



The relationship between crab meat picking work and the human development index: A literature review on women workers

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ABSTRACT

Background: Blue swimming crab (*Portunus pelagicus*) is one of Indonesia's major fishery export commodities, with its processing—especially the crab picking work—being predominantly carried out by coastal women. This post-harvest activity plays a vital role in supporting both household and community-level economies, particularly in fishing villages. However, crab picking remains characterized by low wages, informal labor status, and limited access to social protection. **Methods:** This study analyzes the relationship between crab picking labor and the Human Development Index (HDI), focusing specifically on women's contributions to education, health, and per capita household expenditure. Using a qualitative method with a descriptive approach through literature review, the research draws on secondary data related to the roles of women crab pickers in the Northern Coastal region of Java. The study also incorporates analysis of men's roles in the broader crab supply chain, including fishers, traders, and miniplant owners. **Findings:** The results show that women occupy central roles in the post-harvest value chain—particularly in picking, trading (as bakul), and managing household income—yet their access to productive assets and control over economic decisions remains limited. Despite these structural inequalities, women's financial contributions are consistently directed toward improving family welfare, especially in terms of children's education and health, which are core indicators of HDI. The presence of gender-based access and control disparities across the crab supply chain affects not only economic equity but also the effectiveness of human development outcomes. **Conclusion:** In conclusion, this study demonstrates that while women's informal labor in crab fisheries significantly supports HDI indicators at the community level, achieving more inclusive and sustainable coastal development will require policy interventions that formally recognize, support, and empower women's economic roles within fisheries. **Novelty/Originality of this article:** This study provides a new perspective by linking women's informal labor in blue swimming crab post-harvest activities to Human Development Index (HDI) indicators, emphasizing their overlooked contribution to community-level human development in coastal areas.

KEYWORDS: blue swimming crab; coastal women; gender analysis; human development index; informal labor; supply chain.

1. Introduction

The blue swimming crab (*Portunus pelagicus*) is a highly sought-after marine species, renowned for its savory meat and distinctive taste. This species is widely distributed across tropical and subtropical waters, making it an economically valuable resource for many coastal communities worldwide. In Indonesia, the blue swimming crab is among the top fisheries export commodities—following tuna and shrimp—with approximately 90% of

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total national production exported annually to the United States. The steadily increasing global demand has driven intensified harvesting, thus continuously elevating its economic value (Febianah et al., 2023; Setioko et al., 2024) According to (Thuraisingam, 2016) in (Muhaemin et al., 2024)), this crab species inhabits only marine environments. It is typically found on the seabed and thrives in tropical regions, occupying various marine habitats ranging from intertidal zones to offshore waters at depths up to 50 meters. One of the habitats most frequently associated with the species is seagrass beds, which serve crucial ecological functions, providing refuge, foraging grounds, and breeding areas. The presence of healthy seagrass ecosystems significantly affects the survival and population dynamics of *P. pelagicus*. Hence, the conservation of natural habitats such as seagrass beds is essential to ensure the sustainable exploitation of this species, especially given the mounting pressures from both domestic and international markets. Sustainable habitat conservation and fisheries management are key to maintaining the ecological and economic balance in Indonesia's blue swimming crab sector. Furthermore, (Muhaemin et al., 2024) reported that Indonesia ranked second only to Canada in exporting blue swimming crab to the United States, with a total export volume of 26,883 tons.

The economic value of blue swimming crab in Indonesia is also evident at the regional level, such as in Cirebon Regency. According to data from the Food Security and Fisheries Office, crab production in this regency reached 8,239.83 tons in 2021, with Gebang District being the largest contributor, producing 4,879.42 tons or approximately 59% of the total yield (Febianah et al., 2023). Research by Febianah et al., (2023) indicates that blue swimming crabs from Gebangmekar Village meet export standards, although part of the catch is still distributed to local markets. This difference in market destinations has led to variations in the supply chain structure, which continues to face challenges in distribution effectiveness. Therefore, development strategies are necessary to optimize the crab supply chain, enabling business actors—particularly small-scale fishers—to obtain maximum benefits.

In addition to fishers, one of the critical groups in the blue swimming crab industry is the crab pickers. This job falls under the informal sector and is typically undertaken by women, especially the wives of fishers or middlemen. The activity does not require specialized skills, making it widely accessible. The crab picking industry provides substantial employment opportunities and serves as a primary or supplementary source of household income. Women's participation in this sector not only boosts household earnings but also fosters economic independence and women's empowerment in coastal areas. Hence, the blue swimming crab industry—both in terms of production and post-harvest processing—has significant socio-economic impacts on coastal communities and deserves attention within the inclusive and sustainable development agenda Dini (2023). This pattern is consistent with broader findings in small-scale fisheries, where women's contributions are often concentrated in processing, trading, and other post-harvest activities, yet remain underrecognized in formal statistics and fisheries policy (Harper et al., 2020; Lekshmi et al., 2022; Rao et al., 2024).

