



Role of Agricultural Information in Achieving Resilient Livelihood under Climate Change Scenario in Gosaba Block, Indian Sundarbans

Ananya Sarkar

Research Scholar, Department of Library and Information Science, University of Calcutta

Dr. Sabuj Kumar Chaudhuri

Professor, Department of Library and Information Science, University of Calcutta

Abstract

This paper aims to examine the role of agricultural information in achieving livelihood resilience of two coastal communities in Indian Sundarbans under climate change scenarios. Field data were collected using quantitative and qualitative methods including a review of secondary data, group discussion and household survey with 378 tribal households of Gosaba block. The result revealed the level of households' vulnerability by analysing socio-demographic characteristics based on their household assets. This study also identifies the inhabitants of Sundarbans who seek various information at different stages of their farming, a variety of sources used to access information and what kinds of problems they face and lastly concludes with some adaptation strategies for a more sustainable future for their livelihoods. Therefore, this research will serve as an eye-opener for the government and policymakers, serving as a valuable instrument for formulating and executing necessary tactics to mitigate the susceptibility of impoverished individuals and facilitate their utilisation of resources and services to establish a resilient means of subsistence.

Keywords: Adaptation strategy, Climate change, Information, Livelihood, Resilience, Sundarbans, Tribes

1. Introduction

Climate change is silently but significantly altering the social and ecological dynamics of the coastal regions of the Indian Sundarbans, home to thousands reliant on natural ecosystems for their livelihoods and economic stability (IPCC, 2007). The region's vulnerability is compounded by frequent natural disasters like Aila, Fani, Bulbul, and Amphan. Traditionally, livelihoods in the coastal Sundarbans have relied on agriculture, fishing, aquaculture, and other renewable resources, with agriculture being predominant and fishing and aquaculture

forming significant sources of income. However, the impact of climate change has rendered these livelihoods increasingly unsustainable (Human Development Report, 2009). Factors such as remote location, inadequate infrastructure, limited education, under utilisation of agricultural knowledge, and lack of access to modern technology exacerbate the region's instability. To cope, residents often migrate in search of work or resort to borrowing money from moneylenders, leading to deteriorating socio-economic conditions (Ghosh et al., 2016). Recognising the transformative power of information, particularly in empowering rural



communities to improve their socio-economic status and agricultural productivity (Babu et al., 2011), it becomes crucial to equip the coastal people of Sundarbans with contemporary farming techniques to address the challenges posed by unsustainable socio-economic circumstances and achieve consistent and sustainable agricultural development.

2. Literature review

The Sustainable Livelihood Framework (SLF) defines livelihood as the combination of capabilities, assets (including both material and social resources), and activities required for sustaining life (Sunny et al., 2020). A sustainable livelihood is capable of enduring and overcoming stresses while preserving or enhancing its capabilities and assets for both current and future generations, without depleting the natural resource base (Chambers & Conway, 1989). There are five essential key assets, namely natural, physical, human, financial, and social assets, which can be utilised to secure livelihoods by reducing instability. Access to these assets provides opportunities to enhance livelihood security and the capabilities of vulnerable individuals (Tora et al., 2022). Therefore, the framework assumes that when people's livelihoods are unable to cope with or adapt to various shocks or stresses, they become inherently vulnerable and fail to achieve livelihood resilience (Scoones, 2009).

To mitigate the escalating uncertainty resulting from climate change and establish stability, it is imperative to comprehend people's livelihoods by analysing the adaptive strategies employed at the local level by individuals or communities under adverse circumstances (Elasha et al., 2005). Consequently, the livelihood framework can be applied to comprehend the vulnerability of households or communities about their livelihood and how livelihood strategies can

contribute to building adaptive capacity, thus enabling the affected households or communities to become resilient.

