Analysis of the availability of clear *puerulus* lobster seeds from wild catch in Labangka Beach, Sumbawa, West Nusa Tenggara (NTB)

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Abstract. Clear lobster seeds (*puerulus*) are one of Indonesia's fisheries commodities, with an estimated production reaching 103,490,283 per year, and 17% of its potential is found in Sumbawa Island. Labangka District is one of the most promising *puerulus* fishing areas in Sumbawa. This research aims to analyze the availability of *puerulus* from Labangka Beach and the distribution and trade flow. This study was conducted in February–March 2025 in Labangka, Sumbawa. Some data were obtained from the Sumbawa Regency Fisheries Office and interviews with informants. The *puerulus* fishing locations are in Labangka Bay and Cemplung Beach, located in Labangka I, III, and V villages. The catch is dominated by *P. homarus*, with the highest yields in October 2024 (163,532 *puerulus*) and February 2025 (179,150 *puerulus*). The captured *puerulus* are sent to Central Lombok, East Lombok, and Sumbawa. Several actors, such as fishermen, local collectors, and joint business groups, are involved in the local *puerulus* marketing scheme in Labangka. At the provincial NTB and national levels, the involved parties include Lombok-based collectors, cooperatives, and Public Service Agencies appointed by the Ministry of Marine Affairs and Fisheries to regulate the technical aspects of *puerulus* exports.

1. Introduction

Clear lobster seeds (*puerulus*) are one of Indonesia's fishery commodities that have been extensively harvested through artisanal (small-scale, part-time fisheries), often going unrecorded [1]. Through satellite imaging, Indonesia's estimated *puerulus* catch reaches 103,490,283 per year. The waters around Sumbawa Island account for 17% of the national *puerulus* potential, with Labangka District being one of the prominent fishing locations [2]. However, information regarding the potential of lobster seed (*puerulus*) fishing activities in Labangka remains suboptimal [2]. This production is a crucial source of

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income for local fishermen and the state, driving the local lobster aquaculture industry [3].

In response, the Ministry of Marine Affairs and Fisheries has established a quantitative management framework for lobster seed resources through Ministerial Regulation No. 7 and Ministerial Decrees No. 24 and 28 of 2024, aiming to ensure sustainable utilization. According to [4], government regulations or policy changes regarding *puerulus* fishing significantly impact price stability and influence how *puerulus* fishery actors adapt their strategies to comply with these new rules. This study analyzes *puerulus* availability to support sustainable resource management, considering critical aspects such as catch volume and fishing timing.

2. Materials and Methods

2.1 Time and location

This research was conducted from February to March 2025 in Labangka I Village, Labangka III Village, and Labangka V Village, Labangka District, West Nusa Tenggara (NTB), Indonesia (Figure 1).

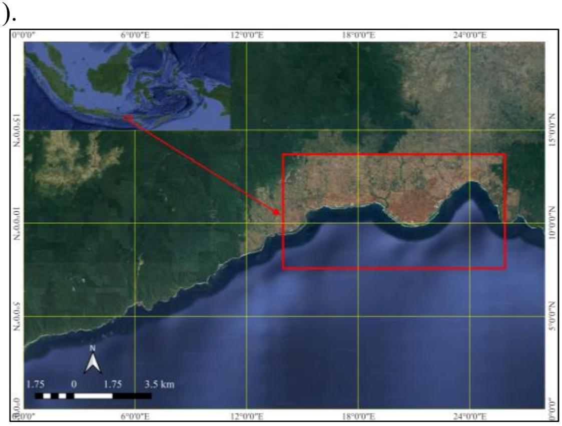

Fig. 1. Research Location: Labangka District, West Nusa Tenggara (NTB), Indonesia.

2.2 Data types and sources

Primary data were collected through field observations and structured interviews using questionnaire instruments with key stakeholders, including fishers, local collectors, and officials from the Provincial Marine Affairs and Fisheries Office. Primary data collection employed a survey method in Labangka I and Labangka III villages, utilizing a snowball sampling technique based on referrals from previous respondents. Secondary data were obtained from local government sources, specifically the Sumbawa Fisheries Office (NTB), covering 2024–2025. The datasets included: lobster seed (*puerulus*) catch production, distribution channels (shipment destinations), number of active fishers, and fishery cooperative groups data.

