Original Research Article

Assessing livelihood strategies pursued by small and marginal farmers of climate-vulnerable Assam State of India

ABSTRACT

This study was conducted to examine the livelihood diversifications of small and marginal farmers'households and determinants of livelihood diversification of Assam state of India under climate-vulnerable situations. 300 sample rural small and marginal households were selected from three highly flood-affected districts. The sampling plan adopted some flexibility as the data collection process coincided with the late part of the COVID-19 pandemic. Data was collected through a structured questionnaire. The data were analyses using descriptive statisticaltools, the non-parametric chi-square test, andthe Simpson Diversification Index. The studyyielded that indicates that most of the respondents tried to diversify their livelihood strategies for economic improvement. However, no dominant strategies were found among the adopted portfolios.Many respondents preferred livestockas portfolio for livelihood diversification. Education and job card holders under the MGNREGA were found to be determinants for diversification indicate that knowledge of farmers and cash in hand. The study suggests allocating more Job Cards to small holders under MGNREGA or providing cash incentives for farming.The study alsoemphasizes the introduction of suitable livestock-based livelihood diversification to cope with climate change and poverty alleviation.

Keywords:*Assam, Climate change, Livelihood diversification,Livelihood strategies,Simpson Diversification Index*

1. INTRODUCTION

Assam, an Indian state in the northeast, is very vulnerable to the effects of climate change. It is one of the states in India that is most affected by climate change. Fifteen of its districts are among the twenty-five most vulnerable to climate change districtsin India (The New Indian Express 2022, September 16). Thetemperature of Assam is predicted to increase by about 2˚ C by 2050. Extreme rainfall events are expected to increase by more than 35.00 per cent compared to the baseline period of 1971–2000(Sarma, 2023).

Proper livelihood strategies play a crucial role in mitigating the risks of climate change for smallholder farmers in Assam. They depend on rainfed agriculture.They have less land, land is primarily fragmented, have fewer resources, and are more vulnerable to climate change. Under a changing climate, ensuring sustainable livelihoods is essential for their economic development. By adopting sustainable farming practices, smallholder farmers can reduce their exposure to climate change and strengthen their resilience (United Nations Development Programme [UNDP], 2018). According toFrost et al. (2023), smallholder

farmers can pursue climate-smart agriculture practices to adapt to and mitigate climate change. Diversifying livelihood options can help smallholder farmers reduce dependence on a single crop or income source. Farmers can spread their risks and improve their capacity for adaptation by diversifying their operations(Beltrán-Tolosa et al., 2022). Supporting the livelihoods of small and marginal farmers in Assam is essential for their well-being, food security, and overall resilience in the face of climate-related risks.

Livelihood strategies are crucial in determining whether rural households will face food insecurity (Tefera et al., 2004). Families that depend on agriculture-based livelihoods are more vulnerable to food insecurity than those who have diversified their livelihoods (Giannini et al., 2021). The livelihood diversification can contribute to household food security (Nyathi & Ndlovu, 2022). The choice of livelihood strategies can significantly impact the food security of rural households (Manlosa et al., 2019). They reported that diversified livelihood strategies are crucial for ensuring food security. Understanding how livelihood strategies affect household food security is essential for sustainable development in subsistence-oriented or semi-subsistence farming systems (Wichern et al., 2017; and Manlosa et al., 2019). Diversifying livelihoods can help increase rural income and reduce vulnerability to climate change, leading to improved food security outcomes. Diversifying livelihoods in rural areas can help increase income and reduce vulnerability to climate change, leading to improved food security outcomes.

Livelihood diversification may comprise on-farm and off-farm activities undertaken to produce extra income and the main household agricultural activities. Engaging in both on- and off-farm activities to create additional income in addition to a household's primary agricultural activity is called livelihood diversification (Israr et al. 2014 and Hussein & Nelson, n.d.). It entails engaging in various income-generating activities to support agricultural production (Biswas & Mallick, 2020). Producing supplementary goods and services in the agricultural and non-agricultural sectors, working as wage labour, working for self-employment in small businesses, and other risk-reduction techniques can all be included in this strategy (Israr et al., 2014).

