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Enhancing Productivity in Freshwater and Bracket Fisheries in Buru District, Maluku Province, Indonesia

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A B S T R A C T

The fisheries sector, a vital economic force in Buru, Maluku Province, faces suboptimal conditions, notably in the unexplored potential of freshwater aquaculture due to limited human resources and skills. This study aims to comprehensively explore and develop aquaculture, providing a focused, integrated approach from upstream to downstream sectors. Success indicators and references are established to guide targeted achievements, benefiting the Local Government and Regional Development Planning Agency in Buru. Employing field observation and discussions, the findings reveal the conventional nature of current freshwater aquaculture practices, emphasizing the urgent need for bolstering technical, operational, and managerial aspects in the sector for optimal productivity

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INTRODUCTION

Buru Regency features extensive marine and fisheries potential, abundant in various economically valuable fish and marine biota across its coastal areas (Wouthuyzen *et al* 2002). The significant fisheries production on Buru Island, encompassing sea fish and seaweed, holds immense promise for community welfare and regional economic prosperity, especially with optimal management and integration into processing practices (Suwartana 1985). Analysis of data from 2009 reveals the success of fishing and production activities, coinciding with a notable increase in the number of fishing households.

However, traditional capture fisheries face ecological threats, such as pollution, ecosystem degradation, and overfishing (Ilmi 2018). In response, there is a pressing need to foster aquaculture activities as a diversified and comprehensive approach, harmonizing with fishery product processing (Riyanto and Mardiansjah 2018). This aligns with the National Policy and Strategy (*Jakstranas*), envisioning small island management as a national benchmark for cross-sector activities at both central and regional levels.

Small islands, like Buru, grapple with developmental challenges, including restricted transportation access, economic scale optimization hurdles, suboptimal management and resource utilization, and deficiencies in basic infrastructure services like clean water, electricity, and accessibility. Despite these hurdles, strategic planning holds the key to unlocking substantial economic opportunities and facilitating sustainable growth.

Economic activities on small islands, exemplified by fishing on Buru Island, demand specialized approaches tailored to available resources (Susilo 2007). To optimize economic scale, strategic development plans are crucial. A key avenue involves planning the expansion of fisheries and coastal cultivation activities, utilizing community-based facilities. This strategy aligns with Buru Regency's strengths, benefiting from abundant fishing human resources. Despite the absence of sophisticated cultivation techniques, the amalgamation of local expertise and influences from immigrants enables effective fishing practices (Umanailo 2015). Moreover, this initiative dovetails with the government's broader vision to position Eastern Indonesia as a central national fishery hub.

Commencing aquaculture development requires crafting a detailed roadmap and operational plan covering aquaculture and post-harvest aspects. This roadmap serves as a guiding framework for the government, offering a thoughtful approach to targeted aquaculture development. It addresses socio-cultural and economic dimensions, propelling Buru Regency toward the overarching goal of achieving food independence.

Buru Regency is strategically focusing on the development of freshwater fisheries, aligning with the overarching goal of achieving food sovereignty. The planning horizon extends until 2020, encapsulating a set of recommendations poised to serve as a blueprint. These recommendations will not only guide the formulation of programs and activities but also foster collaboration among stakeholders under the umbrella of the Buru Regency Regional Government. This initiative is laser-focused with the following objectives: precision in directing operational activities, fostering integration across sectors from

upstream to downstream; establishment of comprehensive targets and clear stages of achievement to serve as robust indicators of success; provision of a valuable reference point for input procurement and optimal resource utilization, essential for enhancing the productivity of freshwater aquaculture.