A clear example of women's role in the informal processing sector is Mrs. Sumisih, a crab picker from Tasikharjo Village, Rembang Regency (Luthan & Zahrani, 2024). Each day, Mrs. Sumisih peels and sorts crab meat based on quality and size, assisted by six group members, most of whom are fishers' wives. This work not only serves as their primary livelihood but also constitutes the backbone of household economies. However, their income heavily depends on the availability of raw materials, i.e., the daily crab catch. When the harvest declines due to weather conditions, seasons, or population depletion, their earnings are also affected. Such economic uncertainty is an inherent part of coastal life, prompting fishing families to seek alternative sources of income.

To cope with these challenges, some fishers temporarily switch to seasonal jobs such as salt farming, dried fish production, or casual labor. However, through the Catalytic Fund program facilitated by FishLog and local partners, Mrs. Sumisih succeeded in enhancing her financial management skills. The program not only provided funding assistance but also offered financial literacy training and business group strengthening. As a result, she was

able to manage her income more effectively, save money, and even expand her small business independently. Her experience is an inspiring example of how well-targeted interventions can enhance the economic resilience of coastal women and foster their self-reliance amid the volatility of the fisheries industry.

The Human Development Index (HDI) is a crucial indicator reflecting regional progress based on human resource quality. HDI serves as a conceptual tool for local governments to assess the success or failure of development efforts (Fahrurrozi et al., 2023). Referring to (Ravallion, 2010) in Fahrurrozi et al., (2023) explain that the United Nations Development Programme (UNDP) utilizes four main indicators to construct the HDI: life expectancy, expected years of schooling, mean years of schooling, and adjusted per capita expenditure representing economic resilience. These four indicators encapsulate the aspects of health, education, and purchasing power, which form the foundation of human development assessments.

In Indonesia, the human development approach is closely linked to poverty alleviation and economic welfare improvement (Maulana et al., 2022). According to Maulana et al., there is a negative correlation between HDI and poverty levels—the higher a region's HDI, the lower its poverty rate. Conversely, a positive correlation exists between HDI and economic conditions. That is, the better a region's economy, the higher its human development quality. This is evident in Indonesia's 2024 HDI, which reached 75.02, an increase from 74.39 the previous year. This improvement indicates that multi-sector development efforts are yielding positive results in enhancing the population's quality of life.

The Human Development Index is a vital measure of societal well-being as it captures progress in health, education, and income. Beyond serving as a statistical indicator, HDI is also a foundation for formulating policies geared toward sustainable welfare. HDI not only reveals the extent to which communities access fair and adequate basic services but also identifies development gaps between regions or social groups. As a non-monetary indicator, HDI highlights dimensions of well-being that cannot be captured through economic growth alone, such as the quality of education and public health. Therefore, improving HDI in a region becomes a strategic marker of social and economic development, particularly for vulnerable groups such as coastal women (Mongan, 2019).

The low HDI in coastal areas and fishing communities—particularly among female crab pickers—often reflects economic disparity and limited access to basic services such as education, healthcare, and infrastructure. (Trijayanti & Mutaali, 2017) emphasized that coastal and rural areas tend to have lower HDIs compared to urban areas, due to various limitations, including low education levels, minimal incomes, and unequal access to essential services. Such disparities reinforce a poverty cycle that is difficult to break, especially in regions heavily reliant on marine resources that are vulnerable to degradation and climate change.

The work of female crab pickers, predominantly conducted by women in coastal zones, plays an essential role in sustaining household economies. This activity not only fulfills daily needs but also serves as a survival strategy for coastal communities facing economic uncertainty. Women in these communities are no longer confined to domestic roles; they are active economic agents contributing directly to household welfare. Their involvement significantly helps prevent poverty, especially given the scarcity of stable formal employment. In the context of human development, their engagement positively influences the household's economic, educational, and health outcomes—three core components of the Human Development Index (Qomariyah et al., 2024a). However, women's participation in income-generating activities becomes more significant for household welfare when it is accompanied by decision-making capacity, control over income, and access to productive resources (Ang & Lai, 2023; Soharwardi & Ahmad, 2020).