3. Objectives

- i. To identify the underlying factors that contributes to the vulnerability of livelihood in the Sundarban region, as well as the subsequent impact on the livelihood assets of the inhabitation
- ii. To investigate the precise role of information and the sources utilised in mitigating the needs associated with their livelihood
- iii. To delve into the adaptation strategies employed by the islanders to achieve resilience and safeguard their sources of income.

4. Methodology

4.1 Scope and coverage

The Indian Sundarbans is located in the north and south 24 Parganas districts of the state of West Bengal. Gosaba block (21°54'N to 22°08'N and 88°29'E to 88°49'E) is located at the fringe of the Sundarbans Mangrove Forest in the district of South 24 Parganas (Anon, 2021). It is one of the most vulnerable disaster-prone areas of Sundarban and upholds a real portrait of people's struggle and survival strategies (Dutta et al., 2021). Another reason behind selecting the block is nearly 70% of the inhabitation is dependent on agriculture and rest is involves in fishing and prawn seed collection (Dasgupta and Shaw, 2014).

4.2 Sample size and sampling procedures

The study populations of this study are the smallholder farmers, fishermen, prawn seed and crab collectors who are traditionally backward and marginalised group of the Sundarbans.



To determine the sample size Cochran formula is used. When the total population is known then the formula is as follows:

$$n = \frac{z^2 * p * q / e^2}{1 + \frac{z^2 * p * q / e^2 * N}{1}}$$

Where: n= sample size; Z= Z value from standard normal distribution (e.g., 1.96 for a 95% confidence interval); p= the proportion of the population i.e. 0.5;q=1-p means (1-0.5); e= desired margin of error (, e.g., 0.05 for a 5% margin of error); N= ST population of Gosaba block (23,343 as per census 2011) (Census, 2011)

$$\text{Here, } n = \frac{\{(1.96)^2 * (0.5) * (0.5) / (0.05)^2\}}{1 + \{(1.96)^2 * (0.5) * (0.5) / (0.05)^2 * 23,343\}}$$

$$= 377.94$$

Roundly 378 tribal household are selected as sample population. Snowball sampling is used to identify the target population to participate for interview.

4.3 Data collection methods

Primary data were gathered through structured interviews, and focus group discussions (FDGs). Secondary data was collected using several sources mostly from

peer-reviewed articles, newspaper articles, case studies and local government document like district gazetteer of South 24 Parganas, Reports, and Census 2011, etc.

Household survey was conducted using closed-ended structured questionnaire on a face-to-face mode to order to avoid biasness. Households were interviewed during the period of February-April, 2023 and lasted 10-15 minutes per household. Apart from the questionnaire survey, the focus group discussion (FGD) also organised to cross check the accuracy of data.

4.4 Data analysis

All the data from interviews and focus groups were accumulated and analysed. The analysis of household survey data was carried out using IBM SPSS Statistics 21 and count, percentages, tables, and charts were used for easy understanding.

5. Results and discussion

5.1 Demographic characteristics

Demographic characteristics and Individual's own asset base work as a mirror to represent the socio-economic scenario of a community (Dutta et al., 2021).

Table 1: Demographic data of respondents

Variable	Livelihood	Attributes	Count	Percentage
Gender	Farming	Male	168	84.0
		Female	32	16.0
	Fishing	Male	133	74.7
		Female	45	25.2
Age	Farming	15-30	41	20.5
		31-45	73	36.5
		46-60	66	33.0
		More than 60	20	10.0
	Fishing	15-30	27	15.1
		31-45	84	47.1
		46-60	45	25.2
		More than 60	22	12.3



Variable	Livelihood	Attributes	Count	Percentage
Marital Status	Farming	Married	155	77.5
		Unmarried	19	9.5
		Widow or Widower	26	13
	Fishing	Married	131	73.5
		Unmarried	14	7.8
		Widow or Widower	33	18.5
Family Type	Farming	Nuclear	178	89.0
		Join	22	11.0
	Fishing	Nuclear	153	85.9
		Join	14	7.8

(Source: Computed by the authors)

As per table 1, 84% of the 200 farmers were male and 16% were female whereas, for 176 fishers, 74.7% were male. Both for farmers and fishers, most of the respondents were from middle age group (70.89%) i.e. 31-60. Majority of the respondents were married (75.66%) and belong from nuclear families (87.57%).