The motivation behind livelihood strategies can vary widely. It may include factors such as accumulation for consumption and investment, risk spreading, coping with temporary crises, adapting to long-term declines in income or entitlements, and taking advantage of local resources, culture, and opportunities (Hussein & Nelson, n.d). Diversifying livelihoods in rural areas can reduce dependence on a single income source and increase resilience to climate change impacts through agricultural, non-farm, and livestock diversification. Diversifying agricultural practices can help mitigate the risks associated with climate change. Diversification can help the state's overall economic development by lowering reliance on a single sector, paddy. Additionally, it can increase employment opportunities and raise standards of living (*Agriculture – Status of Environment Related Issues: Assam ENVIS Centre, Ministry of Environment and Forests, Govt. of India*, n.d.).

The main natural disasters that Assamese farmers experience each year are floods and untimely drought. The annual flood, which also impacts people's spirits, frequently results in the loss of crops, livestock, homes, arable land, and human lives. Such yearly losses are reportedly in the millions of rupees (The Agricultural Sector in Assam: Its Importance | Assam Portal, n.d.). The migration of rural youths from the farm sector to the non-farm sector

in Assam is a significant phenomenon. It reflects the changing dynamics of livelihoods and employment opportunities in the region.

A thorough analysis of small and marginal farmers' livelihood strategies is necessary to determine their livelihood possibilities and perceived profitable agricultural activities in the future to develop a strategy to improve their livelihoods. So, the present study was conducted to assess the livelihood strategies of marginal and small farmers of Assam. Assessing the livelihood strategies pursued by small and marginal farmers in Assam is necessary in identifying new livelihood strategies that are more sustainable and resilient in the face of changing environmental and economic conditions.

2. METHODOLOGY

2.1 Selection of study areas and respondents

The study was proposed in 2019; however, the researchers encountered data collection period with the COVID-19 pandemic situation. Following a proper sampling design during the pandemic was challenging for various reasons. Though there was some relaxation in movement in many places from the last part of 2020, sporadic restrictions hindered following the proper sampling plan for the study. Therefore, it was decided to collect the data during the first part of 2021 in a flexible sampling plan. In Assam, there were no official records of farmers for each village with phone numbers, landholding size, age, etc., in a proper way.So, it was difficult to select respondents properly. Therefore, after discussing with experts, a flexible sampling plan was followed by modifying the original one. In a podcast, a researcher of IFPRI also mentioned that they carried out survey works during the pandemic by changing their data collection procedure with a flexible sampling plan (Gupta, 2020). ILO also suggested some relaxation for the sampling plan to collect data from the field in the face-to-face interview method (ILO- Department of Statistics, 2020).

Though utmost care was taken in data collection from the respondents, respondents' responses might still reflect the impact of the COVID-19 pandemic period. The data collection was conducted under a broad study covering two years as a benchmark at ten-year intervals (2010 and 2020). In the present study, only some findings of 2020 were presented as it also provides some important results.

Finally, one agroclimatic zone of the state was selected and three districts of the zone, namely Majuli, Golaghat and Jorhat were selected randomly for the study.At that time, offices were running with limited staff. The field-level extension staff, like Agricultural Development Officers (ADOs) and Agriculture Extension Assistants (AEAs) were also busy handling the impact of COVID-19 on agriculture. Still,District Agriculture Officers(DAOs) were able to discuss the matter of the selection of villages with some ADOs and AESs over the phone.In this way, a list of 10 villages suitable for the study from each districtwas collected from DAOs of the selected district. Finally, five villages were selected randomly from the lists of each district so that at least 20 respondents could be interviewed for the study. As there was no official list of farmers and their telephone numbers, advanced intimation to the selected farmers was not possible. Snowball sampling was followed to find potential respondents who could give useful information (ILO Department of Statistics, 2020).

At the time of data collection, those who were available and agreed to the interview were considered respondents. The process could not provide the requisite number of respondents of 100 from each district to make the total number of respondents 300. Therefore, one more village from each district was added to fill the shortfall. Ultimately, six villages from each district were selected for the study.

This sampling approach has some limitations. Since the selection of villages was not based on a specific sampling plan, the sample may not be representative of the entire population. As the sample size was reduced, the preciseness of findings was also low, which might not be suitable for generalisation in all situations. It is important to consider potential biases and limitations associated with this method.

2.2Measurements of livelihood strategies and extent of livelihood diversification

In the study, livelihood strategies were measured in terms of income-generating activities adopted by the respondents for livelihoods. The Simpson Diversification Index (SID) was adopted to determine the extent of respondents' livelihood diversification (Khatun &Roy,2012).The analysis provided information about the means adopted by the farmers to sustain their lives. The index is easy to compute and interpret, as follows.

$$\text{SID}= 1 - \sum_{i=1}^{n} p_i^2$$

Where,

SID = Simpson Index of Diversification

n =Total number of income sources and

p_i =Income proportion of the i^{th} income source

where SDI is the Simpson Diversification Index, N is the total number of revenue sources, and p_i is the proportion of revenue from i^{th} source. The value would vary from 0 to 1. The index value is zero when there is only one source of income. The value increases with more income sources and more evenly distributed income shares. The score reaches one as the level of diversification increases. When a lone source of income exists, $Pi = 1$, then $SDI = 0$.