2.3 Data analysis

The obtained secondary data were processed using Microsoft Office Excel 365 and presented in graphical format. Interview results were visualized through marketing channel diagrams and descriptive narratives cross-referenced with existing literature to contextualize the secondary data.

3. Result and Discussion

Puerulus fishing has emerged as the primary livelihood for Labangka District communities, which lack alternative agriculture or livestock occupations. This fishing activity, which began in 2013, initially adopted techniques from *puerulus* fishermen in Lombok. During 2013–2014, fishermen operated using wooden boats, selling their catches directly to collectors in Lombok. By 2014, the fishing method transitioned to cage systems (Figure 2, right), supported by investments from Lombok–based collectors affiliated with local collectors Labangka. These investors purchased the catches and provided operational support, including marine transportation and fuel for fishing operations. The institutional framework developed significantly in 2016 with the establishment of two Fishermen's Joint Business Groups, which expanded to 24 Joint Business Groups by 2025. While the Sumbawa Regency Fisheries Office had documented the administrative and institutional structures from fishermen to local collectors by 2019, comprehensive data on *puerulus* production remained suboptimal due to technical and administrative system limitations. The regulatory landscape further evolved in 2024 when Joint Business Groups membership became a prerequisite for obtaining *puerulus* shipment quotas, with additional institutional involvement from Cooperatives and Public Service Agencies in the export transaction processes.

3.1 *Puerulus* collection sites

The *puerulus* fishing grounds are located in specific areas such as Labangka Bay and Cemplung Beach. Each fishing location has distinct oceanographic conditions, though they are generally situated near river estuaries. These fishing operations typically occur at depths ranging from 8 to 60 meters, utilizing cages equipped with various instruments, including generators, lights, and fishing gear (pocong). According to [2], *puerulus* fishing sites in Sumbawa, NTB, can extend to depths of 20–40 meters and are frequently adjacent to river flows. As noted by [5], the fishing gear used to catch *puerulus* by the local community in NTB is often called "pocong." This fishing tool is made of a 6–8-meter-long net, along which folded cement sacks are arranged as attractors. These sacks serve as shelters for the *puerulus*, protecting them from predators and oceanographic factors.

Fig. 2. Map of the lobster seed (*puerulus*) production area in Labangka District, Sumbawa, NTB (left), and *puerulus* fishing unit (right).

The *puerulus* fishing grounds in Labangka are divided into two primary locations: Labangka Bay and Cemplung Beach. Geographically, Labangka Bay falls within the administrative areas of Labangka I Village and Labangka III Village, while Cemplung Beach is part of Labangka V Village. Fishing activity is more concentrated in Labangka Bay due to demographic factors and the limited operational area at Cemplung Beach. Labangka

Bay encompasses multiple fishing zones, including Boro Beach, Liang Ate, Samara Beach, Laju Beach, Liang Mayung, Lepu Beach, Kokar Udang Beach, and Sarang Beach. In contrast, *puerulus* fishing at Cemplung Beach is confined to its eastern side. Field observations revealed that current velocities in Labangka Bay are significantly stronger than those at Cemplung Beach. Despite this difference, both locations share a key characteristic: nearly all fishing sites are near river estuaries. According to [2], Labangka District has been formally identified as a *puerulus* fishing zone, though further data verification is required regarding fishermen and collector numbers, catch volumes, and precise fishing locations. [6] which noted that *puerulus* fishing sites along the southern coasts of East Java and Yogyakarta are similarly influenced by river discharge, affecting water turbidity and habitat conditions.

Puerulus fishing operations employ cage units (Figure 1, right) with supporting instruments including generators, lighting systems, and pocong fishing gear. Field observations and interviews revealed that fishing activity peaks during new moon periods and gradually decreases as the full moon approaches. The operational timeframe is strictly nocturnal fishermen typically begin operations at 4:00 p.m. by activating generators and deploying fishing gear. These fishing gears are retrieved and inspected the following morning at 06:00. The captured *puerulus* are then stored in bottles before being collected by local buyers. As noted by [2], fishing gear operations typically occur at dusk and dawn for harvest retrieval. [4] Findings that *puerulus* fishing is a part–time occupation, often combined with other livelihood activities.