Despite their significant contributions, HDI in coastal or fishing communities remains low. Qomariyah et al. (2024) note that low HDI frequently correlates with economic inequality and limited access to essential services. Low educational attainment, inadequate healthcare facilities, and insufficient public infrastructure remain major challenges. The

seasonal and environmentally dependent nature of fisheries further exacerbates socio-economic conditions. These factors perpetuate a cycle of poverty that hinders sustainable improvements in quality of life. Thus, increased attention to empowering coastal women and enhancing access to basic services is vital for more equitable human development. This indicates that women's economic participation alone is insufficient to improve human development outcomes if it is not supported by access to social protection, institutional recognition, and equitable control over resources (Baker et al., 2024; Perera et al., 2022).

Although economically significant, crab picking as an informal sector faces multiple challenges, including income instability and limited access to education, healthcare, and welfare facilities. The precarious nature of the work makes laborers vulnerable to economic fluctuations, which in turn affects their overall quality of life. Furthermore, low wages and a lack of social protection hinder female workers from achieving better welfare and contribute to the low HDI at both local and national levels (Puspitawati et al., 2019; Romdhon, 2021). This condition reflects the broader precariousness of women's informal labor, where women's productive contribution is often separated from formal labor rights, welfare protection, and social security coverage (Hanoum & Imelda, 2025; Perera et al., 2022; Roumpakis, 2020).

One blue swimming crab-producing area facing structural issues in the supply chain is Sukoharjo Village, Rembang Regency, where the majority of residents work as crab fishers (Sari et al., 2016). Unlike the regulated system of fish auction centers (TPI), crabs in this village are sold directly to middlemen, who then process them into fishery products such as canned crab. The dominance of middlemen in the market mechanism leaves fishers with little control over selling prices, despite rising demand. Consequently, fishers remain marginalized in the supply chain, earning lower margins compared to collectors who control distribution and pricing.

In coastal social structures, men generally exhibit higher productivity and economic participation than women, influenced by physical attributes, socio-cultural constructions, and longstanding practices (Burhanuddin et al., 2020). Men are perceived as physically more capable of engaging in labor-intensive jobs (Isnaini et al., 2023). Meanwhile, women's biological roles as mothers require time for pregnancy, childbirth, and childcare. Additionally, women often have less access to education due to social norms that prioritize men as primary breadwinners. However, with growing awareness of gender equality, women are increasingly participating in economic sectors. Their presence in the workforce holds potential to accelerate economic growth, as women's incomes support household needs and stimulate domestic consumption, which in turn contributes to economic expansion.

Women's involvement in the informal economic sector—such as blue swimming crab picking in coastal areas—serves as concrete evidence of their contribution to development. One of the key indicators used to assess development success is the Human Development Index (HDI), which encompasses three main dimensions: health, education, and a decent standard of living. The crab-picking work that is predominantly carried out by women not only sustains household economies but also opens up opportunities for improved access to education and healthcare for family members. In this context, women's work in the informal sector becomes an essential component of human development, even though its contribution is often overlooked in official statistics. However, structural challenges such as low wages, lack of social protection, and unequal access to public services continue to limit the extent to which women's economic contribution can be transformed into broader improvements in education, health, and decent living standards.

Against this backdrop, this study aims to analyze the correlation between crab picking—an occupation largely undertaken by coastal women—and Human Development Index (HDI) outcomes, particularly in Indonesia's coastal regions. The primary focus is on understanding how women's economic activities in the informal fisheries sector can contribute to improvements in education, health, and per capita expenditure indicators. In this context, crab picking is not only a reflection of household economic activity but also an expression of resilience and adaptive strategies employed by fishing communities in

response to limited access to formal employment and basic services. This study also seeks to introduce a gender-based perspective into the discourse on human development, which has long been centered on the formal sector and male actors. Through a literature review approach, the article identifies structural challenges faced by female workers while also exploring strategic opportunities to enhance their welfare through more inclusive coastal development policies—policies that position women as active agents in improving HDI outcomes and alleviating poverty within coastal communities.

2. Methods

2.1 Research Design

This study employs a qualitative research design with a descriptive approach. The qualitative design is chosen to explore and understand the meanings, values, and social roles of women working as blue swimming crab pickers and men involved in the crab supply chain in coastal areas along the northern coast of Java. Qualitative research enables an in-depth understanding of social phenomena through holistic and interpretative analysis, emphasizing participants' perspectives, experiences, and social realities (Samsu, 2021). The research process is naturalistic, meaning that the researcher does not intervene or manipulate the conditions being studied.

The study uses a descriptive method to systematically and accurately describe the division of labor between women and men in crab-related economic activities. This approach does not aim to test hypotheses or establish causal relationships but rather to identify, classify, and interpret social phenomena within coastal communities. The descriptive method allows the researcher to capture the complexity of economic, social, and cultural life in a comprehensive manner. Although formal hypotheses are not central, initial assumptions may guide the identification of relevant patterns (Samsu, 2021).