In the present study, to examine the extent of livelihood diversification at the unit level, the sample households were classified based on the level of diversification into four categories: not diversified (0), less diversified (>0 to <0.29), moderately diversified (0.29 to <0.59), highly diversified (0.59 to <1) and fully diversified (1). The value of SID ranges between 0 to 1. The first category was made with the lowest score (0) where only one source of portfolio was for income generation. So, the category was termed as 'not diversified'. Likewise, the highest ranked category was termed as 'fully diversified' for those respondents whose SID score was 1. In between, three more categories were made with class intervals based on maximum and minimum scores obtained by the respondents. Here, the class interval was found to be 0.29. In the present study, the minimum score obtained by a respondent was '0' and the highest score obtained was '0.88'.

2.3 Selection of determinants of livelihood diversification and hypothesis:

Among these determinants of livelihood diversification, educational level, family type, migration, procession of job card under Mahatma Gandhi National Rural Employment

Guarantee Act (MGNREGA), and market accessibility were hypothesised as statistically significant predictors of livelihood diversification.

2.4 Statistical measurement followed:

For data analysis, descriptive statistics, non-parametric chi-square test, and cross-tabulations were followed to conclude.

3.1 RESULTS AND DISCUSSION

3.1Livelihood strategies pursued by respondents

Table 1 shows that 300 respondents adopted 17 different types of livelihood strategies. The table depicted that most smallholder farmers followed a combination of 'paddy+ vegetables + piggery' as livelihood activities in the study areas. As paddy is Assam's main crop, farmers as much as possible to cultivate paddy in their fields. Among livestock, farmers wanted to incorporate piggery, which increased their income. Now, piggery is a popular and profitable livelihood option for farmers in Assam (Animal Husbandry and Veterinary Department, Assam, n.d.). It was commonly practised by some tribes and communities (Shyam et al., 2017) but has the potential to spread among other communities. The government of Assam has also started a Pig Development Project to help pig farming in the state (Animal Husbandry and Veterinary Department, Assam, n.d.). From that perspective, the findings will help the project to identify potential farmers from the study areas. The table reflected that most of the livelihood activities were combined with paddy, pig farming, vegetable cultivation, dairy (indigenous), poultry (backyard), fishery, weaving, etc.

Table 1: Livelihood strategies pursued by small and marginal farmers in the study area

(n=300)

S.N	Livelihoodstrategies	Frequency	Percentage
1.	Paddy+ Vegetables + Piggery (improved)	52	17.33
2.	Fruit crops + Dairy (indigenous)	12	4.00
3.	Vegetables + Piggery (improved)	47	15.67
4.	Nursery + Fruit crops + Paddy	10	3.33
5.	Poultry (backyard) + Weaving	23	7.67
6.	Duckery (indigenous) + Plantation crop	31	10.33
7.	Dairy (indigenous) +Fishery + Paddy	38	12.67
8.	Piggery (improved) + Service + Kitchen Garden	14	4.67

9.	Gotary (indigenous) + Piggery (improved) + Paddy	11	3.67
10.	Plantation crop + fishery	8	2.67
11.	Remittance	13	4.33
12.	Bamboo + Small business + Poultry (backyard)	9	3.00
13.	Fishery +Small business	10	3.33
14.	Weaving + Kitchen Garden	5	1.67
15.	Service + piggery (improved) + Duckery (indigenous)	7	2.33
16.	Small business + paddy	6	2.00
17.	Remittance + weaving	4	1.33
	Total	300	100.00%

Table 1 indicates that there were not any dominant livelihood strategies observed among the respondents. It indicates that no existing livelihood strategy provided sustainable livelihood to the respondents. Therefore, some profitable, mainly livestock-based enterprises should be incorporated. The farmers in Assam have been incorporating the livestock sector in livelihood activities to increase their livelihood (Livelihoods Tracking System Assam State Rural Livelihoods Mission (ASRLM), n.d. & Livestock Census, 2023). It also reported that in Assam, smallholders with indigenous species mainly do livestock production activities. Thus, more improved animals, fodder/feed technology, and livestock services are needed to help small and marginal farmers access reliable markets and earn more.However, few households (4.33%) solely depended on remittance which indicates that they had no other source for livelihood. The result shows that people of rural Assam already incorporated remittance as a livelihood portfolio. Dey and Laskar (2022) also mentioned that in Assam, remittance impacted to improve poverty.It can be inferred from table 1 that respondents adopted diverse activities to sustain their livelihoods.However, there is a need for identification of effective portfolio for livelihood diversification for small and marginal farmers and adoption of such practices to enhance income levels and improve overall livelihoods.

