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CONCEPTUAL MODEL OF INTEGRATED POLICY IN THE MANAGEMENT OF FISH WASTE IN THE NORTH COASTAL AREA OF CIREBON

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***Abstract*—**

Fishery waste management in the northern coastal area of Cirebon faces significant challenges due to the increasing volume of fish production and processing industries that generate both organic and inorganic waste. This condition creates environmental pollution risks, decreases coastal health in communities, and hinders the accomplishment of sustainable development targets. The research project aims to formulate a conceptual model of integrated policy that bridges regulations, actors, and practices in fishery waste management systems. The research utilises a qualitative approach through a literature review and secondary data analysis from relevant government agencies in Cirebon. The findings reveal that the effectiveness of fishery waste handling relies on the synergy of three key components: (1) clear, consistent, and adaptive regulations; (2) multi-stakeholder engagement, including local government, industry, fishermen, local communities, and academia; and (3) innovative and environmentally friendly waste processing practices such as bioconversion, organic fertilizer production, and alternative energy utilization. The proposed conceptual model paves the way toward a circular economy in fisheries, which not only reduces pollution but also enhances local economic value. This study contributes to policymakers, particularly the Cirebon local government, in designing more integrated, collaborative, and sustainable fishery waste management strategies.

Keywords: integrated policy, fishery waste, sustainable management, circular economy

I. INTRODUCTION

The northern coastal area of Cirebon is an important hub for West Java's marine and fisheries economy. Fishing and downstream processing activities are concentrated at the Kejawanan Archipelago Fishing Port (PPN Kejawanan) and

the network of traditional processing centres for products such as shrimp paste, salted fish, and other processed goods. Official data from the Ministry of Marine Affairs and Fisheries shows that the PPN Kejawanan is the main landing port, with squid and various other catches as the dominant commodities; the volume and turnover of these commodities indicate a high intensity of upstream-downstream fishing activities in Cirebon. (Ministry of Marine Affairs and Fisheries [KKP], 2023; Prasetyo et al., 2022)

On the other hand, the flow of residual material from fishing activities—both organic (offal, heads, scales, shrimp/shellfish shells) and inorganic (ice plastic packaging/raw materials, raffia rope, styrofoam, net/juvenile fish fragments, and even damaged fishing gear)—creates pressure on the coastal environment. Research in northern Java shows that fishing gear components (especially gillnets) contribute to marine debris (ghost gear), a phenomenon that impacts ecosystems, navigation safety, and the productivity of small-scale fishermen common along the northern coast. The findings in northern Central Java are ecologically and socially relevant to the northern coast of Cirebon, which has similar fishing characteristics. (Yulistiono et al., (2023))

Environmental pressure in Cirebon also comes from land-to-sea waste leakage. Research on the Pengarengan River—a route for fishing boats to the Java Sea—found a high fraction of plastic waste moving to the coast, coinciding with poor waste management practices among the surrounding community. This situation explains why Cirebon's coastal areas are often sites of waste accumulation, hindering fishing activities and triggering illegal landfills in inactive fishpond areas. (Yulistiono et al., (2023); Indah & Novie, (2025)).

At the governance level, Indonesia already has a multi-level regulatory framework. Law No. 18/2008 serves as the umbrella for waste reduction and management; Presidential Regulation No. 97/2017 (National Waste Management Strategy) targets a 30% reduction and 70% management of waste by 2025; and Presidential Regulation No. 83/2018 establishes the National Action Plan for Marine Waste Management with a target of reducing plastic waste in the ocean by 70% by 2025. At the local level, Cirebon City Regional Regulation No. 4/2018 and Cirebon Regency Regional Regulation No. 5/2022 regulate waste management in the city and regency areas. However, these mandates are spread across sectors (Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, local governments) and have not specifically linked the life cycle of fish waste (from fish landing sites/piers, processing units, to markets/coastal areas) as an integrated system.

The context of local urgency becomes increasingly clear when looking at waste generation data. Cirebon City reportedly generated >200 tonnes of waste per day in 2023 (DLH), while the Cirebon City Open Data portal and the KLHK SIPSN provide time series and performance indicators for waste reduction and management that highlight implementation challenges at the city/district level. In coastal areas, some of this waste has the potential to leak into estuaries and the sea if collection, sorting, and TPI/port infrastructure are inadequate. (Open Data Cirebon City, (2021–2024); SIPSN KLHK, (2024)))

In the Cirebon fisheries value chain, processing MSMEs (e.g., the terasi centres in Mundu, Astanajapura, Pangenan, Losari) are still dominated by traditional practices and household scale. This condition makes it difficult to consistently implement operational standards for cleanliness, source separation, and organic-inorganic residue processing without institutional support and incentives. Meanwhile, fisheries organic waste actually has the potential to become a value-added material (e.g., chitosan from shrimp shells for adsorbents/heavy metals, food-biomedical), making the circular economy approach relevant for the coastal area of Cirebon, which is strong in processed shrimp and fish products. Astjario, P., et al. (2013); Kurniawidi et al., (2022); Yulistiono et al., (2023); Indah & Novie, (2025)).

