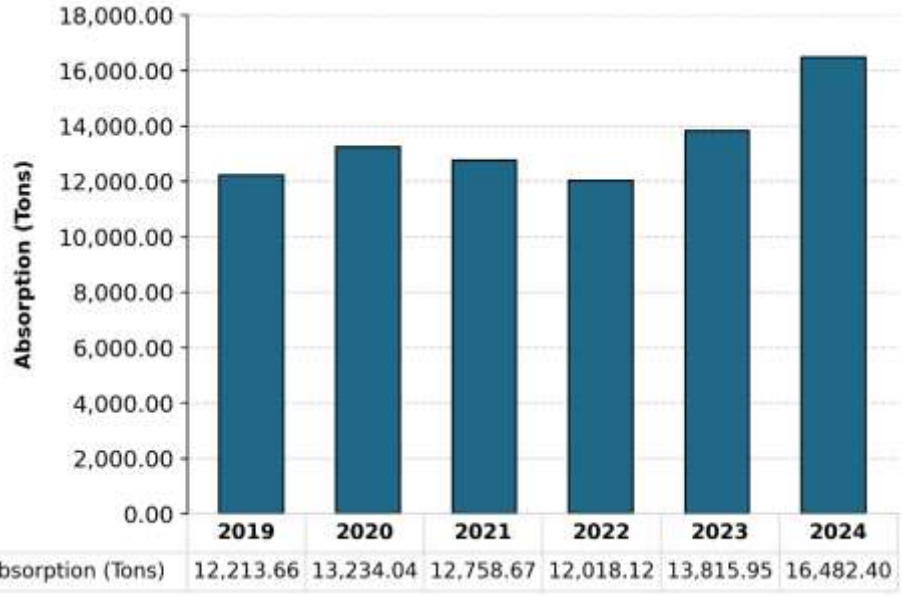


Figure 1. Absorption of fresh fish, processed fish, and total absorption (2019–2024)

Based on the trends in **Figure 1**, the market share of processed commodities climbed from 39.14% (2019) and successfully dominated the total absorption at 52.54% in 2024. This transition confirms that value-added products (downstreaming) are increasingly crucial in the architecture of the Badung fisheries market. Nevertheless, this percentage surge purely represents the composition of real consumption in the study area and does not necessarily prove that all of these processed commodities are produced exclusively from raw materials caught by local Badung fishermen. There is a high probability that the supply deficit to meet this demand surge is filled by cross-regency

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fish movements or the supply of frozen products from outside the region due to the suboptimal local processing capacity.

The escalating absorption of processed products strongly indicates broad economic prospects for processing businesses and product diversification. However, to execute these opportunities, product formulation must be precisely synchronized with buyer specification requirements (especially the HoReCa sector), the ability to maintain quality standards, the certainty of raw material availability, and infrastructure efficiency. This phenomenon aligns with the findings of Anam and Prihatini (2022) regarding the evaluation of the national fisheries processing industry, which proved that raw material supply deficits and inefficient facility utilization are the primary triggers of industrial stagnation. Therefore, an essential foundation for development in Badung Regency is that downstream investments must absolutely be preceded by mapping the certainty of raw material supplies, measuring the real capacity of users, calculating operational costs, and validating the targeted captive market.

Aggregate Absorption Projections and Interpretation Limitations

Based on the Linear Trend/Least Squares forecasting model, the total absorption of fishery products in Badung Regency is projected to escalate by 15.68%, moving from 16,293.90 tons in 2026 to 18,848.05 tons in 2030. When broken down by component, this growth trend is entirely driven by processed products, which are projected to surge from 9,540.07 tons in 2026 to 12,333.27 tons in 2030. Conversely, the fresh fish component is projected to experience stagnation and a slight correction from 6,753.82 tons to 6,514.78 tons during the same period.

Methodologically, this projection serves as a baseline instrument for planning post-harvest handling capacity, yet it cannot be interpreted as an absolute certainty of market growth. The model evaluation shows a coefficient of determination (R^2) for the fresh fish series of only 0.0145. This figure indicates a high variance of historical fluctuations that cannot be explained linearly, although the composite model accuracy remains highly relevant with a Mean Absolute Percentage Error (MAPE) of 6.4983%. Therefore, interpreting this projection demands the execution of adaptive planning and must be periodically calibrated with factual data regarding supply volumes, price fluctuations, and the capacity utility of local industry actors.

