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ARTICLE

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HOW WETLAND DEPENDENT COMMUNITY SUSTAIN LIVELIHOOD AND NUTRITION: CONTRIBUTION OF DUMA WETLAND TO SUPPORT SDGs

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Wetlands, known as the "kidneys of the earth," play a crucial role in supporting small and marginal fishers' livelihoods and nutritional needs. The study aimed to determine fishers' socio-economic conditions, fish consumption patterns, and factors affecting fish purchasing in Duma Wetland. It surveyed 100 fishers from four villages using simple random sampling, revealing a moderate income inequality (Gini coefficient 0.3097) among fishers. Despite constraints like high prices and limited availability, households consume 20.60 kg of fish per capita annually, above India's average. Family size and education significantly influence fish purchasing, highlighting the complex interplay between socio-economic factors and nutrition security, this study addresses Sustainable Development Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-being), and Goal 12 (Responsible Consumption and Production).

Introduction

Since time immemorial, fishing has been one of the primary occupations of humankind, all major civilizations flourished on the bank of water bodies. Moreover, it has been regarded as a vital source of livelihood for coastal and inland fishing communities, providing essential nutritional security that would otherwise be unavailable for them[1]. The fisheries sector is crucial for economic activity, export earnings and employment in many developing countries, and is also an important source of food for mankind[2]. Fish, compared to other animal proteins, is less expensive and offers high nutritional value. While it may seem relatively costly by weight, its nutritional benefits outweigh the cost, making it an important solution to India's long-term food problem[3]. Annual per capita fish consumption of India increased from 4.9 to 8.89 kg, an increase of 3.99 kg (81.43%) with a growth rate of 4.05%[1]. Fish consumption patterns play a crucial role in shaping dietary habits, livelihoods, and cultural practices among fishing communities worldwide.

Wetlands are important fisheries resources and most productive ecosystems in the world, comparable to rain forests and coral reefs and offer multiple ecosystem goods and services benefitting millions of people[4]. They support rich biodiversity[5] and are important feeding and breeding grounds of fishes. Wetlands help in achieving many of the Sustainable Development Goals (SDGs) set by the United Nations (UN) in its 2030 Agenda, by restoring naturally occurring ecosystems through for example, land and water management[6]. Research conducted in various parts of the globe show that the wetlands contribute significantly to the rural livelihoods by providing income and nutritious food through fisheries[7-10]. These fisheries offer affordable and readily available animal protein and nutrients of high quality[11], Addressing hunger and promoting rural development in communities facing food insecurity can significantly contribute to achieving

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Sustainable Development Goals 2 (Zero Hunger), 3 (Good Health and Well-being), and 12 (Responsible Consumption and Production).

Floodplain wetlands or lakes, covering a total area of 202,213 hectares, are a vital part of the Ganga and Brahmaputra basins. These wetlands are a significant fishery resource in states like Assam (100,000 ha), West Bengal (42,500 ha), Bihar (40,000 ha), Manipur (16,500 ha), Arunachal Pradesh (2,500 ha), Tripura (500 ha), and Meghalaya (213 ha).In North 24 Parganas, West Bengal, there are numerous wetlands, with Duma wetland being one of the largest horseshoe-shaped wetlands of Asia having an area of 257 ha with a water depth of 8 - 17 ft[12]. It offers numerous livelihood and nutrional security to wetland dependent community.

Numerous research investigations has been undertaken regarding nutritional importance of fish meat in human health[10,11,13-16]. Some studies investigated on socio-economic factors influencing fish consumption pattern had done before[16-20] inspite there exists research gap focusing on consumption patterns of wetland dependent community, specially fishers, by addressing this gap, the present study explores the fish consumption patterns among the fishers of Duma Wetland, shedding light on the types of fish consumed, frequency of consumption, factors influencing consumption choices, and the socio-economic dynamics underlying these patterns. Understanding the fish consumption patterns among the wetland dependent community holds significance not only from a socio-economic perspective but also from a nutritional viewpoint. In essence, this research endeavors to contribute valuable insights into the intricate relationship between fish consumption and the socio-economic conditions of the wetland dependent community, along with a comprehensive analysis of fish consumption patterns specifically among the fisherfolk of Duma Wetland. This research seeks to explore the connections between sustainable fish consumption practices and improvements in food security and nutrition for communities dependent on wetland resources. By doing so, it directly contributes to the fulfillment of Sustainable Development Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-being), and Goal 12 (Responsible Consumption and Production), highlighting the contributions of wetlands in addressing SDGs.