This research is also based on a literature review as a primary method of data collection. A literature review involves examining, analyzing, and critically evaluating previously published works (Mahanum, 2021). The process includes selecting relevant topics, gathering scholarly sources, constructing arguments, and assessing the quality and relevance of the literature. This method provides a theoretical and conceptual foundation for the study and helps identify research gaps, refine analytical perspectives, and align the study with existing academic discourse (Alif & Solihin, 2023).

2.2 Analytical framework and data sources

To analyze gender roles, this study adopts the Gender Framework Analysis (GFA), also known as the Harvard Analytical Framework. This framework is used to examine gender-based divisions of labor and resource distribution within a social context. It consists of three main components: a) Activity profile (division of productive, reproductive, and social roles), b) Access profile (access to resources), and c) Control profile (control over resources and decision-making). This framework enables a structured analysis of how men and women participate in economic activities and how resources are distributed, supporting gender-sensitive development planning (Puspitasari & Puspaningrum, 2019; March et al., 2005).

The data used in this study are derived from secondary sources. These include: a) Statistical data from the Central Statistics Agency (BPS), particularly indicators related to the Human Development Index (HDI), such as life expectancy, education, and standard of living; b) Scholarly articles from national and international journals relevant to informal labor, gender roles, and coastal development; c) Reports from interviews, previous field studies, and publications from non-governmental or civil society organizations focusing on women's empowerment and sustainable fisheries.

2.3 Scope of study

The study focuses on women working as crab pickers in the informal sector and men involved in the supply chain within coastal communities along the northern coast of Java. It examines how these roles contribute to household economies and broader development indicators, particularly HDI. The main objective of this study is to analyze the relationship between women's informal economic activities—specifically crab picking—and human development outcomes in coastal areas. The study also aims to highlight the often-overlooked contribution of informal labor to economic sustainability and social welfare.

3. Results and Discussion

Crab fisheries represent a prominent and economically valuable commodity within Indonesia's marine and coastal sectors. Historically, blue swimming crab (*Portunus pelagicus*) fisheries reached a stage where nearly all the catch was graded as first-class for export, highlighting its significance to the national economy. The Java Sea remains the most productive area for crab harvests, supported by an expansive network of small-scale processing facilities known as miniplants. These miniplants serve as the backbone of the crab value chain, executing a variety of functions including procurement, processing, storage, distribution, and marketing. They also absorb substantial operational risks, such as dealing with rejected shipments and offering financial assistance to small-scale fishers. Therefore, product standardization and supply chain efficiency are crucial to maintain competitiveness in international markets (Jumiati & Abidin, 2024).

Despite the increasing industrialization of the sector, the majority of labor in miniplants is female—primarily housewives and the wives of fishers. These women typically work informally, beginning their shifts at 8 a.m. and finishing in the late afternoon, depending on supply availability and processing demand. Their tasks involve meticulous sorting and manual picking of crab meat, often in teams of four to five workers per table, categorized by quality types such as lump meat, jumbo, special, and clawmeat. The final products are then weighed, packaged, and stored in iced containers for shipment or further processing in pasteurization units (Simbolon et al., 2022).



Fig.1. One of the miniplants in Rembang

Though often unrecognized in formal employment statistics, female crab pickers form a critical component of the fisheries value chain. Their work is essential not only to ensure product quality and consistency, especially for export standards, but also to maintain continuity within the supply chain itself. These women often carry intergenerational knowledge of seafood handling practices, passed down through families in coastal communities. According to Qomariyah et al., (2024), their presence stabilizes the post-harvest sector and anchors local economies during periods of fluctuating fish catch or declining marine resources. This finding is in line with international evidence showing that women's work in small-scale fisheries and post-harvest activities is often economically important but remains statistically and institutionally invisible (Harper et al., 2020; Rao et al., 2024).

The role of women in this labor-intensive industry extends far beyond the physical act of picking crabs. In communities such as Rembang, Pamekasan, and Tuban, women play an integral role in household income generation and economic decision-making. As reported by Jumiati & Abidin, (2024), women working in five miniplants in Tuban's Palang Subdistrict contributed an average of 57% to total household income. In certain cases, particularly among widows or single mothers, the women were the sole breadwinners. Despite working informally, their financial contributions significantly improved household stability, enabling better access to education, nutrition, and healthcare. Such household-oriented income allocation is consistent with studies showing that women's employment status, education, and decision-making autonomy are closely associated with household welfare and empowerment outcomes (Ang & Lai, 2023; Soharwardi & Ahmad, 2020).

