



Coastal Commons and Food Security: Case Study of Sundarbans, West Bengal

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Abstract. Sundarbans, a region with 4.5 million residents, 85% of whom depend on paddy cultivation, fishing, crab gathering, and honey collection. Food insecurity is widespread—44% of households cannot secure even two square meals a day. Climate change further threatens traditional livelihoods by disrupting the freshwater supply. Given the background, this paper explores the role of coastal commons in providing food security, specifically regarding two pillars- physical availability and accessibility in the Sundarbans, using the Household Consumption Expenditure Survey 2022. The study reveals that 99% of households consuming food from the commons are marginal landholders, with a major proportion belonging to the Priority Household (PHH) ration card holders. However, significant disparities in food consumption value, especially among Other Backwards Classes (OBC) with unreserved, Scheduled Caste and Scheduled Tribes, suggest structural barriers to equitable access. Despite relying on a representative sample of Sundarbans due to data limitations, the paper highlights the need for further research on the socio-ecological and institutional factors influencing coastal commons and food security.

Keywords: Coastal Commons, Food and Nutritional Security, Marginalised group

1 Introduction

Commons accessible to a community positively affect the community's livelihood, income, standard of living, and food security [1]. It is the resource available to a community without property rights, which is non-excludable but rivalrous. Fallow agricultural lands, rivers, forests, grazing land, and groundwater are examples of traditional commons. However, diverse natural resources, including beaches, mangroves, mudflats, and dunes, are coastal commons that provide vital support for the livelihoods of coastal communities, particularly fishing activities. To understand the coastal communities and dependence on coastal commons, "ecosystem/foodweb" relationships between essential ecosystem components and local livelihoods are necessary [2]. Human populations are drawn to coastal areas due to developing industry, transport, trade, communication, and services, as well as a disproportionate amount of global consumption and waste production [3]. Coastal Commons are interconnected with socio-ecological systems of the environment, community's livelihood, and governance [4].

Sundarbans, UNESCO recognised largest mangrove forest, spans 10,000 square kilometres in Bangladesh and India, with 40 per cent in India. It is spread across some areas of South Twenty-Four Parganas and North Twenty-Four Parganas in West Bengal, India. Sundarbans is rich in natural resources and ecosystems. Mangrove forests, fisheries, water resources, grass beds, wildlife, and biodiversity of Sundarbans have a key effect on the Livelihood and Food Security of Coastal communities [5]. They offer millions of its resident food and water, protecting them from the effects of natural disasters like cyclones and tsunamis, and acts as a buffer among other crucial ecosystem services: preservation of terrestrial sediments, a massive long-term carbon sink, and a home for several animals, including the endangered Royal Bengal tiger [5]. These Resources from the Sundarbans Region are an example of coastal commons. The mangrove forest and its products have historically been used as food sources, along with fish from rivers. Moreover, timber, fodder, medicines, honey, and other products collected from coastal commons are used daily [6]. One should not underestimate coastal regions' role in ensuring the world's food security [3].

Despite significant advancements in food grain production and a decline in malnutrition rates over the past two decades, malnutrition remains excessively high (India stands at 105 out of 127 nations, according to the Global Hunger Index 2024). Anaemia is ubiquitous nowadays, particularly among women of reproductive age (53%) [7]. Even though West Bengal, a leading food grain-producing state, has food abundance, 18.7% of people had to go to bed without food, and 44% had to borrow [8], which shows the status of food insecurity. One of the leading causes of illness and death in children is micronutrient deficiencies [9].

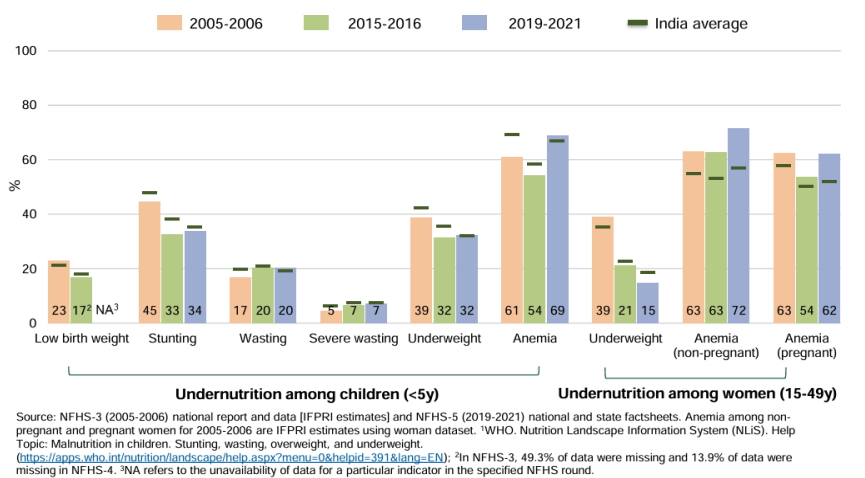


Fig.1. Trends of undernutrition among children and women in West Bengal according to Various NFHS rounds

Figure I, compiled by NITI Aayog using different National Family Health Survey (NFHS) rounds, depicts the trends of undernutrition among children and women in West Bengal. It is evident that from 2015-16 to 2019-20, there was not much improvement in undernutrition among children and women; instead, the situation worsened for stunting and anaemia. South Twenty-Four Parganas always stands in the top 5 for undernutrition among children in West Bengal [9]. Food insecurity is a significant problem, with many individuals in the South 24 Parganas suffering from malnutrition and over 87% of residents lacking food security [10]. Most of the Sundarbans are spread over South twenty-four Parganas, which makes it a vulnerable area for food insecurity. Therefore, it becomes crucial to look at ways to improve the food security of the Sundarbans region, the largest mangrove forest in the World.