3.2 Utilization status of *puerulus* in Labangka

The utilization of *puerulus* as a fishery resource has been ongoing since 2013. Yet, precise data regarding production volumes, fishing units, and involved fishermen remain unavailable - a finding consistent with prior research [2]. However, implementing new regulatory frameworks has significantly improved data reporting standards. The fishing operations are now governed by Fisheries Ministerial Regulation No. 7/2024 and Ministerial Decrees No. 24 and 28 of 2024, which have substantially enhanced administrative requirements for local collectors handling catch transportation. [4] Recent regulatory changes permitting *puerulus* exports under specific conditions have created a more secure operational environment and encouraged renewed fishing activities while maintaining sustainability controls.

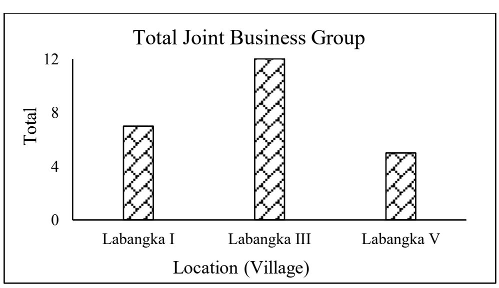

Fig. 3. Development of Fishermen's Joint Business Groups**.**

The utilization of lobster seeds (*puerulus*) in Labangka has undergone significant transformation due to regulatory changes. Under the latest Ministerial Regulation of Marine Affairs and Fisheries, 24 Fishermen's Joint Business Groups operate across three main villages, Labangka I, III, and V, involving 284 fishermen. Most of the 19 groups are concentrated in the Labangka Bay area, distributed as 12 in Labangka I Village and 8 in Labangka III Village. Meanwhile, the remaining 5 groups operate at Cemplung Beach, which

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administratively belongs to Labangka V Village. These Joint Business Groups have become a mandatory administrative requirement for local collectors to obtain lobster seed shipping quotas as stipulated by the Sumbawa Regency Fisheries Office. Legally, Joint Business Groups are defined under Ministerial Decree No. 14 of 2012 as non-legal entity business groups formed through fishermen's collective agreements, primarily aimed at improving members' income. According to Research [1], Historical data shows that in 2014, the total number of *puerulus* fishermen across West Nusa Tenggara Province reached 5,632 fishermen, with the most extensive distribution in Central Lombok Regency (2,451 fishermen), followed by East Lombok Regency (1,691 fishermen), and other regencies (1,490 fishermen). The institutional development of these Joint Business Groups reflects systematic efforts to organize sustainable fisheries while improving coastal community welfare.

Four local collectors dominate the shipment of *puerulus* to Lombok Island. Interviews with these collectors revealed that Joint Business Groups play a pivotal role in proposing shipment quotas, with collectors frequently collaborating across different Joint Business Groups to optimize quota utilization. While each Joint Business Group maintains its membership of fishermen conducting *puerulus* fishing operations, field interviews indicated that not all active *puerulus* fishermen have formally joined these groups. Research by [3] notes that *puerulus* fishing operations are organized through various Joint Business Groups, with some fishermen alternatively affiliated with smaller collectors without minimum catch requirements. As highlighted by [4], Lombok Island has emerged as a production hub for lobster seeds due to their abundant *puerulus* stocks, making the region particularly significant for this fishery sector. The decentralized yet interconnected nature of these operations, combining formal Joint Business Groups structures with informal collector networks, reflects the complex socioeconomic dynamics of Indonesia's lobster seed trade.

Regarding *puerulus* production (Figure 4, left), the peak yields occurred in October 2024 with 163,532 *puerulus* and February 2025 with 179,150 *puerulus*. The primary target species were *Panulirus homarus* and *P. ornatus*, though catches were dominated by *P. homarus*. Throughout 2024, production steadily increased from July through October, followed by a gradual decline from November to January. When compared with previous studies, these figures demonstrate significant regional variation: [1; 2] documented annual catches reaching 5,244,000 *puerulus* in Lombok during 2014, while [3] reported average monthly yields of approximately 126,020 *puerulus* (totaling 1,512,240 annually) along Lampung's western coast. This comparative analysis reveals substantial fluctuations in *puerulus* abundance across different fishing grounds and temporal periods, with the Labangka region exhibiting distinct seasonal patterns characterized by mid-year productivity surges.