Furthermore, this absorption projection does not yet represent an absolute balance sheet between supply and demand in Badung Regency. As emphasized in the study by Tran et al. (2017), a comprehensive assessment of the fisheries supply balance at the macro level requires the integration of additional variables, such as the contribution of the aquaculture sector, inter-regional commodity trade flows, cold storage stock movements, post-harvest loss percentages, and unrecorded subsistence consumption in

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the market. Thus, the development trajectory of facilities and partnerships in Badung must be executed incrementally to reduce the risk of over-investment in infrastructure that does not align with the actual supply carrying capacity.

HoReCa Segmentation Scenarios and Local Catch Coverage Ratios

To dissect demand specifications in the downstream sector, this study formulated HoReCa needs scenarios modeled from 44 strategic sample units (19 accommodations/hotels and 25 restaurants/cafes). Based on moderate scenario assumptions (9.60% hotel growth and a 3% escalation in consumption intensity), the needs of this sample will increase from 552.16 tons in 2026 to 703.44 tons in 2030. Meanwhile, under the high scenario (15.97% hotel growth and a 5% intensity escalation), the needs are projected to surpass 870.35 tons in 2030.

Although this model operates on a limited sample size and is not extrapolated as a total census of the entire Badung tourism population, this simulation proves the high sensitivity of the food service sector's demand to tourism growth. This finding strongly aligns with the empirical study by Lawley and Howieson (2015), which confirmed that quality consistency and supply continuity are the most crucial variables for professional chefs (the HoReCa sector) when making seafood purchasing decisions. In the context of Badung, this postulate validates the argument that developing structured market partnership strategies, determining product specifications, ensuring logistical delivery schedule precision, and maintaining smooth communication among KUBs, processors, and hotels are non-negotiable strategic imperatives.

As a comparative instrument for upstream capacity, this total absorption projection is juxtaposed with three stagnant scenarios of local marine catch volumes: a low scenario (7,393.96 tons/year), a *status quo* scenario (8,889.57 tons/year), and a high scenario (10,901.92 tons/year).

Table 1. Local Catch Coverage Ratio Against Total Absorption Projection (2026–2030)

Year	Total Absorption Projection (Tons)	Low Scenario (%)	Status Quo Scenario (%)	High Scenario (%)
2026	16,293.90	45.4	54.6	66.9
2027	16,932.43	43.7	52.5	64.4
2028	17,570.97	42.1	50.6	62.0
2029	18,209.51	40.6	48.8	59.9
2030	18,848.05	39.2	47.2	57.8

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Referring to Table 1, there is a consistent downward trend in the coverage ratio from 2026 to 2030 (e.g., in the *status quo* scenario, it decreases from 54.6% to 47.2%). This decline represents the inability of the natural supply curve (marine catch) to keep pace with the aggregate absorption curve (tourism demand). Although this ratio has not accounted for the inflow of products from outside the region, these figures affirm a crucial indicator: fisheries industrialization in Badung Regency can no longer rely solely on the intensification of marine catch volumes; instead, it must absolutely be directed towards value-added enhancement strategies (downstreaming) and the creation of product utility based on the existing supply.

Priorities of the Fisheries Industrialization Strategy

The quantification of strategic factors through the IFAS matrix yielded a score of 2.5019, while the EFAS score was 3.2964. The intersection of these two parameters positions the Badung fisheries ecosystem in Cell II (Grow and Build) of the Internal-External (IE) Matrix. This strategic positioning confirms that the strong pull of external demand (tourism) can serve as a lever for regional economic growth, provided that structured capacity-strengthening interventions from upstream to downstream are implemented.

To formulate the precision of these interventions, the strategy synthesis was evaluated using the Analytical Hierarchy Process (AHP). At the basic criteria level, experts assigned dominant weights to the prerequisites of "Quality, Food Safety, and Compliance" (0.3147) and "Supply Continuity" (0.2908). The accumulation of these two criteria (0.6055) provides a highly rigid market signal: regardless of the excellence of the commodities produced by local fishermen, these products will not be absorbed by the premium food service sector without absolute guarantees of hygiene and daily volume certainty.