LITEARTURE REVIEW

Productivity is production divided by a certain time interval or divided by the land area used. In theory, the productivity level of the area can be influenced by various aspects, both internal and external. Aspects from within the waters that can influence include water quality conditions, the number of floating net cages operated, and the cultivation patterns applied (type of feed, frequency of feeding, etc.), as well as other activities other than aquaculture. Meanwhile, climatic conditions (climatology and meteorology), land use patterns, and social conditions are some aspects from outside the waters that can affect the level of productivity of the reservoir (Saputra *et al.* 2013)

METHODOLOGY

Assessment and situational analysis are pivotal precursors to any activity, furnishing crucial insights into fishing activities, specifically pinpointing challenges and obstacles. At this stage, key information, including the overall condition of fisheries activities, theme determination, and logistical specifics for outreach initiatives, is sifted through. Utilizing internet searches, secondary data, and consultations with the Regional Government and Bappeda of Buru Regency facilitated this evaluative process.

Six distinct steps are involved in conducting a study article (Templier and Paré, 2015): formulation and purpose of the study question(s); looking through the body of current literature; examining inclusion; assessment of the quality of primary research; information processing; interpret the data and compose a summary. Material preparation involves comprehensive library research, collating literature from books, articles, and research findings, garnered through library searches and online exploration. The extension activities were meticulously planned, commencing in early March with coordinated efforts involving the Buru Regency Government, Fisheries Service, Bapedalda, Iqra Buru University, focus group discussions, and field visits. March through April saw the formulation of roadmaps and document preparation.

Program implementation unfolds through: coordination with Buru District Government, Fisheries Service, Bapedalda, Iqra Buru University; Focus Group Discussion featuring the Padjadjaran University Team, Buru Regency Government, fishermen, coastal communities, and stakeholders; field visits and roadmap creation and document preparation. This collaborative endeavor involves various interconnected institutions, with the Padjadjaran University, Institute for Research and Community Service serving as an information intermediary between universities and the community. Facilitated by entities like the Department and local community associations, the shared objective is the enhancement of people's welfare. The communication methods employed encompass field observations, offering insights into the fisheries potential of

Buru Regency and projections for its development, alongside engaging discussions.

RESULTS

Buru Regency, officially established by Law Decree Number 32 of 2008, encompasses an expansive area of 7,594.98 km², comprising 5,577.48 km² of land, 1,972.5 km² of sea, and a water area spanning 57.4 km², featuring a coastline stretching over 232.18 km². The current growth rate for Buru Regency in Maluku Province stands at 3-4% per annum. Its economic landscape is predominantly shaped by agriculture, spanning food crop cultivation, horticulture, plantations, fisheries, and livestock. Fishing activities in the sea constitute the primary livelihood for the Buru Island community, with a noteworthy emphasis on capture fisheries. The production output from sea fishing, particularly the capture of tuna, stands at a significant 517,252 tons, contributing to 20% of the total catch (refer to Table 1).

Capture fisheries, as evident in Tables 2 and 3, emerge as a formidable source of income for Buru Island's regional revenue, owing to substantial production volumes and values. Contrastingly, coastal and freshwater aquaculture activities remain minimal, a fact underscored by the considerably lower number of Fishery Households involved in cultivation compared to those engaged in traditional fishing activities. This trend extends to the formation of fishing groups, which substantially outnumber fish cultivating groups, and the absence of groups focused on fishery product processing (refer to Tables 3 and 4).

Table 1. Advancement of Fisheries Production (Key Commodities) and Sales Value in Buru Regency from 2010 to 2013

Type of Fish	Production				Sales Value (in thousands Rupiah)			
	2010	2011	2012	2013	2010	2011	2012	2013
Skipjack Tuna	460,31	685,79	480,06	508,860	1.380.921	2.057.385	1.440.169	1.526.580
Tuna	464,68	697,105	487,97	517,252	2.323.423	3.475.948	2.433.163	2.579.153
Mackerel Tuna	328,52	489,45	367,09	389,111	989.556	1.468.344	1.101.258	1.167.333
Halfbeaks	71,40	106,38	87,23	92,462	178.499	265.939	218.070	231.154
Indian Mackerel	287,14	427,80	342,24	362,778	861.430	1.283.414	1.026.731	1.088.335
Yellow Tail	105,55	158,13	131,24	139,118	316.663	474.375	393.731	417.355
Red Snapper	38,25	56,99	45,59	48,331	95.636	142.484	113.987	120.826
Grouper	45,96	68,47	56,15	59,516	229.793	342.360	280.736	297.580
Giant Trevally			65,31	69,225			195.921	207.676
Anchovy	417,12	621,45	435,02	461,117	1.042.798	1.553.627	1.087.539	1.152.791
Sardine	529,34	788,64	512,62	543,374	1.323.344	12.123	7.880	8.353
Mackerel Scad	532,84	793,86	754,17	799,416	1.598.519	2.381.576	2.262.497	2.398.247
Yellowtail Scad	444,73	662,59	463,81	491,644	1.334.200	1.987.777	1.391.444	1.474.931
Commong Silver-biddy	3,25	4,85	3,98	4,215	8.137	12.123	9.941	10.537