The core issues that have emerged are policy and governance fragmentation: authority is dispersed, data is not always integrated across systems (fishing ports, environmental agencies, the National Solid Waste Information System), infrastructure at critical points (fish landing sites, piers, fish markets, processing centres) is not uniform, and the behaviour of business actors and coastal communities has not been fully internalised into 3R/circular practices. At the same time, there is a policy opportunity: linking national mandates (Jakstranas & RAN Sampah Laut) with regional policies (Jakstrada, Perda) and PPN Kejawanan to build an integrated policy conceptual model that: (1) maps the flow of fisheries waste materials from source to downstream, (2) aligns roles & instruments (regulations, incentives, infrastructure, education), (3) opens up circular/valorization channels (e.g., chitosan/compost/BSF), and (4) strengthens open data-based monitoring and reporting. (Presidential Regulation of the Republic of Indonesia (2017); (KKP PIPP, (2025))

Based on this gap, this study proposes building an integrated policy conceptual model for managing fishery waste in the northern coastal area of Cirebon. The model is designed to: (i) reduce waste leakage into the sea; (ii) improve collection and sorting efficiency at port/center nodes; (iii) accelerate the circular economy of organic and inorganic residues; and (iv) clarify the coordination architecture between actors and financing mechanisms (public-private-community). Academically, this model fills a gap in cross-sectoral policy design specifically for fisheries waste in the context of coastal cities and districts in Indonesia (SIPSN KLHK, (2024)).

II. METHOD

This research uses a qualitative approach with a literature study design. This approach was chosen because the research focus is not on direct field data collection, but rather on a critical review of relevant literature, regulations, and policy documents, in order to build an integrated policy conceptual model. According to Creswell (2018), qualitative research allows researchers to interpret social phenomena and policies in depth, emphasising meaning, processes, and context.

The data sources for this research consist of: Policy and regulation documents: Law No. 18 of 2008, Presidential Regulation No. 97 of 2017, Presidential Regulation No. 83 of 2018, Cirebon City and District Regional Regulations, as well as derivative documents such as the National Waste Management Strategy (Jakstranas), Regional Waste Management Strategy (Jakstrada), and National Action Plan for Marine Waste; Academic literature: national and international journals related to marine waste management, fisheries waste, integrated policy governance, and circular economy; Official secondary data: annual reports from the Cirebon City/District Environmental Agency, waste generation data from the KLHK's National Waste Information System (SIPSN), PPN Kejawanan Statistics reports from the Ministry of Marine Affairs and Fisheries, and Cirebon City open data publications.

Data collection was conducted through: A systematic search of academic databases (Scopus, Google Scholar, DOAJ), official government portals (KLHK, KKP, Cirebon Regional Government), and online repositories; Document studies of regulations, reports, and policy publications; Literature selection using inclusion criteria: (i) published in the last 10 years (2014–2025), (ii) relevant to fisheries waste management and coastal policies, (iii) available in full text format.

Data analysis techniques were performed using content analysis combined with thematic synthesis. First, the literature is categorised by theme: policy governance, fisheries waste, marine debris, circular economy, and the local context of Cirebon. Second, coding was done to identify core concepts, problems, and recommendations. Third, the synthesis results are used to build the conceptual framework for the integrated policy model. According to Bowen (2009), document analysis is effective for exploring patterns, contradictions, and opportunities for integration within policy documents. With this approach, the research focusses on how various regulations and literature can be integrated into a single conceptual model.

The validity and credibility of the research are maintained through source triangulation, which involves comparing the analysis results from various types of documents (regulations, government reports, academic journals).

The final result of this method is an integrated policy conceptual model that maps: the flow of fisheries waste management from upstream to downstream; relevant actors, authorities, and policy instruments; cross-sectoral coordination mechanisms and circular economy schemes for fisheries waste in coastal Cirebon.