3.2 Extent of livelihood diversification

The livelihood diversification among the respondents was depicted in table 2, that most respondents (71.70%) were moderately diversified, indicating that they adopted some sources and depended on almost all the income sources. On the other hand, 12.30 per cent of the respondents were less diverse. Again, it was indicated that 11.70 per cent of respondents were highly diversified i.e., they had adopted different income sources and depended on all the sources for livelihood. Only 4.33 per cent of respondents depended solely on one source for livelihood. The results from the study pointed out that, for income generation, the respondents mostly adopted different livelihood activities. The findings support the report of Sharma et al. (2022) who reported that most households in India have two or even more livelihood options.

Table 2: Extent of livelihood diversification of the respondents

Status of diversification	SID value range	Percentage of respondents
Not diversified	0* (Possible minimum score)	4.33
Less diversified	>0 to < 0.29	12.30
Moderately diversified	0.29 to <0.59	71.70
Highly diversified	0.59 to <1	11.70
Fully diversified	1**(Possible Maximum score)	0

*Minimum possible scale value=0 & **Maximum possible scale value=1

Actual minimum score obtained=0 and maximum score obtained=0.88

Class interval=0.29

3.3Association between selected variables and livelihood diversification

3.3.1 Association between education and livelihood diversification

In case of the association between education and livelihood diversification, table 3 asserted that most of the respondents had above primary level of education and moderately diversified their farm. This group represents 51.00 per cent of total respondents. It was reported in the table that there is a significant association between education and livelihood diversification. The chi-square value was x^2 (3, N=300) =12.576, p= 0.006*, which indicated that the higher education of respondents had more livelihood diversification. Some studies also found that education was a determinant in the adoption process of livelihood diversification strategies (Habib *et al*.,2023& Khatun & Roy, 2012).

Table 3. Frequency and percentage distribution of respondents according to the association between education and livelihood diversification (SID)

Category	Response	Livelihood diversification based on SID value				Total(%)
		Not diversified (%)	Less Diversified (%)	Moderately Diversified (%)	Highly Diversified (%)	
Education	Below HSLC passed	6(2.00%)	10 (3.33)	62 (20.67)	20 (6.67)	98(32.67)
	HSLC passed & above	7 (2.33)	27 (9.00)	153 (17.67)	15 (5.67)	202(67.33)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

Note: Pearson chi-square,X^2=12.576, df =3, p =.006*

3.3.2 Association between family type and livelihood diversification (SID)

The association of family type and livelihood diversification is presented in table 4. It describes that most joint families were moderately diversified, with 36.67 per cent of the total respondents. The chi-square test found no significant association between family type and livelihood diversification, indicating no difference in livelihood diversification whether families were nuclear or joint. Generally, in joint families, more family labourers are available in rural areas (Biswas, 2020, September 13). That was also not reflected in the study. In India, joint families are still prevalent, especially in rural areas. In the study, the proportion of joint families was the same as that of nuclear families. The findings were contradictory to the report given by Shaikh (2017, July 5).

Table 4.Frequency and percentage distribution of respondents according to the association between family type and livelihood diversification (SID)

Category	Response	Livelihood diversification based on SID value				Total
		Not diversified (%)	Less Diversified (%)	Moderately Diversified (%)	Highly Diversified (%)	(%)
Family type	Nuclear	10 (3.33)	14 (4.67)	105 (35.00)	17 (5.67)	146(48.67)
	Joint	3 (1.00)	23 (7.67)	110 (36.67)	18 (6.00)	154(51.33)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

Note: X^2=5.894, df=3, p=.117

3.3.3 Association between education and livelihood diversification

Table 5 depicted that 89.33 per cent of respondents had not adopted migration as a source of livelihood. The chi-square test confirmed no association between migration and livelihood diversification. However, table 1 reflects 13 respondents totally dependent on remittance.The findings contradict the studies of Bouapao, (2013) and Hussein and Nelson (n.d.).