Previously, in the pre-colonial period, the usage of local woods in Sundarbans was governed by particular, well-established laws, traditions, and conventions among the communities, and anyone who disobeyed these practices faced harsh penalties [6]. However, with the increasing state monopoly power and powerlessness of communities in Sundarbans, resources have been depleted over the years. In the Indian Sundarbans, around 4.5 million people reside, of whom 85 per cent depend on cultivating only one type of paddy crop for their livelihood [11]. Other jobs include fishing, gathering crabs, and collecting honey from the woodlands.

About 200,000 fishermen work in the Sundarbans' waterways every day, and their primary source of income comes from the inshore, estuarine, and coastal fisheries [8], which also helps the community to provide food security. Approximately 90% of aquatic species are regarded as having their nesting grounds along the eastern shore in the Sundarbans [12]. There are about 20 pairs of identified prawns and 44 species of crabs in the Sundarbans area, excluding fish species [12]. Mangrove wood, used for fuel and construction, is an important resource. Honey gathering is a favourable source of traditional livelihood, along with growing fruits, vegetables, and rice, complementing livestock farming, such as raising cattle, poultry, and goats.

Given the background, managing coastal diversity and community resilience and linking it to food security can supplement a few crucial sustainable development goals. Food from coastal commons supports SDG 1 (No Poverty) by providing livelihoods through fishing and resource harvesting. It

contributes to SDG 2 (Zero Hunger) by offering essential nutritional resources like fish and mangrove products. Additionally, sustainable management of coastal resources aids SDG 13 (Climate Action) by promoting climate resilience through healthy ecosystems like mangroves that protect against environmental disasters. Most poor and backwards-class people depend on the resources of the coastal commons. In recent years, eco-tourism has also become a growing source of income for many people in the Sundarbans. According to historical trends, the mangrove area has declined by approximately 71.9% since 1776, leading to an "Endangered" status. Even though the current rate of mangrove degradation in the Indian Sundarbans (less than 0.11% of the total mangrove ecosystem) is low, historical losses and ongoing threats, such as fish population declines, climate change, hydrological modifications, and pollution, remain significant concerns [13].

The rest of the paper is organised as follows: issues from the literature and theoretical framework in Section 2, objective in Section 3, a description of the study area in Section 4, data sources and methodology in Section 5, Findings and discussion in Section 6, and the last section, 7, is the conclusion.

2 Issues from Literature

In the era of privatisation and encroachment, the commons hold significant importance for the poor and marginalised community. The debate on commons management was initiated by Hardin's *Tragedy of the Commons* [14], wherein he argued that without regulation, individuals acting in their self-interest would inevitably deplete resources. To prevent such a tragedy, Hardin advocated for state intervention. In contrast, Elinor Ostrom contended that community-based governance often leads to more efficient and sustainable commons management [15]. Some studies have highlighted the importance of commons for the livelihood of poor and marginalised communities [1, 16, 17], noting their contribution to reducing income inequality and increasing employment. A study conducted in 1994-96 across major agroecological zones of West Bengal revealed that women constituted a substantial proportion of collecting resources from the commons [18]. Despite this, women's access and authority over the commons have diminished with increasing depletion and commercialisation. Even the livelihoods of tribal communities in the North Eastern states heavily depend on the commons, as they rely on traditional agricultural practices on common lands [19]. However, climate change has recently affected mangrove areas, marine fish, and freshwater fish, threatening the survival of the commons [20, 21]. Almost 27% of the population's livelihood in India depends on forest resources, and there is enormous pressure on forest commons for fuelwood and fodder [22]. Consequently, effective resource management and local governance are needed to ensure the sustainable use of these resources [19].

The consumption of foods collected from the commons—such as forests, rivers, and grazing lands—has significantly contributed to nutrition and local dietary diversity [23,24]. In the literature, such foods are often referred to as “uncultivated foods” or “wild foods” [25]. Estimates from 2011–12 indicate that 5.8% of all Indian households relied on at least one of these “free foods” monthly, underscoring their importance and justifying their inclusion in the National Sample Surveys (NSS) [26]. These refer to plant and animal species sourced through gathering, hunting, foraging, fishing, or other methods outside formal cultivation [27]. The contribution of these resources to nutrition is difficult to measure or identify, as it varies across time and gender [28]. The contribution of natural resources beyond forests plays a

crucial role in local dietary diversity, particularly for poor households [23,29]. These resources also support marginalised and tribal communities during lean seasons [30]. One study from rural Cameroon found that the forest foods contributed approximately half of women's total daily energy intake. However, a significant inverse correlation was observed between the Household Food Insecurity Access Scale and Forest Food Consumption Score, demonstrating that forest foods are important in ensuring food security in these forest-dependent communities [31]. People even collect medicinal plants from the commons for their own use [27]. One of the studies of Northern Nigeria found that 67 wild foods from 53 plant species are important as a supplement to the daily diet during food scarcity [32]. In the Western Himalayas, most respondents reported that they collect these foods because they are tasty and nutritious (85%) as well as freely available (68%) [33]. In fact, decreasing the collection of wild foods from commons may result in protein deficiency [34]. A study conducted in Nepal identified several factors contributing to the declining use of wild edible plants, including the time required for their collection and preparation, a loss of traditional knowledge regarding their health and nutritional benefits, and their relatively low economic value [35]. In addition, changes in resource accessibility and availability further threaten the continued consumption of these foods. Despite their significance, the interconnected relationships between nutrition, wild food availability, forest governance, and land use change have received limited attention [36]. Consequently, capturing the complex interactions among wild food consumption, nutrition, and local community perspectives is essential to inform more effective policy interventions [34].