These economic contributions can be linked to household-level welfare dimensions associated with the Human Development Index (HDI), which measures quality of life through dimensions such as life expectancy, educational attainment, and standard of living. Women's incomes are often prioritized for children's education and family health expenditures, both of which are key indicators of HDI. Furthermore, their economic autonomy can positively influence household decision-making and long-term family planning. (Dini, 2023) noted that the emergence of home-based crab processing as a livelihood option for fisherwives not only diversifies income but also transforms social norms around gender and labor, empowering women to participate more actively in community development.

However, the economic opportunities offered through miniplants are not without limitations. Despite their productivity and long hours—often exceeding eight hours per day—most female crab pickers earn wages below the regional minimum wage. In Tuban, for instance, monthly earnings generally range between IDR 2,000,000 and IDR 2,500,000, falling short of the 2024 district minimum wage of IDR 2,532,234.8. Furthermore, none of the respondents from (Jumiati & Abidin, 2024) study reported receiving a formal salary or social benefits such as health insurance, paid leave, or retirement security. This reflects the precariousness of informal work and underscores the need for inclusive labor protections in the fisheries sector. Similar patterns are found in post-harvest aquatic food systems, where women's labor can support product quality and market continuity while remaining precarious due to informal contracts, limited bargaining power, and unequal access to social protection (Perera et al., 2022; Rao et al., 2024).

Moreover, the working conditions are highly dependent on external variables such as weather, ice availability, and market dynamics. Ice shortages, for example, were identified as a significant barrier to maintaining meat freshness, potentially leading to quality deterioration and buyer rejection (Simbolon et al., 2022). In post-harvest fisheries, such risks are often gendered because processing and handling activities are commonly performed by women, making them more exposed to quality losses, spoilage, and income instability (Kaminski et al., 2020). Such vulnerabilities make crab pickers' livelihoods increasingly uncertain, especially in the face of climate variability and resource depletion. According to the Ministry of Marine Affairs and Fisheries (MMAF), crab production in Indonesia declined dramatically from a peak of 269,795 tons in 2017 to 101,924 tons in 2021. The cause of this decline includes overfishing, insufficient regulation enforcement,

and shifting export market conditions. In Demak's waters (WPPNRI 712), resources are now considered fully exploited, with current catch levels reaching the allowable maximum of 18,806 tons annually (MMAF, 2022)

These ecological stressors directly impact the sustainability of the crab supply chain and the well-being of those who depend on it. In Rembang Regency, fishers and crab pickers alike reported a noticeable decline in crab size and quality, which in turn affects production volumes and overall profitability. BPS, (2023) statistics confirm this trend, revealing a downturn in both production volume and economic value of crab landings between 2022 and 2023. Key contributing factors include destructive fishing practices, lack of gear selectivity, and limited economic literacy among fishers, which constrains their ability to adapt to sustainable management principles (Trijayanti & Mutaali, 2017). For women in post-harvest fisheries, declining catch availability can reduce access to raw materials, increase production costs, and heighten livelihood vulnerability, especially when storage facilities and alternative livelihood options are limited (Appiah et al., 2021).

Despite these challenges, the resilience demonstrated by women in the crab industry is notable. Their ability to adapt, manage fluctuating household incomes, and continue working under informal and insecure labor conditions reflects a larger narrative about women's unrecognized labor in small-scale fisheries. While current government and NGO interventions—such as microfinance initiatives and financial literacy programs—have offered some support, more systemic efforts are needed to elevate the status and security of women in fisheries value chains. However, resilience should not be romanticized as a substitute for structural support, because women's adaptive capacity in fisheries is often constrained by limited access to assets, social protection, and formal decision-making spaces (Galappaththi et al., 2022; Oloko et al., 2024). This includes formal recognition of their work, incorporation into national employment and welfare programs, and gender-responsive fisheries policies.

Importantly, the transformation of women's roles—from domestic caregivers to central economic actors—signals a shift in coastal gender relations. Home industries and miniplants provide spaces where women can gain practical business skills, negotiate better income, and participate in informal savings networks. Over time, these changes have the potential to recalibrate power dynamics within households and communities, especially when supported by enabling policy frameworks and inclusive economic planning.

Table 1. Profile of productive, reproductive and social activities

Activity	Women	Men
Productive		
Blue swimming crab fisher		✓
Middle trader (tengkulak)	✓	✓
Small trader (bakul)	✓	✓
Crab peeler	✓	
Miniplant owner	✓	✓
Reproductive		
Household care	✓	
Sosial		
-	-	-

(Qomariyah, 2024)

The table within the Gender Analysis Framework (GFA) (Table 1) offers an in-depth understanding of the respective roles of women and men in the blue swimming crab (*Portunus pelagicus*) fishery industry. This table categorizes five types of activities by gender participation: crab fishers, middle traders (tengkulak), small traders (bakul), crab pickers, and miniplant owners.