Table 5:Frequency and percentage distribution of respondents according to the association between migration and livelihood diversification (SID)

Category	Response	Livelihood diversification based on SID value				Total
		Not diversified (%)	Less Diversified (%)	Moderately Diversified (%)	Highly Diversified (%)	(%)

Migration	Yes	0(0.00)	3 (1.00)	28 (9.33)	1 (0.33)	32(10.67)
	No	13 (4.33)	34 (11.33)	187 (62.33)	34 (11.33)	268(89.33)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

Note: X^2=5.300, df=3, p=.151

3.3.4 Association between job card of MGNREGA and livelihood diversification

In the case of the association of job cards and livelihood diversification, it was explored from the study that most job card holder respondents were moderately diversified. The MGNREGA provides job cards to rural households to ensure one hundred days of guaranteed unskilled work for which they get wages in bank accounts. From the chi-square test (Table 6), it was also found that there was a significant association between job cards and livelihood diversification. So, it indicated that the higher the job card, the higher the rate of livelihood diversification, so the null hypothesis was rejected. Job cards provided 100 days' wages in cash, which might help the respondents to diversify. The findings also indicate that cash in hands is essential for smallholder farmers to diversify their livelihood. So, the job card was an important determinant that can improve their annual income. It indicates that cash flow was important for livelihood diversification.

Table 6:Frequency and percentage distribution of respondents according to the association between job card and livelihood diversification

Category	**Response**	**Livelihood diversification based on SID value**				**Total**
		Not diversified (%)	**Less Diversified (%)**	**Moderately Diversified (%)**	**Highly Diversified (%)**	**(%)**
Holding of job card of MGNREGA	Yes	6 (2.00%)	17 (5.67)	146 (48.67)	24 (8.00)	193(64.33 %)
	No	7 (2.33%)	20 (6.67%)	69 (23.00)	11 (3.67)	107(35.67%)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

Note: X^2=8.795, df=3, p= .032***

3.3.5 Association between access to market and livelihood diversification (SID)

The result (Table 7) of the association between access to market and livelihood diversification affirmed that 58.33 per cent of the respondents had access to the market to sell their farm produce with moderate diversification. However, there was no association between the access to market and livelihood diversification, which was shown through the chi-square value, *i.e.*, 0.713 with p value of 0.870. Therefore, the null hypothesis was accepted.

Table 7: Frequency and percentage distribution of respondents according to the access to market and livelihood diversification (SID)

Category	**Response**	**Livelihood diversification based on SID value**	**Total**

		Not diversified (%)	Less Diversified (%)	Moderately Diversified (%)	Highly Diversified (%)	(%)
Access to market	Yes	11 (3.67)	32 (10.67)	175 (58.33)	28 (9.33)	246(82.00)
	No	2 (0.67)	5 (1.67)	40 (13.33)	7 (2.33)	54(18.00)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

Note: X^2=0.713, df=3, p=.870

3.4 Alternate livelihood options based on existing livelihood diversification

Table 8 stated that more than half ofthe respondents (55.67%) had opted for an alternate livelihood option. So, the table indicated that if there were good alternative livelihood options, most respondents would change their existing livelihood activities.

Table 8. Frequency and percentage distribution of respondents according to alternate livelihood options based on existing livelihood diversification

Category	Response	Not diversified (%)	Less Diversified (%)	Moderately Diversified (%)	Highly Diversified (%)	Total (%)
Alternate Livelihood option	Yes	9 (3.00%)	10 (3.33%)	126 (42.00%)	22 (7.33%)	167(55.67%)
	No	4 (1.33%)	27 (9.00%)	89 (29.67%)	13 (4.33%)	133(44.33%)
Total		13(4.33%)	37(12.33%)	215(71.67%)	35(11.67%)	300(100.00%)

X^2=14.752, df=3, p= 0.002***

4. CONCLUSION

The study found that education levels and the possession of a job card influence livelihood diversification in climate-vulnerable areas. The study suggests that development agencies, governments, and non-governmental organisations (NGOs) should priorities education and job card under MGNREGA access to all needy people. Based on the study, it is suggested that Government should providecash for farming to needy farmers which will help small and marginal farmers for livelihood diversification. Though there were no suitable portfolios to add to sustainable livelihood strategies, many small and marginal farmers tried livestock like pigs, poultry, and dairy. The study suggests that the government should emphasis systematically developing the livestock sector to assist Assam's small and marginal farmers to make proper livelihood strategies in the face of climate change.

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