III. RESULTS AND DISCUSSION

The concept of governance views public policy not only as a product of government, but also as the result of interactions between various actors (the state, the market, and civil society). Rhodes (1996) emphasised the importance of policy networks in addressing complex cross-sectoral issues. In the coastal context, integrated governance refers to Integrated Coastal Zone Management (ICZM), which emphasises cross-sectoral and cross-governmental coordination to balance economic, ecological, and social development (Cicin-Sain & Knecht, 1998). For the coastal area of Cirebon, this theory is relevant because the management of fish waste involves many actors: the Ministry of Marine Affairs and Fisheries (fishing ports), the Ministry of Environment and Forestry (waste), Local Government (Regional Regulations), MSMEs, and fishing communities.

Anderson (2015) states that the policy cycle consists of five stages: (1) agenda setting, (2) policy formulation, (3) adoption, (4) implementation, and (5) evaluation. In the context of this research, the policy cycle theory is used to: Map the national and regional regulatory positions related to marine debris and fisheries waste, Analyse the extent to which these policies have been implemented on the Cirebon coast, and Assess the gap between regulations and field practices.

With this approach, fisheries waste management can be positioned as a strategic policy issue within the regional and national development agenda.

The Brundtland Report (WCED, 1987) introduced the principle of sustainable development as development that meets the needs of the present generation without compromising the future generations. This principle is contextualised in fisheries waste management through a circular economy approach. The circular economy emphasises reuse, recycle, and reduce to create new added value from production waste. The Ellen MacArthur Foundation (2013) formulated this concept into three principles: (i) design without waste and pollution, (ii) keep products/materials in use, and (iii) regenerate natural systems. In the case of Cirebon fisheries waste, circular economy theory provides a framework for utilising organic waste (e.g., chitosan production, fertiliser, BSF feed) and inorganic waste (e.g., plastic and net recycling).

Elinor Ostrom (1990), in Governing the Commons, emphasised the importance of collective governance over shared resources. Fisheries waste on the coast can be viewed as a common-pool resource problem, where if not managed collectively, it will lead to negative externalities such as marine pollution, declining fisheries productivity, and socio-economic losses. This theory is relevant for explaining why local institutional mechanisms (e.g., fishermen's cooperatives, MSME associations) are needed to regulate waste management practices, in addition to regulations from the central and regional governments.

From the four theories above, it can be synthesised that an integrated policy model for managing fishery waste must meet the following aspects: governance (cross-sectoral/actor integration, ICZM), public policy (formulation to evaluation cycle), sustainability (circular economy as an instrument for transforming waste into added value), and local institutional aspects (fishermen's participation, MSMEs, and coastal communities). With this theoretical framework, the research has a strong conceptual foundation for formulating an Integrated Policy Model suitable for the coastal context of Cirebon.

The literature review aims to place the research within the context of theoretical developments, empirical findings, and regulations related to the management of fish waste in coastal areas. There are three main focusses: (1) the concept of integrated policy governance, (2) fisheries and coastal waste management, and (3) the circular economy approach and policy innovation.

1. The Concept of Integrated Policy Governance

   Integrated governance emphasises cross-sectoral, cross-actor, and cross-governmental-scale coordination in policy formulation. In the coastal context, this involves the central and local governments, fishing port authorities, processing industries, fishing communities, and civil society. Integrated Coastal Zone Management (ICZM) has long been developed globally as an approach to synergise economic development and ecological protection (Cicin-Sain & Knecht, 1998). In Indonesia, the integration framework is manifested in the National Strategic Plan for Waste Management (Presidential Regulation No. 97/2017) and the National Action Plan for Marine Waste Management (Presidential Regulation No. 83/2018). However, various studies confirm that the fragmentation of authority among ministries (KLHK, KKP, and local governments) still hinders the effectiveness of implementation (Hapsari et al., 2020; Lestari & Trihadiningrum, 2019). Therefore, a conceptual model is needed that can bridge across actors and position the issue of fisheries waste as an integral part of the waste management system.

2. Fisheries and Coastal Waste Management

   Fishery waste consists of two main categories: organic (guts, scales, heads, bones, shells) and inorganic (packaging plastics, nets, styrofoam). Studies show that organic waste can be a source of pollution if not managed immediately, as it produces methane and ammonia gases, and reduces the quality of seawater and ponds (Yulistiono et al., 2023). Additionally, ghost gear (lost/discarded fishing gear) is a significant contributor to marine debris in the waters north of Java, including the Java Sea around Cirebon. Research shows that the high estimated amount of incidental nets carried by ocean currents impacts coral reef ecosystems and the productivity of small-scale fishermen (Richardson et al., 2019; Yulistiono et al., 2023). In the local context, research by Prasetyo et al. (2022) on the Pengarengan River in Cirebon found a high fraction of plastic waste due to low public awareness. This demonstrates the close link between land-based waste management systems and the health of coastal ecosystems.