Coastal commons include water, forests, beaches, and pastures [37]. For the last few decades, the rapid growth of the aquaculture industry has changed the socio-ecological dynamics of coastal communities across the Asian delta [38]. Despite these changes, the open-access nature of coastal resources continues to serve as a vital safety net for impoverished populations. Almost 82% of households in Sundarbans, India, depend on forests, and 32% are involved in crab collection due to its high profitability [39]. Undernourishment is widespread in the Sundarbans region [40,41,42], making the management of coastal fisheries essential for improving food security [43]. Over the years, due to state regulations and policies, there has been a shrinkage in coastal space, leading to conflicts between small-scale fisheries and large-scale enterprises [44]. The Blue Economy framework is driving economic growth along India's coast, but it is also causing conflicts among user groups, reducing land and resource access for small-scale fishermen. These changes threaten their livelihoods and food security [45]. The increasing focus on shrimp farming for feed rather than food raises three critical concerns: the implications for nutrition security, the livelihoods of individuals involved in dried fish processing and marketing, and the sustainability of marine ecosystems in coastal areas [46].

Many studies have highlighted forests' important role in food security [47, 48, 49, 50]. However, much less attention has been given to the role of commons—especially coastal commons—in helping marginalised communities to meet their food needs [51, 52, 53]. In India, literature connecting the food security of vulnerable households with access to commons is minimal. While some studies briefly mentioned the contribution of water bodies and grasslands [54,1], this gap is particularly concerning in places like the Sundarbans. Despite having abundant coastal commons, the region faces

serious food insecurity challenges [55,56]. Therefore, it is important to understand the food consumption from coastal commons across social groups to create more inclusive and locally grounded food policies.

2.1. Theoretical Framework

The Food and Agriculture Organisation (FAO) defines food security as: "It exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." However, understanding the role of coastal commons in household food security in the Sundarbans requires engaging with two prominent theoretical perspectives. The first, rooted in the collective action tradition [15], focuses on how communities can effectively manage common-pool resources, such as forests, rivers, and wetlands, through local governance, rule-making, and cooperation. This perspective has contributed significantly to resource management theory, particularly in contexts where ecological sustainability is threatened by overuse or weak regulation.

A second and equally influential perspective draws on Amartya Sen's (1981) entitlement approach, which shifts the emphasis from resource availability to access conditions [57]. Scholars such as Beck and Jodha emphasised that access to commons for marginalised and land-poor households is often mediated by power relations, caste dynamics, and institutional exclusions [58, 59]. From this perspective, food security is not only a matter of availability, but of socially and historically formed access, echoing Sen's argument that famines often occur not due to lack of food, but due to people's inability to command food through legal or customary entitlements. This framework is especially relevant in the Sundarbans, where vulnerable communities depend on coastal commons. Here, food security is not just about the availability of resources but also about people's entitlements, structured by their socio-economic status, local institutions, and long-standing power dynamics, that determine who can access and benefit from these commons. Despite its strengths, the entitlement approach has been critiqued for downplaying resource use's institutional and ecological dimensions. Scholars such as Leach, Mearns, Scoones [60] and Devereux [61] noted that it tends to focus on individual or household-level access while neglecting the collective governance systems and environmental sustainability emphasised in the collective action literature. Additionally, it has been criticised for being structurally static, failing to capture the dynamic and contested nature of commons access, especially in socially diverse and ecologically unstable environments. Bourdieu's concept of 'symbolic capital,' which emphasises the role of social power, status, and networks in shaping access to resources, often influences it beyond what formal entitlements suggest [62]. However, given the primary focus of this study on those who consume food from the commons and how access varies across social groups, the entitlement approach offers a lens to understand commons-based food security that incorporates social equity concerns. Therefore, this paper adopts the entitlement approach as its core framework to analyse patterns of dependency on coastal commons and to highlight structural inequities in access to food consumption. The chart in Fig. 2 depicts the linkage of Amartya Sen's entitlement model to the coastal community's food security.

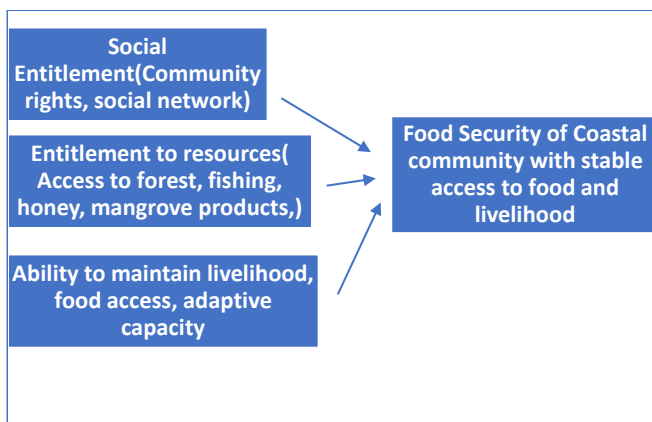


Fig.2. Amartya Sen's Entitlement approach framework for food security of the Coastal community

(Author's construct)

3 Objective

The main objectives of this paper are to look into the

- I. Dependency on commons for food consumption across social groups in the Sundarbans region of West Bengal.
- II. The role of Sundarbans' Coastal Commons in supporting two pillars of food security- physical accessibility and availability.