First, the role of women as crab pickers, bakul, and miniplant owners is highly significant. The role of crab pickers reflects that women possess specific skills that enable them to contribute directly to enhancing the added value of crab products (Romdhon, 2021b).

As bakul, women participate in the marketing of the catch, which improves their access to markets and helps diversify household income sources (Sari et al., 2016). On the other hand, as miniplant owners, women are also involved in crab processing, indicating that their involvement is not limited to production activities but also extends to management and decision-making at the production level.

Meanwhile, men dominate two key activities, namely as crab fishers and middle traders (tengkulak). Their involvement in these roles reflects the prevailing social structure, wherein fishing is often perceived as a more “masculine” and high-risk occupation. As intermediaries in the marketing chain, tengkulak play a significant role in setting prices and managing product distribution, although this also restricts the potential profits that can be gained by fishers (Sari et al., 2016).

This division of labor illustrates the complex gender dynamics within the fisheries industry. On the one hand, women’s involvement in various activities highlights opportunities for enhancing their economic independence, but on the other hand, their access to resources and strategic decision-making in business is often limited by prevailing social norms (Puspitawati et al., 2019). By understanding gender roles within productive activities, we can illustrate both the potential and the challenges faced by fishing communities and design more effective interventions to improve the welfare of all actors in the fisheries supply chain. Therefore, women’s participation in productive activities should be distinguished from women’s control over resources and decision-making, because participation alone does not necessarily indicate empowerment (Anderson et al., 2021; Galappaththi et al., 2022).

Based on Table 1, women play a dominant role in post-production activities such as crab picking, acting as bakul, and middle traders. Meanwhile, men are more involved in core production activities such as being crab fishers and miniplant owners. Nonetheless, both women and men can act as middle traders, indicating some overlap in roles within the supply chain. However, ownership and control over larger-scale enterprises such as miniplants still require further attention because access to capital, business networks, and strategic decision-making may remain uneven between women and men. This reinforces the assumption that gender-based labor division in the fisheries industry is not only related to job type but also involves access to and control over economic resources.

This inequality is also reflected in the disparity of marketing margins obtained by different actors. Fishers—mostly male—earn the lowest margin at Rp15,707/kg, while middle traders earn Rp55,000/kg, and bakul—mostly women—earn the highest margin at Rp85,000/kg. This indicates that women acting as bakul have high income potential, although they remain burdened by unpaid domestic work such as household duties. Moreover, the high margins received by bakul are also influenced by additional costs such as crab picking—performed by female crab pickers (Sari et al., 2016). Thus, although women are actively involved in the supply chain and make significant contributions to the product’s economic value, their bargaining position and access to resources remain limited. This condition reflects a broader pattern in small-scale fisheries value chains, where women may contribute substantially to value addition but remain constrained by limited bargaining power, unpaid domestic responsibilities, and unequal control over productive assets (Galappaththi et al., 2022; Rao et al., 2024).

According to BPS, (2017), coastal communities contribute approximately 25% of Indonesia’s total poor population, amounting to 7.87 million people. In this context, women in fishing communities play a vital role in sustaining household welfare. They are not only active in the domestic sphere but also in productive sectors such as crab picking, petty trading, and even acting as household heads (Indrawarsih & Ratri, 2023). This role contributes to household economics, allowing families to meet basic needs such as education and healthcare—two critical indicators in the Human Development Index (HDI). Women’s roles in managing household finances, such as regulating daily expenditures averaging Rp201,150.00 or allocating income for children’s education, represent a form of strategic control in human development. This supports the argument that women’s

contribution to household finance is not merely supplementary, but also strategic in shaping household welfare decisions related to education and health (Ang & Lai, 2023).

Nevertheless, the income disparity between fishers (Rp124,482.00/day) and middle traders (Rp1,563,864.00/day) indicates an economic gap in the supply chain that affects the ability to access basic services. Most women have access only to informal and low-income economic activities. In contrast, small- and medium-scale middle traders have stronger capital and networks, allowing them to source crab across regions for export (Lestari et al., 2014). Therefore, improving gender-based welfare cannot rely solely on increasing women's economic roles; it must also be accompanied by a redistribution of access and control over productive resources and decision-making to foster overall HDI improvement in coastal communities. Therefore, improving women's welfare in the crab supply chain requires not only increasing their participation in economic activities, but also strengthening their access to capital, market information, and collective bargaining mechanisms.