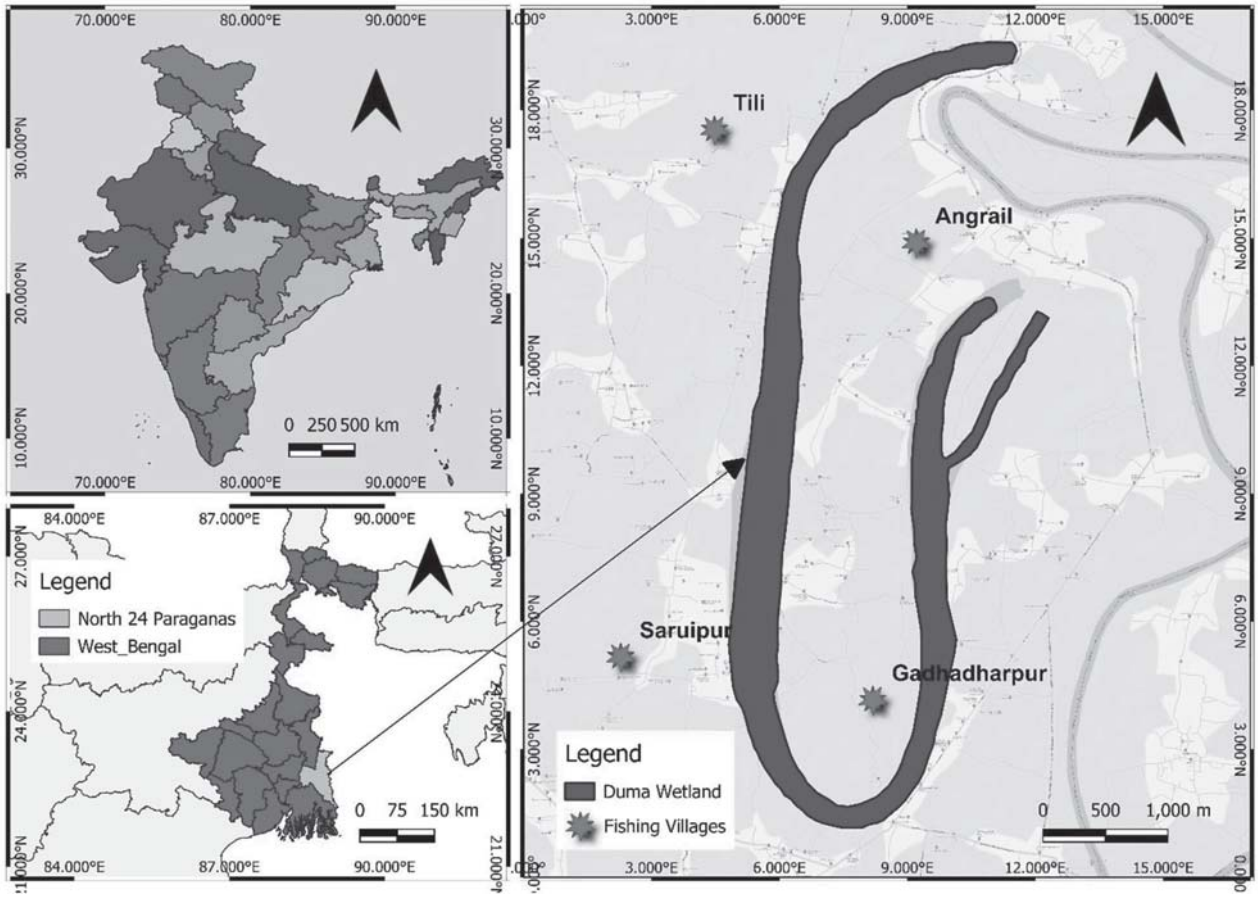

Fig. 1: Locale of the Study

Materials and Methods

Methodology: *Study Area:* The Duma wetland is in the North 24 Parganas District of West Bengal. It is a perennial wetland that plays a crucial role in the region. The management rights of the Duma wetland are held by the Duma Fishermen Cooperative Society Ltd, which comprises 1081 members, including 30 women fishers belonging to socio-economically backward classes.The wetland is vital for fisherfolk in nine villages, providing essential resources like agricultural produce, livestock, fish, water, timber, and non-timber items. It also offers crucial services such as biodiversity preservation, flood control, carbon capture, nutrient recycling, wastewater purification, and groundwater replenishment[21]. More than 500 active fishers are engaged in fishing indigenous fish species like *Gudusia chapra*, *Amblypharyngodon mola*, *Systomus sarana*, *Puntius* spp., *Glossogobius giuris*, *Macrognathus* spp., Catfishes, and small-sized murals. Additionally, the wetland is managed using the 'Grass carp model' to address weed-related issues[22].

Sampling Method: A simple random sampling method was employed to survey 100 respondents out of 500 active fishers from January to March 2022. Four villages namely Angrail, Tili, Saruipur, Gobardhanpur, were selected from each corner of the wetlands, and from each village, 25 fishers were chosen randomly. Semi structured interview schedule was employed to know their fish consumption pattern and socio- economic status.

Data Analysis: The study investigated various socio-economic variables to understand their influence on the dependent variable fish purchasing capacity i.e.the amount of money spent per month on purchasing fish, using regression analysis. These independent variables encompassed Age, Marital Status, Gender, Caste, Education, Family members, House type, Occupation and Income. Through analyzing these variables, the research sought to gain insights.