4 Study Area

South Twenty-Four Parganas is the largest and second most populous district of West Bengal. Metropolitan cities like Kolkata cover one side, and the other side is the riverine villages of Sundarbans. Sundarbans, UNESCO recognised as the world's largest mangrove forest, spans 10,000 square kilometres in Bangladesh and India, with 40 per cent located in India. It is home to rare and endangered animals like the Royal Bengal Tigers. Sundarbans in India, spread across the North and South Twenty-four Parganas districts of West Bengal, and it is between 30° 24' - 30° 28' N longitude and between 77° 40' - 77° 44' E latitude. The Ganga, Meghna, and Brahmaputra rivers combine to form the vast delta region. As per the 2011 Census, there are six blocks in North 24 Parganas and thirteen blocks in South 24 Parganas, constituting India's Sundarbans.



Fig.3. Map of Sundarbans

Source: https://3.bp.blogspot.com/KsXLxD2Udvk/U3HI_5h9UqI/AAAAAAAAADds/LeeObFtGXWO/s1600/Sundarbans.png

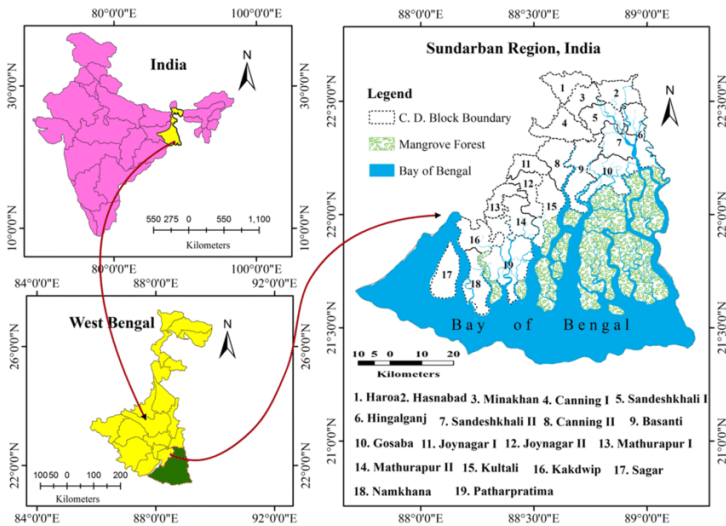


Fig.4. Map of the Sundarbans blockwise

Source: Location Map of Sundarban Region, West Bengal, India, n.d.
https://www.researchgate.net/figure/Location-map-of-Sundarban-region-West-Bengal-India_fig8_332237439

5 Data Sources and Methodology

This study uses the latest Survey of Household Consumption Expenditure, 2022-23, conducted by the National Sample Survey (NSS) Office, Government of India. It has been conducted from August 2022 to July 2023. This survey collects consumption quantity, value, and sources at the household level for different food and non-food items for a recall period of 7 or 30 days. The survey records specific foods from several food categories. Seven mutually exclusive sources have been given: ‘only purchase,’ ‘only home-grown stock,’ ‘both purchase and home-grown stock,’ ‘only free collection,’ ‘only exchange of goods and services,’ and ‘Others.’ Besides that, no secondary data source is available to connect the consumption of food items collected from the commons.

Therefore, the analysis considers 'free collection' as a representative case for consuming food sourced from the commons. For the analysis, rural households in South 24 Parganas are considered a representative case for the Sundarbans region. This is justified by the fact that 13 out of the 19 blocks of the Sundarbans fall within South 24 Parganas, which itself comprises a total of 29 blocks. According to Census 2011, 74.42% of the population in South 24 Parganas resides in rural areas; notably, 50.77% of this rural population belongs to the Sundarbans region. Furthermore, within the Sundarbans, 96.4% of the population lives in rural areas, while only 3.6% live in urban areas (Sundarbans Profile). The existing literature consistently highlights the importance of traditional commons in supporting the livelihood security of rural, poor, and marginalised populations. As Sundarbans is primarily rural and no block-wise data is available in NSS, it considers rural households of South 24 Parganas who reported consuming food through "free collection" as a representative sample. This approach offers a reasonable proxy for understanding food consumption from coastal commons in the Sundarbans region.

For this analysis, we identified 173 rural households in South 24 Parganas that reported consuming 'free food'. These households consume a range of items, including vegetables—such as potato, tomato, spinach and other leafy greens, green chilies, gourd, and pumpkin (collectively categorised as 'Vegetables'); fruits—such as banana, apple, coconut, grapes, guava, papaya, and orange (grouped under 'Fruits'); aquatic resources—such as fish, prawn, crab, and oyster (categorised as 'Fish-crabs'); other items like garlic and tamarind (grouped as 'Spices'); Tea leaves categorised under 'Beverages', khesari, soya chunks (grouped as 'Pulses'); sunflower, soyabean, palm oil, vegetable oil, etc. (categorised as 'Edible oil').

In addition to information on consumed food items, we compiled data on household categories, households' major sources of income, household ration card type, land holdings and the value of food consumption (Rs.). This allows for understanding the extent of dependency on the commons for food among different social groups and household types within the Sundarbans region.