Spinny Lobster	0,88	1,30	1,04	1,106	6.566	9.783	7.826	8.296
Crab	3,13	4,67	3,78	4,005	23.484	34.988	28.340	30.041
Sea Cucumber	1,68	2,50	2,00	2,121	12.592	18.760	15.008	15.908
Seaweed			18,88	20,013			132.160	140.090
Others	1.525,76	2.267,01	1.593,13	1.688,718	2.685.204	692.607	184.366	195.428
Total	5.260,54	7.836,99	5.851,30	6.202,38	14.410.764,	16.213.613,89	12.330.76	13.070.614

Table 2. Yield and Value of Marine and Inland Fisheries in Buru Regency from 2009 to 201

Fisheries	Production Year									
	2009		2010		2011		2012		2013	
	Volume (Tons)	Value (thousands Rp)	Volume (Tons)	Value (thousands Rp)	Volume (Tons)	Value (thousands Rp)	Volume (Tons)	Value (thousands Rp)	Volume (Tons)	Value (thousands Rp)
Sea	4.762,38	14.064.531	5.260,54	14.410.765	7.836,99	16.213.614	5851,30	12.330.769	6.202,38	13.070.615
Land	193,40	1.511,45	25,69	105,755	47,33	600.115	42.25	355.186	26,41	728.050
Sea/Land (culture)	630,60	4.034,30	233,18	1.390,45	422,91	2.809,26	195.4	1.497,436	282,76	1.839.000

Table 3. Advancement of Fishery Households and Fishing Infrastructure/ Facilities in Buru Regency from 2009 to 2013

Description		Year				
		2009	2010	2011	2012	2013
Fishery Household	Farms			8	9	9
	Ponds	-		45	66	68
	Sea	5.272	5.385	7.363	7.731	7.766
Boat	*Ketinting* Engine	559	836	1.209	1.362	1.362
	Outboard Engine	300	456	596	666	703
Motorboat		2	2	2		
Boat (without motor)	Jukung	1.597	1.683	2.392	2.409	2.323
	Small	758	802	1.280	1.284	1.334
	Medium	498	587	833	833	823
	Large	60	66	94	94	94

Table 4. Enumeration of Fishing Groups and Fishing Villages in Buru Regency, 2009 – 2013

District	Number of Villages					Fishing Villages					Number of Fishermen Groups				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Namlea	11	12	12	12	7	10	10	10	10	7	116	121	150	160	145
Airbuaya	8	23	23	23	10	8	8	8	8		133	232	275	285	122
Waeapo	18	31	31	31	7	3	3	3	3	9	70	75	85	90	
Waplau	9	10	10	10	9	5	5	5	5	5	171	179	214	214	125
Batabual	5	5	5	5	5	5	5	5	5	5	32	38	46	50	122
Teluk Kayeli					5										149
Lolong Guba					10										
Waelata					10					5					
Fena Leisela					13					5					73
Liliali					5					4					131
Total	51	81	81	81	81+ 1 UPT	31	31	31	31	40	522	645	770	799	867

Table 5. Fisheries Production Targets for the Fisheries Sector 2011 – 2017

Production	2011	2012	2013	2014	2015	2016	2017
Capture	7.839,99	7.877,48	8.000,00	8.500,00	9.000,00	9.500,00	10.000,00
Culture	422,91	529,00	661,00	826,00	1.033,00	1.291,00	1.614,00