5.2 Livelihood assets of the respondents

5.2.1 Natural assets

Natural assets include environmental resources, wild life etc.

5.2.2 Human assets

Human Assets represents the ability, knowledge, experience, work skills and good health, etc. (UNDP, 2017).

Table 2: Human assets of respondents

Variable		Attribute	Count	Percentage
Education	Farmers	Primary	67	33.5
		Upper Primary	38	19.0
		Secondary	19	9.5
		Higher secondary	9	4.5
		Graduation and above	7	3.5
		Uneducated	60	30.0
	Fishermen	Primary	51	28.6
		Upper Primary	32	17.9
		Secondary	13	7.3
		Higher secondary	7	3.9
		Graduation and above	9	5.0
Main Occupation	Farming	Farmer	139	69.5
		Agriculture Labor	61	30.5
	Fishing	Fisher	137	76.9
		Meen and Crab collector	41	23.0



Variable		Attribute	Count	Percentage
No. of income generating activities	Farming	One	38	19.0
		Two	94	47.0
		More than two	68	34.0
	Fishing	One	54	30.3
		Two	77	43.2
		More than two	47	26.4
Active earning member of a family	Farming	One	74	37.0
		Two	86	43.0
		More than two	40	2.0
	Fishing	One	59	33.1
		Two	74	41.5
		More than two	45	25.2

(Source: Computed by the authors)

Table 2 reveals that the majority of participants either lacked formal education (33.33%) or had only completed primary schooling (31.21%). While not essential for sustenance, education aids in adapting to new technology and making informed decisions. Regarding occupation, many respondents pursued multiple activities. Only 24.33% relied on a single income source, indicating the need for additional financial support.

Consequently, most households, including children, contributed to income generation, with 42.32% having two breadwinners.

5.2.3 Financial assets

Financial resource represents income from livelihoods, includes savings, investments, credits, pension, remittances, etc. (Lax and Krug, 2013).

Table 3: Financial assets of respondents

Variable	Livelihoods	Attribute	Count	Percentage
Average Income	Farming	1k-7k	96	48.0
		7.1k-14k	70	35.0
		More than 14k	34	17.0
	Fishing	1k-7k	101	56.7
		7.1k-14k	54	30.3
		More than 14k	23	12.9
Access to credit	Farming	bad	156	78.0
		Good	44	22.0
	Fishing	bad	128	71.9
		Good	50	28.1

(Source: Computed by the authors)



Table 3 summaries that, 51.28% of the respondents have earned within 7000 monthly, whereas, only 15.07% have earn more than 14k/month. However, the credit facility of the Sundarbans also was bad (75.13%) enough. The main source of cash credit comes from moneylenders, NGOs or bank. The condition of cooperative also was

not so good here.

5.2.4 Physical assets

Physical assets such as roads, schools, houses, and access to technology, can enhance productivity and foster economic growth (Lax and Krug, 2013).

Table 4: Physical assets of respondents

Variable	Livelihoods	Attribute	Count	Percentage
House	Farming	Pakka	42	21.0
		Semi-pakka	75	41.5
		Kacha	83	37.5
	Fishing	Pakka	30	16.9
		Semi-pakka	62	49.4
		Kacha	88	34.8
Communication and Transport facility	Farming	Pakka	100	50.0
		Semi-pakka	76	38.0
		Kacha	24	12.0
	Fishing	Pakka	60	33.7
		Semi-pakka	97	54.4
		Kacha	21	11.8

(Source: Computed by the authors)

From table 4, it is found that most of the people of study villages lived in either kacha (45.23%) or semi-pakka (36.24%) house. Very few of them (19.04%) lived in pakka houses. Inter-village communication of the Sundarbans was mainly water-based and transport facility was not satisfactory. Developed communication system can help for easy market access, which is necessary to

improve economic status.