This study utilises descriptive statistical techniques, including pie charts and bar graphs, to summarise the data and draw initial inferences. The non-parametric Kruskal–Wallis H test was used to determine whether there were statistically significant differences in the median food consumption values among the different social groups.

To compute the Kruskal–Wallis statistic, H , all N observations from the k samples have been combined and ordered from least to greatest. Let r_{ij} denote the rank of X_{ij} in this joint ranking, where $R_i = \sum_{j=1}^k r_{ij}$ and $R_j = \frac{R_i}{n_j}, j = 1 \dots k$.

The test statistic is calculated as:

$$H = \frac{12}{N(N+1)} \sum_{j=1}^k n_j \left(R_j - \frac{N+1}{2} \right)^2$$

where $\frac{N+1}{2} = \left(\sum_{j=1}^k \sum_{i=1}^{n_j} r_{ij} / N \right)$ is the average rank assigned in the joint ranking

For our analysis, the null hypothesis H_0 states that there is no difference among the distribution of food consumption value across all social groups. The test statistic H follows a chi-squared distribution with $(k-1)$

degrees of freedom. If the computed p-value is less than the significance level $\alpha=0.05$, H_0 is rejected, indicating that at least one social group differs significantly in terms of food consumption value.

Following a significant Kruskal–Wallis H test, Dunn’s test was performed to look into pairwise comparisons of food consumption across social groups. To control for the increased risk of Type I error due to multiple comparisons, the Sidak correction was applied.

Number of pairwise comparisons given by:

$$m = \frac{k(k-1)}{2}$$

Sidak-adjusted significance level is $\alpha' = 1 - (1 - \alpha)^{1/m}$

Where:

k = number of groups (social groups)

α = overall significance level ($\alpha = 0.05$)

α' = adjusted significance level

α' is the adjusted threshold used to determine significance in pairwise tests.

All statistical analyses were conducted using STATA 17 and MS Excel.

6 Findings and Discussion

This section focuses on the results based on Household Consumption Expenditure, 2022-23, to better understand the socio-economic characteristics of Sundarbans and dependence on Sundarbans’ coastal commons for food by different social groups.



Fig.5. Districts with high rates of free food collection based on Location Quotients (2009–10 and 2011–12)

Source: Narayanan, 2021

Before the discussion, it is important to note that Figure 5, adapted from Narayanan’s study [26], illustrates the districts in India with high rates of free food collection. The data indicate that, over time, there has been relatively little change in the geographical distribution of dependent households on freely collected resources. Notably, the

Sundarbans region (highlighted within a boxed area in the figure) demonstrates consistently high levels of reliance on free food collection during both the 2009–10 and 2011–12 survey periods.

6.1 Major income of the households:

In the Sundarbans region, self-employment accounts for 43.91% of household income, followed by casual labour (38.9%). Of these, 51 per cent of the self-employed work in agriculture, while 47 per cent are casual labourers in the same sector (Figure 6).

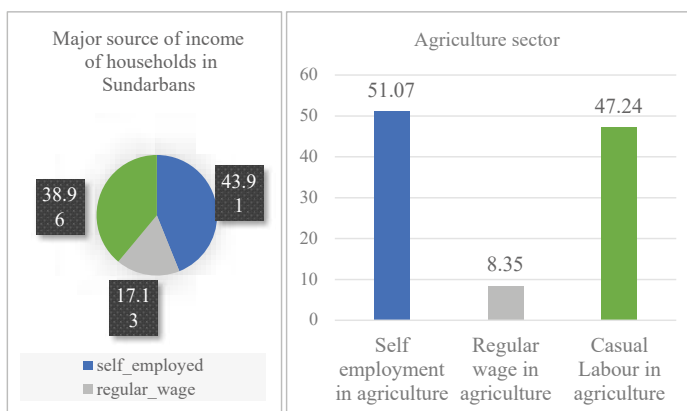


Fig.6. Households' major source of Income and their share in the agriculture sector

Source: Author's construct using Household Consumption Expenditure Survey, 2022

On the other hand, 53.4 per cent of the households that consume food from the commons are self-employed, and 43 per cent of them work in agriculture. The percentage of casual labour is nearly identical in each instance. This indicates that households that consume food from the commons are mostly self-employed and casual labourers in the Sundarbans region. (Fig. 7)

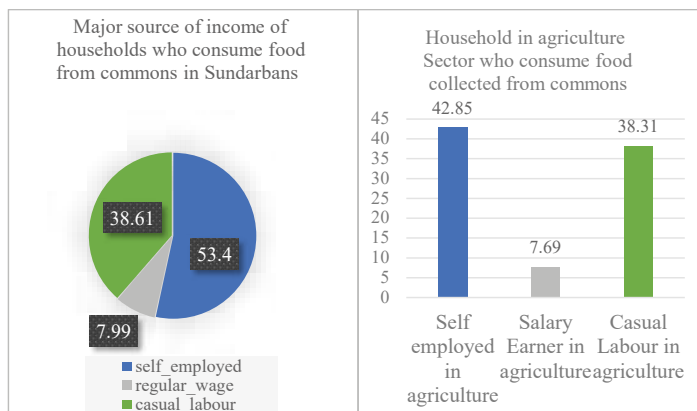


Fig 7. Households' major source of income who consume food from the commons and the percentage share of these households in the agriculture sector

Source: Author's construct using Household Consumption Expenditure Survey, 2022

6.2 Religion of the Household in Sundarbans:

The Sundarban region has 64% Hindu families, and the remaining are Muslim households (Depicted in Figure 8). Out of these, Figure 9 supports that around 69% of the households that consume food from the commons are Hindu, whereas 31% are Muslim.