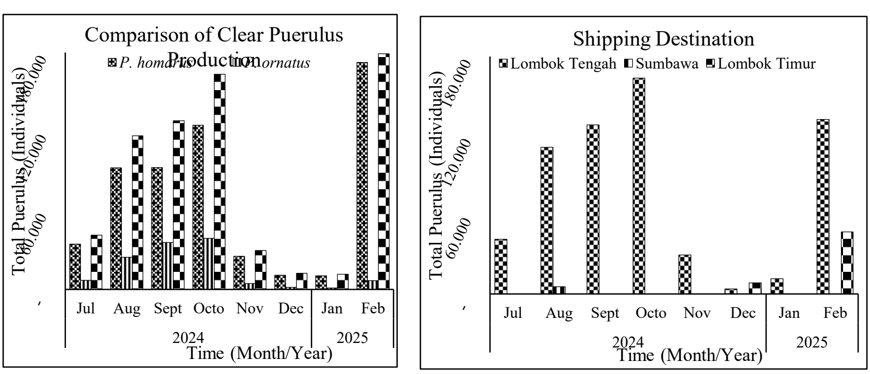

Fig. 4. *Puerulus* production quantities (left) and distribution channels (right) in Labangka District, 2024-2025.

The fluctuation in catch yields is influenced by seed availability, with the optimal fishing season occurring between August and October. Interviews with fishermen revealed that the decline in catches from November to January is due to the decreasing availability of seeds and a reduction in the number of operating fishermen. This is partly caused by a temporary shift in profession to corn farming. Additionally, some fishermen described that calm water conditions contributed to the low catch yields. [2] *puerulus* catches in Lombok Island typically occur from April to October, with the peak optimal fishing period between July and September. [3] Meanwhile, *puerulus* fishing in West Lampung Coast takes place from June to October, with fishermen's operational duration lasting around 20–30 days.

The catch production of *puerulus P. ornatus* is consistently lower compared to *P. homarus*. According to [7], five species of *puerulus* can be caught in southern Lombok Island: *P. homarus*, *P. ornatus*, *P. versicolor*, *P. longipes*, and *P. polyphagus*, with *P. homarus* being the most dominantly captured species. [8] reported that the *puerulus* catch composition in Lombok Island is dominated by *P. homarus* as the most abundant species (between 65% and 85%), while the proportion of *P. ornatus* varies between 15% and 35%. This catch composition is estimated to remain consistent across several southern coastal areas of Java and Sumbawa

The collected pueruli are then shipped to Lombok Island, with the highest shipment volume (621,459 *puerulus*) destined for Central Lombok. However, shipments shifted to East Lombok between 2024 and early 2025. Interviews with local collectors revealed that cooperatives' purchasing capacity and prices influenced this shift in shipment destinations. In contrast, local *puerulus* sales remain very low, with only 5,604 *puerulus* shipped to local aquaculture in Bungin Island and Kaung Island in Alas District, Sumbawa. According to [1], Lombok has become a central hub for seed production due to its abundant *puerulus* stocks. [10] notes that lobster aquaculture in Indonesia began in the early 2000s on Lombok Island, relying on wild-caught.

The high production of *puerulus* in Labangka District presents significant potential for developing the lobster aquaculture industry in Sumbawa Regency. This will require cooperative engagement and government stakeholder support to ensure sustainability while facilitating connections between *puerulus* fishermen, aquaculture operators, and consumer lobster markets. Strengthening the local aquaculture sector is critical for absorbing excess *puerulus* catches and stimulating economic activity across related sectors. [8] emphasizes that *puerulus* harvesting should be supported by developing lobster grow-out aquaculture systems. This approach could boost coastal economies by creating year-round *puerulus* fishing opportunities beyond seasonal limitations. For instance, an annual catch of 10 million *puerulus*, based on Vietnam's lobster aquaculture productivity benchmarks, could yield over 2,000 metric tons of marketable product valued at potentially exceeding US$150 million. Such production levels would have a negligible impact on mature lobster populations, given Indonesia's abundant *puerulus* stocks.