3. Circular Economy and Policy Innovation

   The circular economy paradigm offers solutions based on reuse, recycling, and processing fish waste into value-added products. For example, shrimp and crab shell waste can be processed into chitosan, which is used as a heavy metal adsorbent, food ingredient, and biomedical product (Aranaz et al., 2021). The application of a circular economy on the coast is also related to the development of bioenergy, organic fertilisers, and alternative maggot-based feed (BSF). Studies in Indonesia confirm that the potential of fish waste has not been fully utilised due to limitations in

infrastructure, policy incentives, and the capacity of MSMEs (Sulistio & Widodo, 2021). An integrated policy linking national regulations, local regulations, and local practices at the PPN Kejawanan and the Cirebon fisheries MSME centre will open up opportunities for a more systematic implementation of the circular model.

4. Research Gap

From the literature, it can be seen that:

a. Research on marine debris and ghost gear in Indonesia is still predominantly focused on ecological aspects; cross-sectoral and fisheries waste-specific policy aspects are relatively underexplored.
b. National and regional regulations are in place, but there is no integrated conceptual policy model specifically for fisheries waste management on the coast.
c. Circular innovation has been studied at the academic level, but implementation at the coastal MSME scale, such as in Cirebon, is still limited.

The coastal area of Cirebon has intensive fishing activities, especially at the PPN Kejawanan and other Fish Auction Sites (TPI) in Cirebon Regency. This activity generates organic waste (offal, scales, heads, crab/shrimp/shellfish shells) and inorganic waste (ice plastic, styrofoam, used nets, and packaging). The Cirebon City Environmental Service report (2023) recorded waste generation of over 200 tonnes per day, some of which came from the coastal sector and fish market. If not managed, this waste has the potential to cause pollution, odour, and blockage of river mouth channels that flow into the Java Sea. Research by Prasetyo et al. (2022) found a high fraction of plastic waste in the Pengarengan River, which flows into the Cirebon coast, indicating a close relationship between land and sea waste.

Regulatively, there are many relevant policies :

1. Law No. 18/2008 concerning Waste Management.
2. Presidential Regulation No. 97/2017 concerning the National Strategy for Waste Management.
3. Presidential Regulation No. 83/2018 concerning the National Action Plan for Marine Waste Management.
4. Cirebon City Regional Regulation No. 4/2018 and Cirebon Regency Regional Regulation No. 5/2022 concerning Waste Management.

However, implementation on the ground still faces fragmentation :

1. The Ministry of Environment and Forestry (KLHK) focusses on waste in general, the Ministry of Marine Affairs and Fisheries on port and fisheries aspects, while local governments manage landfills/waste collection sites.
2. Data between agencies is not fully integrated (for example, KLHK's SIPSN with PPN Kejawanan's internal data).
3. Waste management infrastructure at fish landing sites and fisheries MSME centres is still limited.

This condition highlights the need for cross-sectoral policy integration (governance integration), as stated by Rhodes (1996).

Fisheries organic waste has added value when managed circularly :

1. Shrimp/crab shells → chitosan (heavy metal adsorbent, food, biomedical) (Aranaz et al., 2021).
2. Fish waste/offal → alternative feed, organic fertiliser, black soldier fly (maggot) raw material (Sulistio & Widodo, 2021).
3. Used plastic and nets → recycled products or simple construction materials.

However, in Cirebon this practice is still limited to the scale of academic experiments. There is no integration with local policies that provide incentives or institutional support. In fact, according to circular economy theory (Ellen MacArthur Foundation, 2013), optimising waste utilisation can create triple benefits: economic, social, and ecological. According to common-pool resources theory (Ostrom, 1990), successful management of shared resources requires collective rules and community participation. In the context of Cirebon :

1. Fishermen's associations can be a driving force in waste management at the port.
2. Cooperatives for small and medium-sized enterprises (SMEs) processing fish have the potential to initiate the utilisation of organic waste into value-added products.
3. Coastal communities and monitoring groups (Pokmaswas) can be involved in education and monitoring of waste disposal into the sea.

Local community involvement will increase policy legitimacy and reduce resistance to the implementation of new policies.