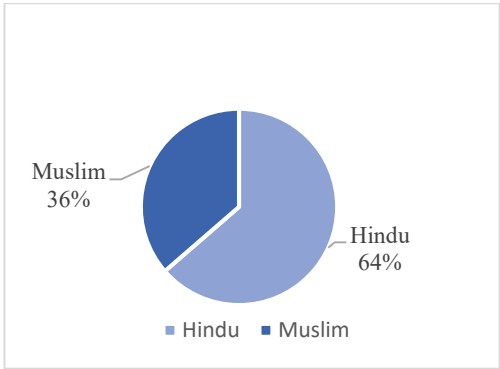


Fig.8. Religion of households living in Sundarbans

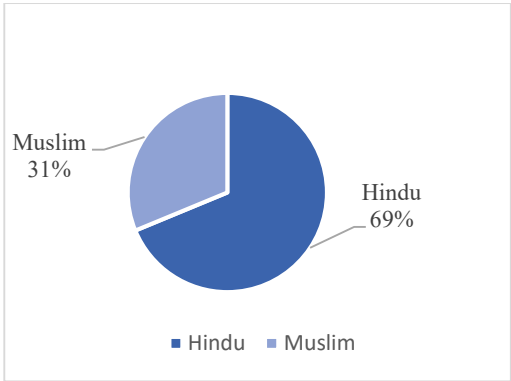


Fig.9. Religion of Households who consume food from the commons in Sundarbans

Source: Author's construct using Household Consumption Expenditure Survey, 2022

6.3 Social Group of Household:

In the Sundarbans area, the majority of the population is in the ‘others’ category, i.e., the unreserved category (57 percent), followed by Scheduled Caste (SC), Other Backward Class (OBC), and a very negligible percentage (1 %) of Scheduled Tribe (ST) (fig.10).

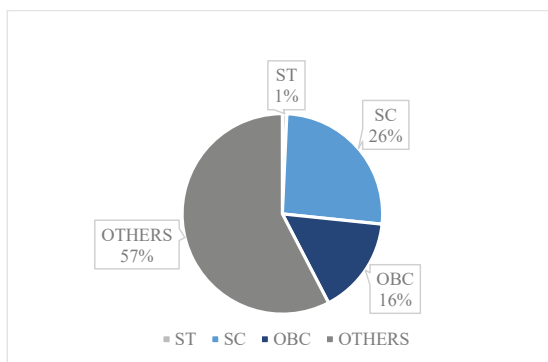


Fig.10. Social group of the Sundarbans region

Source: Author's construct using Household Consumption Expenditure Survey,2022

Therefore, among households that consume food from the commons, the majority (45.31%) belong to the "Others" or Unreserved category, followed by Scheduled Castes (SC), who constitute 42.62% of such households (Figure 11). While the Unreserved category represents the dominant social group in the Sundarbans, the substantial share of SC households dependent on commons highlights the reliance of marginalised communities on these resources for their food needs. Households from the Other Backwards Classes (OBC) account for 9.52%, whereas the representation of Scheduled Tribes (ST) is negligible. This limited presence of ST households can be attributed to their small proportion within the Sundarbans' overall population, comprising only about 1% of the total demographic.

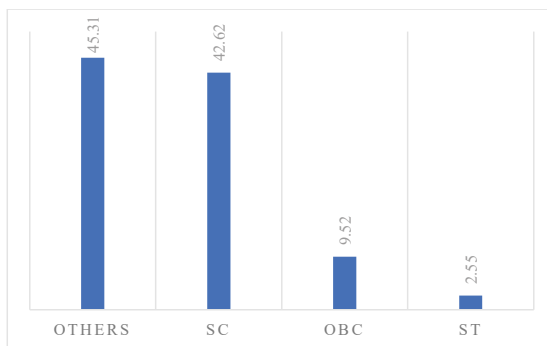


Fig.11. Percentage of households that consume food from the commons in the Sundarbans region

Source: Author's construct using Household Consumption Expenditure Survey,2022

6.4 Land -holdings:

In the NSS report of Survey of Household Consumption Expenditure, 2022-23, data regarding the total area of all owned land, i.e., owned and possessed or leased out land, has been given in acres. According to the Agriculture Census of 2015-16, households have been classified as 'Marginal' if they possessed less than 1

hectare of land, ‘Small’ if they held 1- 2 hectares, ‘Semi-Medium’ if they possessed 2-4 hectares of landholdings, ‘Medium’ for 4 to 10 hectares of landholdings and ‘Large’ if they possessed more than 10 hectares. In the Sundarbans Region, 97 per cent of the households possessed less than 1 hectare of landholdings, falling under Marginal households. Only 3 per cent fall under Small. However, when considering the households that consume food from Commons, 99 per cent of the households are marginal. It shows a strong dependency on commons for food, primarily by the Marginal households. Figure 12 depicts the landholdings-wise percentage of the household category in Sundarbans. Figure 13 illustrates the percentage share of households per landholdings that depend on the Commons for food consumption.