5.2.5 Social assets

Social asset encompasses the social networks, relationships, and social support, which can create economic opportunities and foster resilience during times of crisis (Davis, 2000).

**Table 5: Social assets of respondents**

Variable	Livelihoods	Attribute	Count	Percentage
Kin Network	Farming	Good connectivity	174	87.0
		Bad connectivity	26	13.0
	Fishing	Good connectivity	165	92.6
		Bad connectivity	13	7.3
Community Network	Farming	Good connectivity	71	35.5
		Bad connectivity	129	64.5
	Fishing	Good connectivity	63	35.3
		Bad connectivity	115	64.6

(Source: Computed by the authors)

Table 5 has revealed that kin network of the Sundarbans (89.68%) was very strong means respondents interact with their friends/ neighbours on a regular basis on common issues, interests or needs. In case of community network, sometimes village meetings (35.45%) were organised on various issues, but most of them were biased by influential or political persons.

6. Socio-economic dynamics of the Sundarbans

The Sustainable Livelihood Approach (SLA) is instrumental in assessing the respondents' current status. In the Sundarbans, economic, natural, and physical assets are particularly vulnerable to climate variability, reducing adaptive capacity. However, social connectivity remains strong. Human assets suffer due to limited training, skills in alternative income generation, and knowledge, leading to reliance on high-interest loans from moneylenders. Inadequate infrastructure, market facilities, and limited access to credit pose significant threats to life and livelihood. If this community could be enriched with livelihood asset by overcoming all uncertainty, then the overall standard of life will be improved. To realise, information

can play a crucial role for executing developmental and welfare activities in this coastal area in a planned way.

7. Information facilitates overcoming livelihood vulnerability

Information emerges as a crucial resource across all aspects of human development (Uzezi, 2015). The economic sector of the Sundarbans is heavily influenced by weather conditions, directly impacting those reliant on agriculture and fishing for livelihoods (IPCC, 2012). In this context, socio-economic empowerment through information is vital to combat chronic poverty and hunger.

7.1 Climate change perceptions of the respondents

This section explores the respondent's perceptions of climate change.

7.1.1 Awareness about climate change

Information on climate change and its impacts on coastsuch as awareness about rising sea levels, changing weather patterns, can help the community to follow necessary adaptation strategies and sustainable practices.

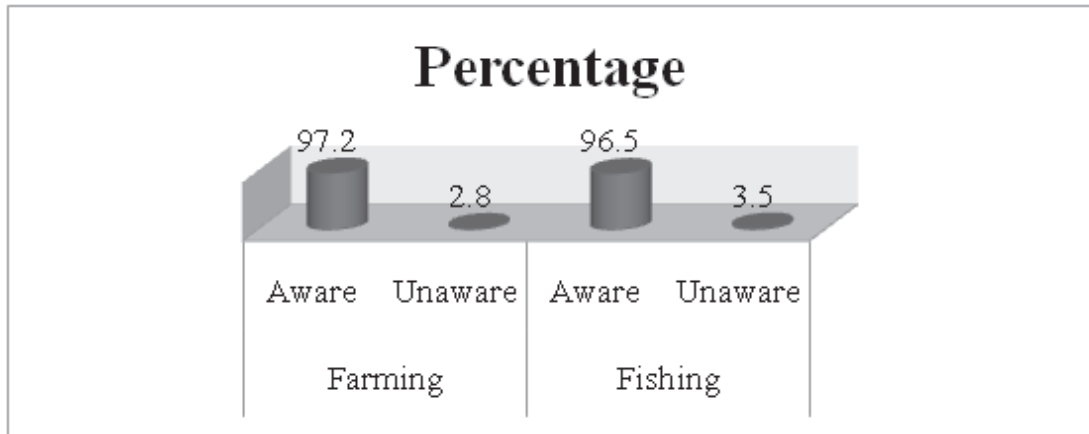


Figure 1: Awareness about climate change

This study shows that, 97.2 % of farmers and 96.5 % of fishers were sufficiently aware about the concept of climate change.

essential to empower threaten communities timely, for reducing the impact of looming hazards on their lives and livelihoods (Gondwe, 2019).