Based on literature analysis, empirical conditions, and theoretical framework, a conceptual model was formulated with the following components :

1. Policy Level : National (Jakstranas, RAN Sampah Laut, Law No. 18/2008); Regional (City/District Regulations, Jakstrada); Local (PPN Kejawanan SOP, TPI regulations, coastal village/urban regulations)
2. Actors and Roles : KLHK (regulatory framework and reporting system (SIPSN)), KKP (port and TPI management); Local Government (TPS/TPA management, MSME supervision); Community (implementation of circular practices, field supervision)
3. Policy Instruments : (Regulatory (regional regulations, TPI waste management SOP); Economic (fiscal incentives, partnerships with recycling industries); Technical (provision of sorting infrastructure, organic waste cold storage, coastal waste banks); Social (3R education, strengthening fishermen's cooperatives/MSMEs).
4. Process Flow : Source (TPI, port, MSMEs) → Sorting → Processing (compost, chitosan, BSF, plastic recycling) → Value-added product → Market/industry → Monitoring (SIPSN, VAT reports).
5. Output and Outcome : Reduction of waste leakage into the sea, increase in circular economy added value, and improvement in cross-sectoral policy and coordination effectiveness.

Essentially, the following explains the conceptual flow of the integrated policy model for managing fish waste in the northern coastal area of Cirebon.

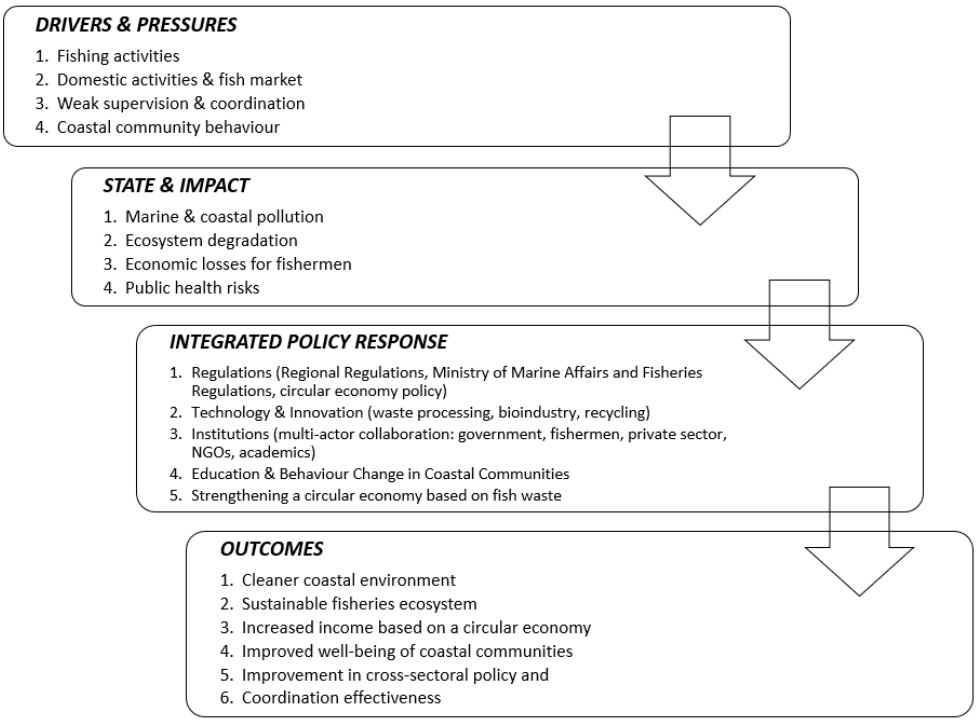

Figure 1. Conceptual Model Of Integrated Policy

IV. CONCLUSIONS

Academically, this model fills a research gap regarding cross-sectoral policy integration, particularly in the area of fisheries waste. Practically, this model can serve as a blueprint for local policy to integrate national regulations with local practices, while also promoting the development of a circular economy on the Cirebon coast.

This research uses a literature study approach, so the data obtained is still secondary. There has been no direct empirical verification through field surveys or policy implementation trials. The data used primarily comes from official publications such as BPS, KKP, and local documents. However, the timeliness of the data sometimes doesn't align with the actual dynamics on the ground, for example, regarding the volume of fish waste or infrastructure readiness.

Future research can be conducted using a quantitative approach with survey, interview, and direct observation methods to validate the integrated policy model linked to the green economy, resulting in an economic product that incorporates the perceptions of fishermen, business owners, and local policymakers.

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