Table 6. Fisheries Group Production Targets in the Fisheries Sector 2011 – 2017

Production	2011	2012	2013	2014	2015	2016	2017
Fisheries Group Production	85,00	85,00	85,00	85,00	85,00	85,00	85,00

DISCUSSIONS

In charting the course for the Maritime and Fisheries sector, Buru Regency sets ambitious production targets, anticipating growth in both the capture and aquaculture sectors (refer to Table 5), along with intensified post-harvest processing production (refer to Table 6). The marine and fisheries sector on Buru Island is a crucial source of local income for regional development. On a practical level, fisheries activities on Buru Island encompass fishing at sea and cultivating fish in coastal and freshwater areas. Aligned with the Regional Mid-Term Development Plan or the Central Mid-Term Development Plan for Buru Regency 2012-2017, various activities can be implemented to synergize and fortify marine and fisheries efforts, particularly in cultivation and post-harvest.

Capture Fisheries

Fishing activities, particularly in seawater, significantly outweigh aquaculture activities in both coastal and freshwater regions (Sudarmo *et al* 2016). This is evident in the substantial volume of seawater fish production, notably surpassing that of freshwater fisheries. Tuna, comprising 20% of the total catch, is the primary commodity harvested from the sea around Buru Island, amounting to 517,252 tonnes. Data from Buru Island Fisheries Production (2013) indicates a marine fish catch volume of 6,202.38 tons, with freshwater catch at 26.41 tons, and freshwater aquaculture at 282.76 tons.

The potential for increased marine catch is closely tied to the fishing gear employed (Nofrizal *et al* 2018). Hand-line or single fishing rod use dominates sea fishing (20%) on Buru Island. While environmentally friendly and selective, hand-lines have a limited exploration rate for achieving large production volumes. Augmenting production involves expanding the fishing fleet and exploring deeper fishing areas to enhance catch opportunities (Sefnat and Marei 2023). Such endeavors must be accompanied by infrastructure development, notably cold storage facilities. However, Buru Regency faces challenges in this aspect, with minimal operational cold storage, limited investment, management constraints, and insufficient electricity and fuel for operational needs. The existing cold storage, managed by a third party in Waplau Village, has a capacity of 100 tons, and an additional facility is still under construction. The current capacity falls short of accommodating the substantial fish catch production.

Aquaculture

Buru Regency holds immense potential for the development of coastal and freshwater fisheries. Beyond its extensive coastline, the region boasts numerous freshwater lakes and water sources with commendable water quality in both aspects of quantity and quality. In areas where Javanese transmigrants have

settled, freshwater cultivation, including tilapia and common carp, has thrived. While the Fish Seed Center (FSC) has been fulfilling the demand for fish seeds, the type, volume, and quality are yet to meet the growing needs. Over the past three decades, at least 10 freshwater fish farming groups have been cultivating. The demand for their produce is high, catering not only to local needs but also supplying the market demand of approximately 11,000 common carp farmers from Java. Expanding freshwater fish cultivation is feasible, utilizing Floating Net Cages in freshwater lakes distributed across various locations in Buru Regency.

Development hurdles in Buru district's freshwater fish cultivation pertain to proper cultivation management, ensuring a consistent supply of quality seeds, and providing high-quality feed (Wungkana *et al* 2022). The utilization of commercial feed is minimal due to exorbitant prices and unreliable feed continuity. While the use of brackish waters remains limited, coastal areas can be utilized for fish cultivation with relevant species such as milkfish and saline tilapia. Opportunities for brackish fish cultivation align with plans to establish shrimp ponds, construct a fishing port, and establish a cold storage and flying fish processing industry in Masarete Village.

Buru Island's medium-term plan includes the construction of a Fish Meal Factory in Lalah Village, Namlea District, integrated with an ice flake factory, fish trade, and distribution. This initiative serves as a crucial support factor for the advancement of freshwater and brackish water cultivation, fostering self-sufficiency among fish farmers by providing locally sourced feed ingredients.