Lorenz curve[23] was used to assess income inequality among fishers within families. This involved plotting the cumulative proportion of income earned by fishers against the cumulative proportion of fishers, comparing the distribution of income to an ideal scenario of perfect equality. Then, Gini coefficient was calculated. This number tells us how unequal the income distribution is. If it's closer to 0, income is more evenly spread; if it's closer to 1, income inequality is greater.

G=A+BA

Where:

- G represents the Gini coefficient.
- A is the area between the Lorenz curve and the line of perfect equality (the 45-degree line).
- B is the area under the line of perfect equality (the 45-degree line) up to the total population or total income.

Results

Understanding socio-economic features of the selected wetland dependent community is necessary as it affect their fish consumption preferences. The overall socioeconomic features of the sample respondents are presented in Table 1.

Table 1. Socioeconomic Features of Respondents

Variables	Percentage (%)
Gender	
Female	3
Male	97
Marital Status	
Married	96
Unmarried	2
Widow	2
Age (Years)	
Up to 35	4
35 to 55	54
>55	42
Member of co-operative	
Yes	86
No	14
House type	
Kutcha	50
Pucca	34
Semi-pucca	16
Family members	
Up to 4	41
5 to 7	53
>7	7
Education	
Illiterate	11
Primary education	47
Middle level	23
Secondary level	14
Higher secondary	5

The demographic analysis of the wetland dependent community reveals a significant middle aged group presence within the community. Specifically, 54% of the respondents are categorized as being up to 35 to 55 years of age. The educational background of wetland dependent community, predominantly primary education (47%), and 23% of the sampled populace have attained middle-level education. Predominant prevalence of respondents resides in kutcha houses (50%), followed by pucca houses (34%) and semi-pucca houses representing a smaller yet significant portion. The majority of respondents (53%) reported having family sizes ranging from 5 to 7 members. However, the average family size across all respondents was found to be 3.96 members. This indicates a variation in family size distribution within the studied population.