7.1.2 Early-warning before devastating cyclones

Effective early warning system is

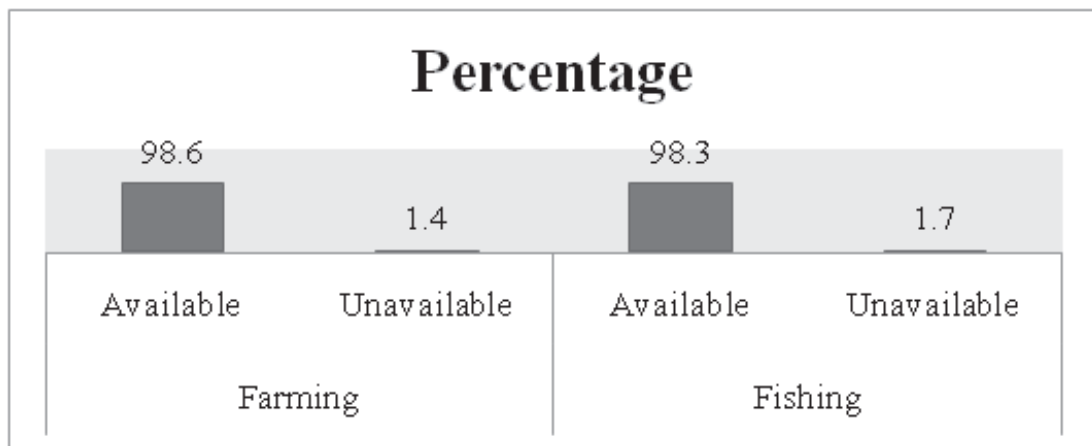


Figure 2: Early-warning before cyclone

This study disclosed that, 98.6% of farmers and 98.3% of fishers of the surveyed

population were received early warning before natural calamities.



7.1.3 Sources of climate information

Table 6: Sources of climate information

Sources	For Farmers (200)		For Fishers (178)	
	Count	Percentage	Count	Percentage
Formal Sources	29	14.5	21	11.7
Informal Sources	131	65.5	136	75.8
Documental Sources	5	02.5	8	04.5
Mass media	103	51.5	91	51.1
Others	16	8.0	11	6.1

(Source: Computed by the authors)

According to table 6, respondents prefer informal sources (70.63%) and mass media (51.32%) for getting climate information than other sources.

7.2 Types of information they seek at various stages of their livelihoods

Generations of Sundarbans residents have traditionally relied on farming and

fishing, yet changing climate conditions present novel challenges, exacerbated by a lack of guidance on addressing these uncertainties. To navigate these challenges effectively, they require access to concise, processed climatic, technical, and regulatory information to manage their fields across various stages (Just & Zilberman, n.d.).

7.2.1 Farmers' information needs

Table 7: Farmers information needs

Types	Count	Percentage
Salt tolerance rice Variety	10	5.0
Crop according to soil	153	76.5
Alternative cash crops	110	55.00
Pesticides/ Insecticides	142	71.00
Market price	108	54.0
Agricultural Loan	39	19.5
New technology and equipments	10	5.0

(Source: Computed by the authors)

As per table 7, under this changing weather patterns farmers generally seek information on crop according to soil quality (76.5%), information about pesticides/

insecticides uses (71.0%), market price (54%) and alternative cash crops (55%) than other information.