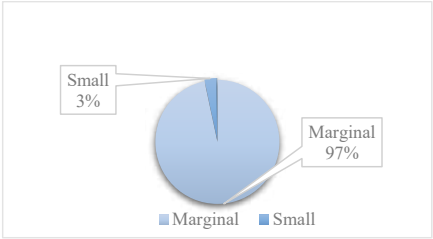


Fig.12. Landholdings-wise Percentage of Household category in Sundarbans

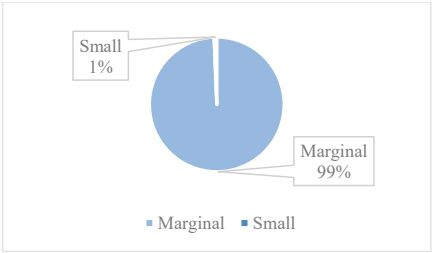


Fig.13: Landholdings-wise percentage of Households that consume food from the Commons

Source: Author’s construct using Household Consumption Expenditure Survey,2022

6.5 Ration Card Type

The Expenditure Survey categorises household ration card holdings into seven types: 1) Antyodaya Anna Yojana (AAY), 2) Below Poverty Line (BPL), 3) Above Poverty Line (APL), 4) Priority Households (PHH), 5) State Food Security Scheme (SFSS), 6) Others, and 7) No Ration Card.

As illustrated in Figure 14, the majority of households in the Sundarbans belong to the Priority Households (PHH) category, accounting for 42% of the population. Similarly, Figure 15 shows that among households that consume food from coastal commons, 42% belong to the PHH group. In addition, approximately 6% of these households hold APL cards, 14% hold BPL cards, and 37% fall under the ‘Others’ category. These findings indicate that households across all ration card categories use coastal commons for food. This underscores the crucial role that access to coastal commons plays in supporting two key pillars of food security—physical availability and

accessibility. Despite having access to government-provided ration schemes, the continued dependence on coastal commons illustrates that these resources serve as a complementary, or in some cases, essential source of sustenance. Consequently, PHH households exhibit a greater dependence on food consumption from the commons than other ration card-holding groups.

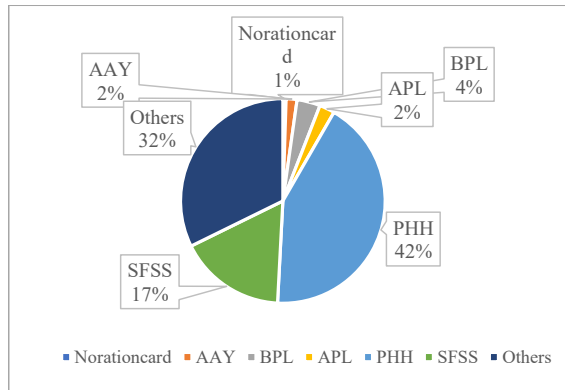


Fig.14. Type of Ration Card of Household in Sundarbans

Source: Author's construct using Household Consumption Expenditure Survey, 2022

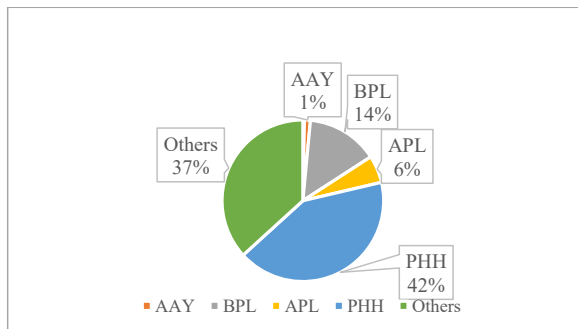


Fig.15. Type of ration card holder of households who consume food from the commons in Sundarbans

Source: Author's construct using Household Consumption Expenditure Survey, 2022

6.6 Differential Consumption from Coastal Commons and Food Security Across Social Groups

People in the Sundarbans collect various food items from coastal commons, including vegetables, spices, fish, crabs, fruits, pulses, edible oils, and beverages. Figure 16 illustrates the total consumption value for each social group, across different food categories, during the seven days before the survey.

Regarding vegetables, the 'Others' group (i.e., the unreserved category) had the highest total consumption value at Rs. 765, followed by the SC group at Rs. 291, and the OBC group at Rs. 114. A similar pattern is observed

in fruits, where the 'Others' group again consumed more than the SC and OBC groups. However, the trend reverses when it comes to fish and crabs. Here, the SC group recorded the highest consumption value at Rs. 2,140, surpassing the 'Others' group, which consumed fish worth Rs. 1,530.

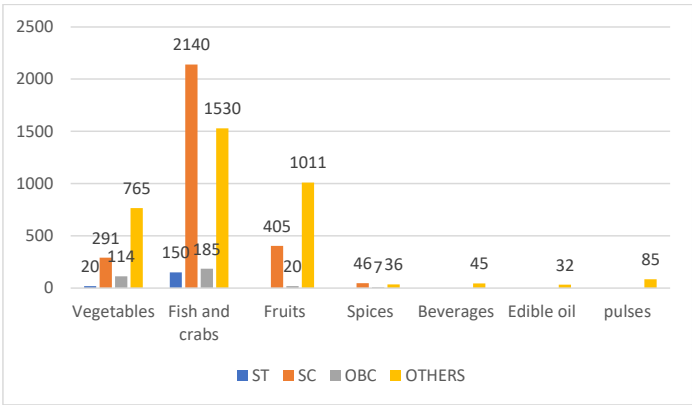


Fig. 16. Total consumption value from the Coastal commons of each social group across different food items