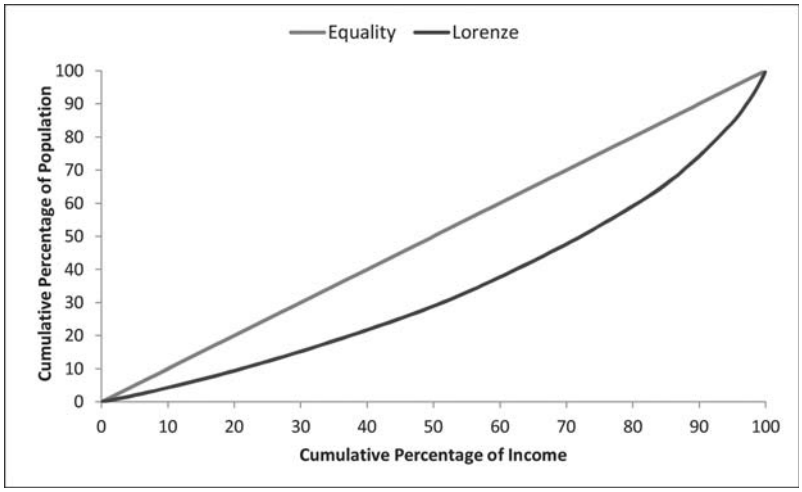

Fig. 1. Lorenze curve indicating income inequalities of fishers

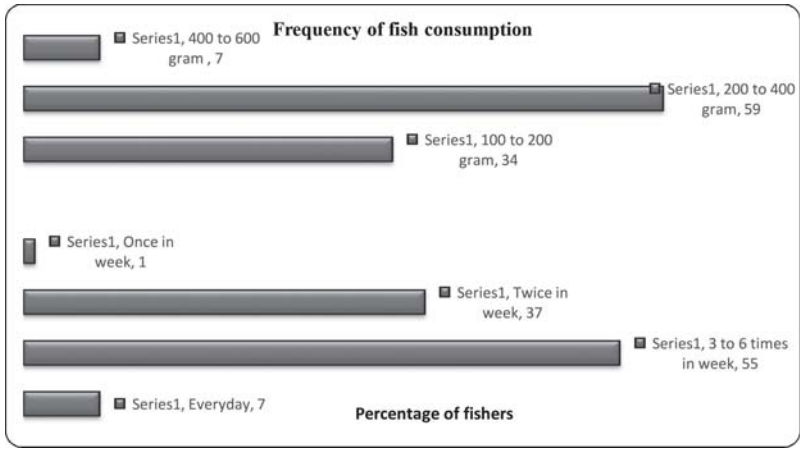

Fig. 2. Fish consumption Frequency and quantity

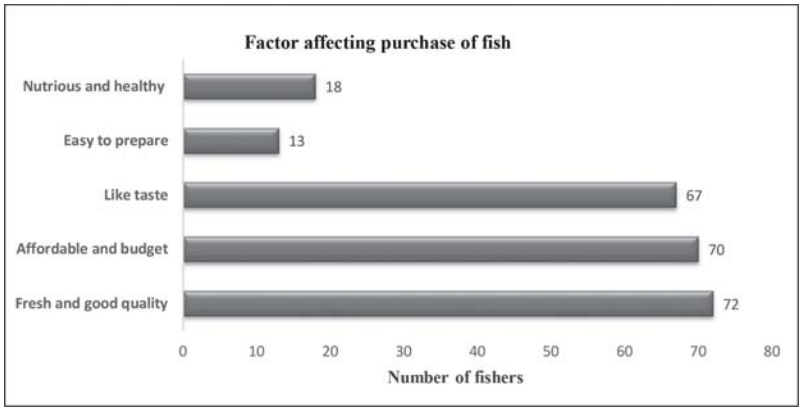

Fig. 3. Factors influencing fish purchase

Income

The average monthly income of the family amounts to Rs. 10,268, with fishing contributing 33.4% to the total family income of wetland dependent community. This indicates a significant reliance on fishing as a source of livelihood within the family.

The calculated Gini coefficient for the fishers of Duma Wetland is 0.3097 and is shown Figure 1, indicating a moderate level of income inequality among them. This value suggests that there is some disparity in the distribution of income among fishers of the wetland community. The corresponding area under the Lorenz curve is 0.1549, representing the portion of total income that contributes to the observed income inequality. These results imply that efforts may be needed to address and mitigate income disparities among fishers in Duma Wetland, possibly through targeted interventions aimed at promoting equitable income distribution and enhancing economic opportunities within the community.

Fish Consumption Pattern

Among the respondents 98 percent fisher were fish eater. The average fish consumption per fisher household is 226.76 grams daily. This amounts to a monthly household fish consumption of 6.80 kg, and an annual average consumption of 81.6 kg. To determine the average per capita fish consumption, the total fish consumption was divided by the average number of individuals per family, which are 3.96.