Table 2. Priority Ranking of Alternative Industrialization Strategies Based on AHP Analysis

Priority	Alternative Strategies (TOWS Model Synthesis)	Relative Priority Weight
1	**A2.** Post-harvest handling, provision of cold chain infrastructure, and central processing facilities at priority nodes.	0.2418
2	**A3.** Quality standardization, legality, document traceability, and certification of processed products.	0.2172

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3	**A1.** Establishment of structured market partnerships and direct supply governance between producers and the tourism sector (HoReCa).	0.1954
4	**A5.** Upstream institutional strengthening, financing facilities, and human resource capacity development for business actors.	0.1685
5	**A4.** Acceleration of product variant diversification (*product upgrading*) and technology for utilizing fish waste by-products.	0.0907
6	**A6.** Arrangement of integrated tourism fisheries areas and synchronization of cross-agency regulations.	0.0863

Referring to Table 2, strategy **A2** (Post-harvest handling and cold chain) occupies the absolute priority. This strongly aligns with the biological anatomy of fishery products, which are highly perishable. As emphasized in the systematic review by Wibowo et al. (2024), disruptions in the cold chain system are the primary triggers of quality depreciation in marine commodities. Therefore, priority A2 must not be reduced merely to a physical construction project (cold storage assets); rather, it must be constructed as a sustainable communal logistics service, complete with operational governance schemes and maintenance cost mitigation.

Subsequent priorities rest on software instruments, namely strategies **A3** (Quality traceability) and **A1** (B2B partnerships). The execution of strategy A3 functions as an "administrative passport" that aligns local product specifications with the strict standards of professional chefs, an urgency whose significance has been empirically validated by Lawley and Howieson (2015) and Rosales et al. (2017). This legality will facilitate negotiations in A1 partnerships, the architecture of which must be designed pragmatically while still accommodating and regulating the functions of aggregator middlemen already operating in the field.

On the other hand, placing strategy **A4** (Product diversification) in the fifth position in no way delegitimizes its significance. This AHP positioning instead reflects sequential logic: downstream innovations in derivative products will only run efficiently if their primary foundations, namely the cold chain, quality compliance, market integration (A2, A3, A1), and capital support (A5), are already operating solidly.

Implications for Implementation Stages (Roadmap)

To ensure that the operationalization of these strategic priorities does not trigger blind investment (*over-investment*), these policy recommendations are constructed into

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a three-phase Roadmap. **Phase I (2026–2027)** focuses on fundamental consolidation in the form of auditing the utilization of existing facilities, improving fresh handling standards at landing points, and initiating trial partnerships. In this phase, the division of spatial roles is established: the Kedonganan–Jimbaran node is focused as the market epicenter and downstream distribution hub, while the Benoa–Tanjung Benoa area is optimized as a supply aggregation point.

The success of the trials in the first phase becomes an absolute prerequisite for entering **Phase II (2028–2030)**, where interventions begin to be scaled up to accelerate the level of commercial downstreaming. Subsequently, **Phase III (2031–2035)** is designed to selectively open opportunities for the expansion of integrated areas (strategy A6).

This incremental roadmap design is highly coherent with the postulates of Anam and Prihatini (2022) regarding the mitigation of inefficiency risks in the fisheries processing industry. Asset expansion and facility enlargement by the regional government should only be executed when the trial results (Phase I) have proven the certainty of raw material supply, the cost-effectiveness of facility operations, and guaranteed absorption by the tourism sector. Therefore, the success indicator of industrialization in Badung is not measured by the grandeur of the buildings constructed, but rather by the real volume increase of local KUB products capable of meeting the strict quality specifications of the HoReCa sector.

CONCLUSION

The conclusion of this study affirms that the fisheries ecosystem in Badung Regency is undergoing a structural transition toward downstreaming. This is evidenced by the surge in the absorption share of processed products from 39.14% (2019) to a dominant 52.54% (2024) of the total aggregate absorption of 16,482.40 tons. The projected absorption, which is forecast to reach 18,848.05 tons in 2030, confirms that local marine catch capacity will be unable to keep pace with the rate of tourism demand. This is reflected in the natural supply coverage ratio (*status quo*), which is projected to decline from 54.6% (2026) to 47.2% (2030). This structural condition is further compounded by upstream production disparities and the high dependence of local fishermen, where 13 out of 30 KUBs (43.3%) are isolated from direct market access and rely entirely on middlemen. Based on the Cell II (*Grow and Build*) position in the IE Matrix, the direction of Badung's fisheries industrialization is no longer rational if it solely focuses on the intensification of raw catch volumes. The AHP analysis validates that "Quality and Food Safety" (0.3147) and "Supply Continuity" (0.2908) are absolute prerequisites for the tourism sector. Consequently, development intervention priorities must be allocated to the provision of post-harvest infrastructure and communal cold chains (0.2418), which

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must be integrated with documented traceability legality (0.2172) and the establishment of direct partnership governance between KUBs and the HoReCa sector (0.1954).

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