The previously compiled access and control table reveals a significant disparity between women and men regarding resource mastery and decision-making in crab fishery economic activities. Although women have access to several productive activities, such as crab peeling, working as vendors, and some even owning mini-plants, their control over the results of their labor remains limited. Men still dominate strategic positions, such as capture fishers, intermediaries, and mini-plant owners, who hold the authority to determine the direction of catch distribution, make economic decisions, and manage capital. This disparity indicates that, despite women's active participation in productive economic activities, they remain subordinate within the economic power structure (Puspitawati et al., 2019). This distinction between access and control is central to gender analysis because women's involvement in economic activities does not automatically translate into authority over income, resources, or strategic choices (Anderson et al., 2021; Galappaththi et al., 2022).

Table 2. Women's Access and Control in the Blue Swimming Crab Supply Chain

Activity/ resource	Women's access	Women's control	Source
Crab fishing	None	None	This activity is carried out by men due to physical demands and work culture (indrawarsih & ratri, 2023).
Crab peeler	Available	Available	The majority of pickers are women, mainly fishermen's wives, and the activity is carried out in miniplants or at home (puspitawati et al., 2019; luthan & zahrani, 2024).
Small-scale trading (bakul)	Limited	Limited	Only some women become small traders and depend on middle traders (tengkulak) for supply and markets (sari et al., 2016).
Access to export market	None	None	Dominated by exporters and large-scale collectors, women are not directly involved (sari et al., 2016).
Business capital	Limited	Limited	Capital often comes from husbands or middle traders. Programs like the catalytic fund help improve capacity (luthan & zahrani, 2024).
Household income management	Available	Available	Women manage household expenses, including consumption, education, and health (lestari et al., 2014).
Children's education	Available	Available	Women play a role in decision-making on children's education (indrawarsih & ratri, 2023).
Family health	Available	Available	Women make decisions related to family health services (qomariyah et al., 2024)
Participation in fisher/fishery cooperatives	None	None	Women are rarely involved in formal fisher organizations (indrawarsih & ratri, 2023).

One reason for this inequality is the minimal formal recognition for informal jobs like crab peeling. Women's access is merely limited to participation in activities, without corresponding control over production results, prices, and distribution. This situation affects women's contributions to strategic decision-making at both household and community levels while undermining their structural empowerment potential. In this context, gender roles not only influence work participation but also affect wellbeing, access to education, and household economic resilience—three essential components for enhancing the Human Development Index (HDI). Thus, the empowerment of crab pickers requires more than work participation; it requires formal recognition, stronger bargaining capacity, and inclusion in decision-making spaces that shape labor, pricing, and resource governance.

Gender inequality in the fisheries value chain not only reflects a justice issue but also directly impacts human development achievements in coastal communities. Adam & Njogu, (2023) reveal that women are largely confined to low-capital, low-profit segments of the aquaculture value chain, with restricted access to training, financing, and decision-making power. When women can participate in economic activities but lack control over outcomes, their involvement becomes superficial and does not translate into improvements in HDI indicators such as education and health. This finding aligns with the Gender Framework Analysis presented in this study, where unequal access and control significantly limit women's capacity to elevate household welfare. Koralagama et al., (2017) further underscore that the invisibility of women in fisheries data and policy results in systemic underrepresentation, deepening socioeconomic disparities. Thus, a development approach that not only grants access but ensures control, formal recognition, and meaningful participation in fisheries governance is critical for achieving inclusive and sustainable human development (Galappaththi et al., 2022; Oloko et al., 2024).

Additionally, another structural issue hindering local actors' involvement in sustainable resource management is the lack of mechanisms for monitoring crab sizes (Huda et al., 2024). In a data-driven fisheries management framework, the availability of size information for the catch is crucial in determining stock sustainability. However, evidence from the field shows that most fishers do not have or do not utilize a monitoring system concerning catch size. Survey results indicate that approximately 69% of fishers do not record their catch based on crab size (Huda et al., 2024). The absence of such systems makes it difficult to assess how many crabs meet the minimum size requirements as per management regulations, thereby increasing the likelihood of concealed overfishing practices. However, monitoring should not only be treated as a technical requirement, but also as a potential entry point for strengthening the role of local actors, including women in post-harvest processing, in sustainable fisheries governance (House et al., 2023).

Moreover, some fishers also neglect to document information regarding location, types of fishing gear, and time of capture, which obscures spatial and temporal data on crab stock distribution (Huda et al., 2024). According to Rudd & Branch, (2017) size and timing-based catch quotas are vital for maintaining marine stock sustainability. Without accurate data concerning the size of captured crabs, conservation efforts become challenging. Furthermore, when catch results do not meet certification standards, crab products from Indonesia risk rejection in international markets currently emphasizing traceability and sustainability in seafood trade.