7.2.2 Fisherman information needs

Table 8: Fisherman information needs

Types	Count	Percentage
Fishing equipments	69	38.76
Market prices	146	82.02
Modern equipment and technology	08	04.49
Packaging and export	12	06.74
Agricultural Loan	78	43.82

(Source: Computed by the authors)

According to table 8, fishers seek information on market prices (82.02%), fishing equipments (38.76%), and loan related queries (43.82%) more than other information.

7.2.3 Sources of information

Table 9 : Sources of information

Sources	For Farmers(200)		For Fishers(176)	
	Count	Percentage	Count	Percentage
Mass media	83	41.5	58	32.58
Documentary Sources	9	04.5	6	03.37
Informal sources	138	69.0	124	69.66
Village meeting	48	24.00	67	37.64
Govt. Officers	16	8.00	28	15.73
Insecticides/ Pesticides shops	169	84.5	142	79.78
Market area	36	18.0	40	22.47
Own experience	179	89.50	137	76.96

(Source: Computed by the authors)

As per table 9, respondents generally prefer own experience (83.6%), informal sources (69.31%), insecticides/ pesticides shops (82.27%), and mass media (37.3%) more reliable than other sources to meet their needs.

7.2.4 Problem faced due to shortage of information

Table 10: Barriers of information seeking

Type of Stresses	For Farmers		Type of stresses	For Fishers	
	Count	Percentage		Count	Percentage
Lack of Knowledge	129	64.5	Lack of Knowledge	113	63.48
Ignorance about information sources	118	59.00	Ignorance about information sources	156	87.64
Lack of extension officers	153	76.5	Lack of extension officers	130	73.03
Poor income	167	83.5	Lack of financial advices	107	60.11
Others	56	28.00	Others	41	23.03

(Source: Computed by the authors)



This finding (Table 10) has highlighted that majority of respondent faced problem due to shortage of information. Among them, ignorance about information sources (72.49%) and lack of extension offices (74.87%) were the major concern. To overcome the above obstacle, coastal people adopt various strategies to achieve resilience in their livelihoods.

8. Information about sustainable adaptation strategy to achieve livelihood resilience

Information regarding sustainable adaptation strategies for achieving livelihood resilience is essential. Adaptation, defined as actions that reduce vulnerability and increase resilience, is crucial in various areas of the coastal Sundarbans. These strategies include livelihood diversification, which involves establishing a diversified portfolio of livelihoods to enhance resilience against shocks and alleviate poverty (Jayaweera, 2010). Studies indicate that current livelihood activities in the region are no longer economically, socially, or environmentally sustainable and require alternative options (Table-4). Migration is another prominent strategy, with a significant number of farming and fishing households migrating annually to states such as Kerala, Karnataka, Maharashtra, Gujarat, Orissa, and Assam in search of work (Mistri, 2013). Additionally, reintroducing salt-tolerant rice varieties like Dudheswar, Getu, Taalsaree, Matla, Hamilton, Lal Swarna, and Nona-swarna (Misra & Mitra, 2020), as well as promoting salt-tolerance fish cultivation in brackish water bheries, which traditionally support species such as mullets, Asian sea bass, Nona Tangra, Parsia, Milkfish, catfish, and tiger shrimp (Mallappa & Shirurr, 2021), are vital strategies in ensuring the resilience of livelihoods in the Sundarbans.

9. Conclusion

The inevitability of climate change on earth has been proven and the coastal communities of the Sundarbans are at the forefront of experiencing its impact. In order to alleviate poverty and preserve the natural resources of the Sundarbans, it is imperative to implement a climate-resilient livelihood strategy. Despite facing challenges such as limited resources and skills, all stakeholders in the Sundarbans have made concerted efforts. However, these initiatives have been unsuccessful due to a lack of coordination between the local population, governance, and policymakers. In order to foster a conducive environment for resilient livelihoods, it is crucial to ensure equal collaboration and participation from all stakeholders.

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