3.3 Marketing chain of *puerulus* in West Nusa Tenggara

Implementing Ministerial Regulation No. 7/2024 along with Ministerial Decrees No. 24/2024 and 28/2024 has significantly impacted institutions involved in *puerulus* exports. Each institution is expected to be crucial in maintaining price stability and conducting a comprehensive analysis of national scale *puerulus* availability and potential. According to [4; 9], there have been regulatory fluctuations regarding *puerulus* export prohibitions and permissions. Five regulatory changes have occurred since 2015: Ministerial Regulation No. 1/2015, No. 56/2016, No. 12/2020, No. 17/2021, and No. 16/2022. These frequent adjustments demonstrate the government's commitment to improving sustainable *puerulus* resource management practices.

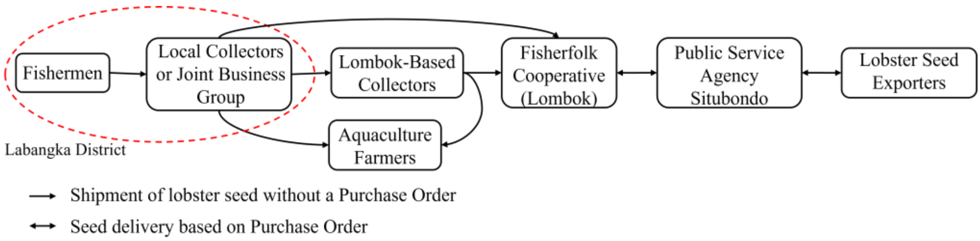

Fig. 5. Marketing Scheme *puerulus* in Labangka, NTB.

Under the new regulation, the *puerulus* marketing scheme is divided into local Labangka and regional or national levels. The involved parties at the local Labangka level include fishermen, local collectors, and joint business groups. These three parties typically form structured affiliations: fishermen catch the *puerulus*, local collectors facilitate marine transportation and provide fuel financing for fishermen. At the same time, the Joint Business Groups manage the shipping quotas that collectors require to market *puerulus* outside Labangka. The key players at the regional NTB and national levels include Lombok-based collectors, cooperatives, and Public Service Agencies. Lombok *puerulus* collectors typically source the seeds from Labangka local collectors and market them for local aquaculture activities in Lombok Island or supply them to cooperatives. *Puerulus* exports through cooperatives that have obtained permits and Purchase Orders (PO) from the Public Service Agency. Specifically, this Public Service Agency is an organizational unit under the Ministry of Marine Affairs and Fisheries tasked with facilitating *puerulus* export activities. This scheme (Figure 5) revitalizes and optimizes several existing institutions, such as the Joint Business Groups that facilitate collectors in providing shipping quotas and ensure legal protection for fishermen. Then, some cooperatives serve as business entities collecting catches from various fishing areas scattered across West Nusa Tenggara. The Public Service Agency is crucial in facilitating shipments from fishermen to exporters, ensuring price stability, and serving as the technical body that calculates Non-Tax State Revenue (PNBP) from *puerulus*. According to [1], the *puerulus* marketing system in Lombok consists of fishermen, local collectors, large collectors, aquaculture farmers, and exporters. [3] notes that the *puerulus* distribution from fishermen in West Lampung to exporters involves several parties, such as local collectors, large collectors, suppliers, and exporters. The suppliers are usually in Lampung Province and Jambi Province, while the exporters come from Jakarta Province and Singapore.

Through the new regulation, the optimization of the functions of institutions such as Joint Business Groups, Cooperatives, and Public Service Agencies is aimed at enhancing coordination according to their respective roles. This scheme (Figure 5) reintroduces and optimizes several existing institutions, starting with local collectors or Joint Business Groups, which facilitate fishing operations by fishermen and ensure legal protection. Cooperatives are business entities that gather catch from various fishing areas across NTB. Public Service Agencies are crucial in facilitating shipments from fishermen to exporters, ensuring price stability, and serving as technical bodies that calculate PNBP from *puerulus*. [4], the payment of PNBP for *puerulus* can benefit the country and serve as an effort by the government to maintain and ensure the sustainability of *puerulus* resources, improve welfare, ensure equitable aquaculture technology, expand investment opportunities, increase foreign exchange, and develop local lobster aquaculture. According to [1], the *puerulus* marketing system in Lombok consists of fishermen, local collectors, large collectors, cultivators, and exporters. [3] The distribution of *puerulus* from fishermen on the west coast of Lampung to exporters involves several parties, including local collectors, large collectors, suppliers, and exporters. Suppliers are usually located in Lampung Province and Jambi Province, while exporters come from Jakarta Province and the country of Singapore.