The lack of monitoring mechanisms for crab sizes is also closely tied to the low recording literacy among fishers. As noted in the report by (Huda et al., 2024), many fishers do not grasp the significance of recording as a basis for long-term resource management. They perceive catch results merely as short-term income, failing to recognize the ecological and economic implications of uncontrolled fishing practices. In fact, 64% of fishers do not document based on the fishing gear used, although the type of gear, such as trawling nets, significantly impacts habitat damage and catch selectivity (Cruz et al., 2015). This condition indicates that traceability reform must be linked not only to product documentation, but also to capacity-building and inclusive governance among fishers, traders, miniplants, and women workers in the post-harvest sector.

This lack of available monitoring mechanisms complicates efforts to implement catch certification systems. Only about 31% of fishers believe their catch meets certification standards, while roughly two-thirds are either unaware of or do not understand those standards (Huda et al., 2024). This situation highlights both a knowledge gap and inadequate support within the upstream fisheries sector, leading to fishers' unpreparedness to meet global market standards. Certification is not only a gateway to international markets but also a crucial tool for enhancing sale prices and preventing export rejection. Evidence from fisheries reform in Thailand shows that traceability can improve visibility and labor governance, but it does not automatically resolve everyday vulnerability unless worker rights, mobility, and working conditions are also addressed (Kadfak & Widengård, 2023).

Therefore, this fourth point becomes essential in efforts to improve crab fisheries governance in Indonesia. Without adequate systems for monitoring catch sizes, the sustainability of crab stocks will be increasingly difficult to maintain. Policy interventions that encourage the procurement of simple measuring tools, training in recording, and data integration from fishers into the supply chain are crucial steps. Additionally, empowering women in quality monitoring and recording the results of peeling at mini-plants can provide innovative solutions, given the high involvement of women in the post-catch processing chain. Such involvement would be consistent with gender-aware participatory monitoring, where women are not only data providers but also actors whose knowledge can inform management decisions (House et al., 2023).

Consequently, the aspect of traceability regarding crab sizes should be integral to national fisheries data reform, not only for conservation purposes but also to improve the wellbeing of coastal communities through fair and sustainable trade systems. This situation reaffirms that issues of access and control over information and resources, as illustrated in the previously discussed table, are closely related to the low effectiveness of fisheries management at both local and national levels. Unlike previous studies that often treat gender inequality and fisheries governance separately, this paper provides an integrated perspective by linking the Gender Framework Analysis (GFA) with traceability challenges and Human Development Index (HDI) outcomes in Indonesia's crab fisheries. It highlights how limited control and recognition of women's roles in post-harvest activities intersect with data gaps in resource monitoring, ultimately constraining both community wellbeing and sustainable trade compliance.

In conclusion, both the lack of women's control in the fisheries value chain and the absence of adequate catch monitoring mechanisms contribute to persistent challenges in human development outcomes and sustainable fisheries governance. Addressing these issues requires integrating gender-transformative approaches and capacity-building efforts into fisheries policy frameworks. Enhancing women's roles in data collection, certification processes, and community decision-making, alongside improving literacy and access to tools for both men and women, will be essential to realize inclusive, just, and sustainable fisheries development in Indonesia.

4. Conclusions

This study highlights the critical yet often underrecognized role of women crab pickers in Indonesia's blue swimming crab (*Portunus pelagicus*) value chain and their broader contribution to human development in coastal communities. Despite their informal employment status, these women support household resilience by contributing to expenditures in education and healthcare—two essential pillars of the Human Development Index (HDI)—while ensuring the consistency and quality of crab processing for export.

Through the application of Gender Framework Analysis (GFA), this study reveals persistent inequalities in access and control over resources between men and women. Although women are heavily involved in post-harvest activities such as peeling and trading, their influence over value distribution, capital, and strategic decision-making remains minimal. Men continue to dominate upstream segments, including fishing, transport, and

ownership of processing enterprises, further consolidating their control over economic outcomes.

This inequality is compounded by structural issues in fisheries governance, particularly the lack of effective traceability systems. The absence of catch size monitoring, gear documentation, and spatial data inhibits sustainable stock management and undermines compliance with international trade standards. These limitations not only constrain the fisheries sector's ecological sustainability but also restrict the inclusion of women and small-scale actors in higher-value markets.

By linking gender disparities with traceability challenges and HDI outcomes, this paper offers an integrated lens to understand the dynamics of exclusion in coastal fisheries. To foster inclusive and sustainable development, gender-transformative policies must be pursued—ensuring that women gain formal recognition, access to resources, and a voice in decision-making. These efforts should ensure that women's contribution is not only recognized as labor input, but also translated into stronger access to social protection, control over resources, participation in monitoring, and representation in fisheries governance. Women are not just economic contributors; they are pivotal agents of resilience and social change in Indonesia's coastal regions.

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All During the preparation of this work, the author used Grammarly to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the content of the publication.

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