Source: Author's construct using Household Consumption Expenditure Survey, 2022

Nonetheless, one-way ANOVA was initially conducted to explore whether there are statistically significant differences in the value of household food consumption from the commons across various social groups. Social groups were categorised as SC+ST (Scheduled Castes and Scheduled Tribes, combined due to small observations in ST), OBC (Other Backwards Classes), and Others. However, the residuals of the model were examined for normality using the Shapiro-Wilk test. The Shapiro-Wilk test on the residuals showed significant deviation from normality ($W = 0.48374, p < 0.001$), indicating that the assumption of normality of residuals was violated. This confirmed the need for further non-parametric alternatives to validate the findings. Given the non-normality of the residuals, the Kruskal-Wallis H test, a non-parametric alternative to one-way ANOVA, was conducted to determine whether there were significant differences in the value of food consumption between social groups.

The results of the Kruskal-Wallis test indicated a significant difference between the groups ($\chi^2(2) = 9.051, p = 0.0108$) at a 5% significance level. When ties in the data were accounted for, the test statistic increased slightly to $\chi^2(2) = 9.157$, with the probability value remaining significant ($p = 0.0103$) at a 5% significance level. Thus, the Kruskal-Wallis test indicates that at least one of the groups has a significantly different distribution of food consumption value from the commons compared to the others.

To further examine the differences in food consumption from the commons among social groups, Dunn's pairwise comparison test with Sidak correction for multiple comparisons was conducted. As an extension of the Kruskal-Wallis test, Dunn's test allows for pairwise group comparisons while controlling for Type I error due to multiple testing.

The results indicated that the OBC group had a significantly different level of food consumption from the commons compared to both the SC+ST group ($z = 2.52$, $p = 0.0174$, $p < 0.05$) and the 'Others' group ($z = 3.02$, $p = 0.0037$, $p < 0.01$). However, no statistically significant difference was found between the SC+ST and 'Others' groups regarding food consumption value from the commons.

Table 1. Dunn's pairwise comparison test with Sidak correction

Comparison	Z-score	p-value	Significance
OBC vs SC+ST	2.52	0.0174	$p < 0.05$
OBC vs Others	-3.02	0.0037	$p < 0.01$
SC+ST vs Others	-0.75	0.5351	NS

These findings offer a clearer picture of how different social groups depend on coastal commons. While previous literature emphasised the greater reliance of marginalised communities on common resources, access to these resources is shaped by broader social structures. Our analysis shows that this dependence is not limited to the OBC and SC+ST groups but also includes the unreserved ('Others') category. In fact, the 'Others' group reports a higher total consumption value from the commons in several food categories, such as fruits, vegetables, pulses, edible oils, and beverages, than the marginalised groups (see Figure 16).

Although, by definition, commons are meant to be accessible to all members of a community, the data suggests disparities in actual access and use. The consistently lower levels of food consumption from the commons by the OBC group, compared to both the SC+ST and Others groups, may indicate unequal access to resources. Furthermore, the absence of a statistically significant difference between the SC+ST and other groups suggests that the consumption patterns of SC+ST are more closely aligned with those of the unreserved category rather than the OBC group.

The food consumption values presented here are likely to vary across seasons. Despite this limitation, the data offers important insights into two essential dimensions of food security: physical availability and accessibility. In the Sundarbans, where coastal commons are abundant, these resources serve as another food source for local communities.

Access to the commons enables communities to consume a variety of nutrient-rich foods. For example, fish is rich in vitamin D, omega-3 fatty acids, and protein. Likewise, leafy green vegetables and fruits gathered from the commons provide essential nutrients such as calcium, iron, magnesium, potassium, fibre, and vitamins A, C, E, and K. These suggest that coastal commons also contribute to food security as people are dependent on these resources for daily consumption. This aligns with Amartya Sen's entitlement approach, which posits that food security is not only determined by the physical availability of food, but also by individuals' ability to access resources based on their entitlements—legal rights, social and economic capabilities, and resource ownership. In this context, the ability of marginalised groups in the Sundarbans to access coastal commons directly influences their food security, as it provides an alternative food source.

However, this study cannot comprehensively assess people's nutritional security due to limitations in the available data. Nonetheless, the observed consumption patterns raise important questions about the equity of access to these resources across social groups.

7 Conclusion

The Sundarbans region, abundant in mangrove forests and rivers, supports daily household food consumption. Although people collect leafy vegetables, fruits, fish, and crabs from coastal commons, estimating the nutritional value of these resources is challenging due to data limitations. This highlights that coastal commons support two crucial pillars of household food security—physical availability and accessibility—in the Sundarbans, where people consume food from the commons alongside other food sources. The study reveals that households consuming food from the commons primarily comprise Scheduled Caste (SC) households, marginal landholders, and the 'Others' category. Notably, 99% of households that consume food from the commons are marginal landholders, and 42% of these households belong to the Priority Household (PHH) category. Furthermore, those who depend on the commons, 53.4 % of the households' major source of income comes from being self-employed, and 38.6% are casual labourers. Compared to SC and unreserved groups, commons-based food consumption is significantly lower among Other Backwards Classes (OBC) households, which may indicate unequal access to resources.

Though this study relies on proxies due to the unavailability of secondary data, it emphasises the potential role of coastal commons in enhancing food security. Further primary research is needed to accurately assess the impact of coastal commons on food security and the socio-ecological and institutional factors influencing resource access and governance.

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