Field observations indicate that four local collectors are routinely shipping to Lombok Island, and one local collector supplies local aquaculture in Sumbawa. Two local collectors regularly ship directly to cooperatives in Central Lombok and East Lombok, while the other two prefer sending their catches to larger collectors on Lombok Island. Additional information reveals that some local collectors in Labangka also engage in transactions with other local collectors in the same area. The differences in the current supply chain structure stem from the impact of existing regulations. Variations in the supply chain can be observed in previous studies: [1] notes that *puerulus* fishermen may choose to engage in independent aquaculture and sell their catches to local collectors, who then supply larger collectors. These larger collectors, in turn, supply exporters. Additionally, *puerulus* fishermen, local collectors, and large collectors can all serve as seed suppliers for local aquaculture operations on a larger scale.[3] highlights that the distribution of *puerulus* from fishermen on the west coast of Lampung involves multiple local collectors, large collectors, suppliers, and exporters from Jakarta Province and Singapore. [1] further explains that the supply chain begins with *puerulus* fishermen or fishing groups supplying companies or collectors at local or larger levels. These companies then supply *puerulus* agents, who gather and store *puerulus* for buyers/investors (companies). Once received by the buyers/investors, the *puerulus* is then provided to lobster farmers in Singapore or Vietnam. The quantity of *puerulus* shipped is adjusted based on demand from aquaculture operators in Singapore and Vietnam, regulated through an export quota system. Companies relay these quotas to local-level collectors through predetermined *puerulus* agents.

The Public Service Agencies serve as a government body that plays a crucial role in the technical aspects of *puerulus* production and export shipments abroad. The export of *puerulus* is primarily destined for Vietnam, with the Public Service Agencies overseeing the process and setting the standards or criteria for eligible shipments. According to officials from the Provincial Marine and Fisheries Office and local collectors in Labangka, public service agencies' shipments are based on POs received from exporters. These POs are then broken down into smaller quotas and distributed to cooperatives appointed by the Public Service Agencies. Field observations reveal that the Public Service Agencies' PO system for cooperatives in Lombok has led to low purchasing prices for *puerulus* from fishermen, ranging from IDR 2,000 to IDR 8,000 per *puerulus*. This situation contradicts Ministerial Decree No. 24/2024 from the Ministry of Marine Affairs and Fisheries, which sets the minimum purchase price for *puerulus* at IDR 8,500. According to [1, 2, 9], most *puerulus* exports are shipped to Singapore and Vietnam. Regarding price trends at the fisherman level, [1] notes that 2012 *puerulus* prices ranged from IDR 2,000–2,500 per *puerulus*. By 2013, prices rose to IDR 13,000 per *puerulus*, and in December 2014, they increased further to IDR 17,000–20,000 per *puerulus*. [3] Reports that 2021 the selling price reached approximately IDR 23,000 per *puerulus*.

Regulatory changes have significantly influenced the roles of various actors in the *puerulus* supply chain. According to [1], until 2014, government involvement was structured through the Provincial Marine and Fisheries Office and the Fish Quarantine, Quality Control, and Fisheries Product Safety Agency (BKIPM), which served as the central supervisory bodies responsible for monitoring and recording *puerulus* production without a quota system. However, since 2021 [4], *puerulus* exports have been permitted under specific conditions, requiring exporters to develop local aquaculture and release at least 2% of captured and locally cultivated *puerulus* back into the wild. At the fisherman level, fishing groups have been established with the involvement of the district and provincial Marine and Fisheries Offices. Officially registered export companies have been formed on a larger, national scale. These companies are overseen by the Ministry of Marine Affairs and Fisheries, which ensures compliance with obligations such as local aquaculture development and tax contributions to the state. The ministry collaborates with other relevant institutions to enforce these regulations.

4. Conclusions

The central *puerulus* fishing location in Labangka Subdistrict is Labangka Bay, where the predominantly caught species is *P. homarus*. The optimal fishing period spans from August until October, with peak production yielding 163,532 *puerulus*. The marketing scheme operates at two distinct levels: the local Sumbawa level, including fishermen, local collectors, and Joint Business Groups. Regional NTB and National Level: Lombok-based collectors, cooperatives, and Public Service Agencies.

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