Fishery Product Processing

The substantial volume of capture fisheries production in Buru Regency presents lucrative opportunities when coupled with post-harvest processing activities. The potential for the post-harvest development of fishery products is considerable, evidenced by existing processing ventures such as seaweed flour, smoked skipjack tuna, tuna floss, and more.

Seaweed processing, specifically with quality cottoni seaweed produced on Buru Island, holds promising prospects. The cultivation and processing of seaweed are evolving in villages like Siahoni, Saliong, and Jamilu. Family-tied cultivators and processors collaborate, yielding seaweed products at a volume of 10 tons per season. The realm of opportunities for seaweed development in post-harvest processing is extensive, given the current limited processing of seaweed products into seaweed flour (Priono 2013). Challenges faced by seaweed processors include technological aspects, as traditional methods have been predominant, and the need to enhance group dynamics.

Scope

The foreseen activities encompass the integrated development of freshwater and brackish water aquaculture, incorporating the utilization of fishery products. Key components involve adept cultivation management, the construction and layout oversight of fish ponds, adopting technology for artificial feed based on local ingredients, reinforcing the human resources capacity (cultivators and government agency officials), fortifying the competence of fisheries and marine human resources and their institutions, and fostering

post-harvest activities. These activities span harvesting, ensuring food safety through quality testing, and delving into marketing strategies.

SWOT Analysis of Fisheries Cultivation Development

Drawing insights from comprehensive observations and analyses encompassing natural resources, environmental services, and socio-economic factors, the SWOT analysis for the Marine and Fisheries Sector in Buru Regency reveals the following:

1) Potential (Strength)
    a. Abundant fishing resources
    b. Favorable water productivity and climate for fisheries
    c. Rich diversity in fisheries
2) Weakness
    a. Insufficient technology for aquaculture
    b. Low capacity in cultivation management
    c. Limited infrastructure supporting cultivation activities
3) Opportunities
    a. Willingness to embrace change
    b. Adequate human resources
    c. Open avenues for collaboration and trade with various entities
4) Threats
    a. Global competition in fisheries trade
    b. Utilization of cultivated land for mining and agricultural activities

Program Plan Recommendations

The proposed program plans are designed to fortify the fisheries sector, focusing on:

1) Freshwater Aquaculture:
    a. Comprehensive Fish Cultivation Extension
    b. Expansion of Freshwater Fish Hatcheries
    c. Technological advancements in fish food production
    d. Water Quality Management in Freshwater Fish Farming
    e. Integrated Quality Management in the Fish Meal Industry
    f. Utilization of local raw materials and fish waste for fish feed
    g. Introduction to Polyculture Cultivation in Brackish Waters
    h. Optimization of Fish Cultivation in floating fish net
2) Processing of Fishery Products:
    a. Seaweed Processing for Nutritious Food Products
    b. Implementation of Grading and Sorting in Seaweed Harvesting
    c. Implementation of Fish Floss Processing Technology
    d. Production of Smoked Skipjack Fish using Liquid Smoke Technology

Implementation Plan

The seamless execution of these activities involves collaboration among key stakeholders: the Buru Regency Maritime and Fisheries Service, Iqro Buru University, Pattimura University Ambon, and local cultivator groups.

CONCLUSIONS

The initiative to develop documents for the fisheries cultivation plan in Buru Regency, as a component of Padjadjaran University Higher Education's Tri Dharma, extends beyond academia. Successful execution requires the active involvement of government officials, stakeholders, and cultivators, aligning efforts to realize the goals of fisheries development. This holistic approach aims to fortify the fisheries sector, fostering increased income and enhanced welfare for the people of Buru Regency. Subsequent activities for the advancement of fisheries cultivation in Buru Regency demand a collaborative synergy among farmers, government bodies, relevant agencies, and universities. This collaborative effort is essential to ensure optimal outcomes and maximize the positive impact on the community.

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