This calculation yields a per capita consumption of 20.60 kg annually, surpassing the national average for India,

which stands at 8.89 kg[24]. It may be because the respondents are living adjoining the wetland and majority belong to fisher folk community. Majority of the respondents (55%) consume 3 to 6 times per week depicts in Figure 2. Firstly, the high prevalence of fish consumption among respondents, with 98% of fishers being regular consumers, underscores the role of fish as a crucial source of nutrition, aligning with SDG 2 (Zero Hunger). The substantial average daily and annual fish consumption per household highlights the importance of sustainable fishery practices in ensuring food security and addressing malnutrition concerns (SDG 3), about 95 % of the fishers consume fresh small indigenous fish species. Factors influencing fish purchase were represented in Figure 3. Fresh and good quality of fish is the major factor that influenced 72% sampled populaces to purchase fish, followed by an affordable price which influences 70% fishers. Only a few, 18% fishers, purchased fish because of its nutritional value, which reflects the fishers' awareness about the nutritional value despite their high consumption rate compared to the national average. Moreover, the study reveals a preference for locally sourced fish, indicating support for SDG 12 (Responsible Consumption and Production) by promoting sustainable utilization of local resources. This preference, coupled with factors such as prioritizing freshness and affordability, underscores the importance of promoting responsible consumption practices that minimize environmental impact while meeting nutritional needs.

The majority, 72% of fishers in the region, did not purchase fish-based snacks, such as fish balls, fish samosas, fish chops, fish cutlets, etc., attributing their avoidance due to a lack of awareness of such products. Conversely, 28% of them do consume these snacks, citing their crispiness, tastiness, and good quality as the primary reasons for their choice. Consumers in the study area exhibit a strong preference for local fishes over those from external sources[25].

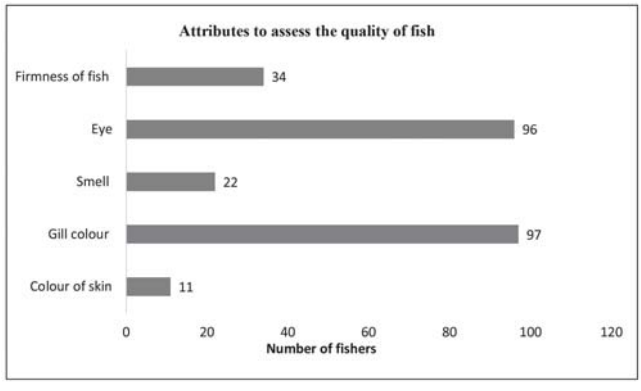

Fig. 4. Fishers attribute to assess the quality of fish to purchase

In assessing the quality of fish, the criteria considered by fishers varied significantly, reflecting diverse perceptions of quality indicators. The gill colour emerged as the most valued indicator, with 97 respondents identifying it as a critical factor in assessing fish quality. This preference is likely due to the common belief that bright, red gills are indicative of freshness and good health in fish. Similarly, the condition of the fish's eye was almost equally prioritized, with 96 respondents considering it a key quality marker, suggesting that clear, bulging eyes are associated with fish that are fresh and of high quality (Figure 4).

Constraints in Fish Consumption

High price, identified as a barrier by 63% of respondents as the major constraint associated with fish consumption. Additionally, 33% reported difficulties stemming from the limited availability of fish, while a smaller proportion, 4%, faced challenges related to lower access. About 95% of fishers consuming small indigenous fish species which emphasized[24]the contribution of floodplain wetland (beel) nutritional security. The purchasing behaviour of the respondents is often influenced by the insufficient quantity of fish caught and necessitating purchases.

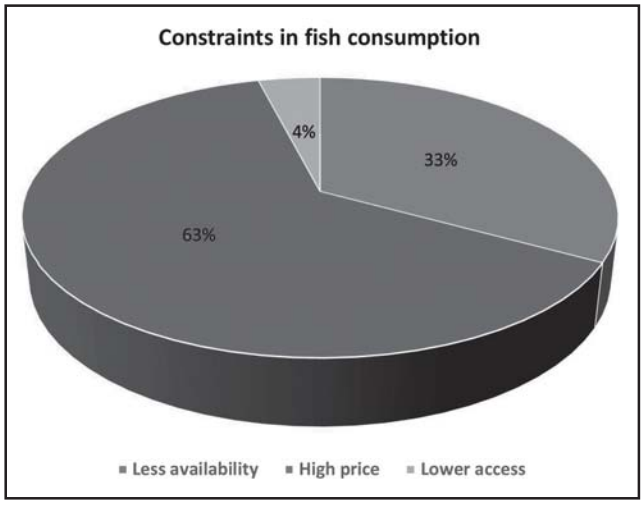

Fig 5. Constraints associated with fish consumption.

Our findings demonstrate a strong positive correlation ($r = 0.65$) between total family income and fish purchase, indicating that as family income increases, respondents tend to allocate more funds towards purchasing fish. This suggests that higher income levels positively influence spending habits related to fish procurement among fishers. A decrease in total household income is associated with a reduction in both the purchase and consumption of fish[17].

Socio-economic Factors Affecting Fish Purchase

The regression analysis indicates several factors significantly associated with fish purchase. Shown in Table 2. Among these, family size showed the strongest positive relationship, with a coefficient of 1389.532 ($t = 7.547$, $p < 0.001$), implying that for each additional family member, fish purchasing capacity will increase. Education level also exhibited a positive influence, with a coefficient of 82.829 ($t = 2.967$, $p = 0.004$), suggesting that higher education levels correlate with higher expenditures towards fish purchase. Age was another significant predictor, with a coefficient of 80.837 ($t = 2.813$, $p = 0.006$), indicating that older individuals tend to spend more on fish purchase. Overall, family size and education level emerged as the most influential factors affecting fish purchasing capacity in this model.

Socio-economic parameters significantly influence consumption patterns, a finding supported by Amevenkuet al., 2019[26]in their study on fishers' household expenditure. The predominant age group of fish consumers falls within the middle years range, indicating that most consumers are in their productive working years. Despite a lack of awareness among consumers regarding the nutritional benefits of fish as an animal protein source, the affordability of fish compared to other protein sources drives their consumption preferences.

Table 2. Factors Affecting Fish Purchase

Factors	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1617.746	6260.239	-	0.258	0.797
Member of society	-1051.993	848.937	-0.085	-1.239	0.219
Working in wetland	347.139	1098.936	0.027	0.316	0.753
Age(years)	80.837	28.733	0.235*	2.813	**0.006**
Gender	-2496.752	1945.008	-0.103	-1.284	0.203
Family member	1389.532	184.108	0.584*	7.547	**0.000**
Education	1082.829	364.985	0.265*	2.967	**0.004**
House type	562.894	473.864	0.100	1.188	0.238
Boat posses	-20.208	599.326	-0.002	-0.034	0.973
Net posses	-2374.127	2012.809	-0.125	-1.180	0.241
SHG membership	1287.809	656.164	0.136*	1.963	**0.053**
Involved in fishing	601.447	706.092	0.062	0.852	0.397

a. Dependent Variable: Fish purchasing capacity

**Correlation is significant at the 0.05 level (one-tailed)*

Conclusion

The study provides valuable insights into the fish consumption patterns and socio-economic dynamics among fishers in the Duma wetland region. The findings underscore the significant role of fish in the diets of communities, with an average annual per capita consumption of 20.60 kg exceeding the national average. High-quality and affordable fish are the primary drivers influencing fish purchase decisions, reflecting the importance of freshness and price in consumer choices. However, challenges such as high prices and limited availability pose barriers to fish consumption for a considerable portion of respondents. Income inequality among fishers was observed with Gini Coefficient 0.30, highlighting the need for interventions to address disparities and enhance economic opportunities within the community. Family size and education level emerged as key determinants of expenditure for fish purchase, emphasizing the importance of socio-economic factors in shaping consumption behaviours. Due to low fish catch in the wetland, there is an insufficient supply to meet local consumption demands, leading fishers and residents to purchase fish from the market. This situation underscores the challenges posed by low productivity and inadequate management in the wetland over recent years, necessitating a reliance on external fish sources for consumption. Overall, the study contributes to a better understanding of the complex interplay between socio-economic conditions and fish purchase patterns, with implications for sustainable development and nutrition security in the region. Specifically, by elucidating the relationship between fish consumption and the socio-economic status of fishers in Duma Wetland, this research directly addresses Sustainable Development Goals 2 (Zero Hunger), 3 (Good Health and Well-being), and 12 (Responsible Consumption and Production). By recognizing the importance of sustainable fish consumption practices in enhancing food security and nutrition among local fishing communities, the findings of this study provide a foundation for policy interventions aimed at

promoting both economic development and environmental conservation in the region and promoting sustainable development goals. ❐

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