***Original Research Article***

**Determinants of small and marginal farmers’ choices of livelihood options in Assam: A Pareto chart analysis**

**ABSTRACT**

In Assam state of India is highly vulnerable to climate change. Because of that small holder farmers are more vulnerable to climate change due to adverse rain, drought, temperature variation, and flood situations. They have limited resources in terms of capital like land and money. Under climate change condition small holders’ farmers are compelled to change their livelihood strategy as existing are not suitable for new changing situations. So, alternative income sources and diversification of farm enterprises extensively helps to get income. In this situation it is important to know the personal-economic factors which influence small and marginal farmers in choosing the livelihood option for the future. Therefore, the present study was conducted to identify major determinants influencing farmers’ choice of livelihood option for future course of action under climate vulnerable districts of Assam. through Pareto Chart analysis. Cross sectional survey method was adopted for the study. The study was conducted in Assam state of India. The total sample size was 300 small and marginal farmers. Farmers’ choice for alternate livelihood option was collected through open-ended questions. Farmers’ six characteristics were selected by categorising them into different sub-categories to find out their dominant factors. To find out the dominant factors, Pareto chart analysis was done which was not commonly done in such type of studies. The findings show that enterprise wise farmers’ different characteristics were dominant over others. The Pareto analysis also indicates those factors where focus should be given to get good results for livelihood strategies. The study suggested that Pareto chart analysis can be a valuable tool in analysing farmers’ choices of livelihood strategies.

1. **INTRODUCTION**

Assam state of India is highly vulnerable to climate change. A total of 16 districts out of India’s 25 highly vulnerable districts to climate change exist in Assam. According to the State Action Plan for Climate Change, extreme rainfall will increase by 38% in the state. It also mentioned that the annual mean temperature in the state has increased by 0. 59 degrees Celsius in 60 years (1951-2010). Assam is the most vulnerable to climate change among the 12 States/ UTs of the Indian Himalayan Region according to the report ‘Climate Vulnerability Assessment for the Indian Himalayan Region using a Common Framework’ (2018-19) as stated by Ministry of Development of North-East Region, (2023). Because of that smallholder farmers are more vulnerable to climate change due to adverse rain, drought, temperature variation, and flood-like situations. They have limited resources in terms of capitals like land and money. Under climate change conditions smallholder farmers are compelled to change their livelihood strategy as existing are not suitable for new changing situations. So, alternative income sources as well as diversification of farm enterprises extensively help to get income. According to Ezung (2021) diversification became a strategic approach used by individuals to fulfil their basic needs and increase their overall well-being. Many farmers based on their resources trying to change or adapt their livelihood strategies. Based on socio-economic, demographic and geographical conditions rural people experience different problems as well as prospects for livelihood diversification. Diversification is a constant process where households introduce new activities. It is more pertinent in climate change conditions.

Different literatures mentioned that the farmers of Assam adjusting their livelihood strategies to cope with the changing climate change. Lack of proper knowledge of suitable options, limited resources and proper handhold support hinders the farmers from selecting appropriate livelihood options. Besides these, their personal, household, village-level characteristics and government policies are also influencing factors for selecting proper livelihood options. Because of climate change in Assam, smallholder farmers’ livelihood strategies are also changing. Many farmers try to choose new options for future courses of action based on their capacity or resources. In this way, they try to make them ready to cope with the situation.

In this situation, it is important to know the personal-economic factors which influence small and marginal farmers in choosing the livelihood option for the future. Once the determinants are known, it is easy for the policymakers, development workers, scientists, and extension functionaries to make necessary interventions based on the determinants. About 70 % of the people are supported by agricultural and allied activities for sustainable livelihood. As the land decreases day by day in present times, the livelihood of small and marginal farmers also becomes unsustainable. According to Surayya *et al.,* (2008), agriculture generates main livelihoods for Indian farmers contributing not only to farmer’s well-being but to rural economy.

In Assam state, the diversification of agriculture is considered a critical strategy for encouraging rapid economic growth and development. This comprises a transformation in the types of crops grown while shifting towards new enterprises. For smallholder farmers high-value crops rather than traditional ones are essential, though everything will depend on their capacity and resources. In many places, it involves adopting different allied activities like fishery, dairy, sheep, horticulture, farming, poultry and goat rearing etc. (Raj, 2010). Diversification of farm enterprises indicates increasing and changing the mode of earning money which is a chief aspect of development in agriculture throughout the world (Kisku & Ghosh, 2017). According to the Food and Agriculture Organization (2001), diversification is the specific source for reducing poverty for small farmers in South and Southeast Asia. Livelihood diversification is a vital approach utilised by people to fulfil their needs and upgrade their well-being. Some studies on livelihood diversification of farmers reported that age of the head of the family, number of family members, education level, farm size and social group were key determinants of diversification of livelihood options (Judit *et al.*, 2017; Khatun and Roy, 2012; Saha and Bahal, 2014; Subramanian, 2018; Walker and Ryan, 1990). The determinants of livelihood diversification are different according to location. Various factors like age of the head of family, general education, gender of the head of the households, agricultural education, size of land holdings family size, number of children and adults in the family, ownership of livestock, risk-averse attitude of households, gender of the head of the households, amount of assets, income per capita, variability of farm income, access to credit, identified as major determinants of livelihood diversification (Agyeman *et a*l., 2014, Block and Webb, 2001, Abdulai, Abdulai & Crole-Reese, 2001), and Ellis, 2008. )

Various literature on different livelihood strategies, focuses on the livelihood options which provide self-insurance, stability, resilience and flexibility to the livelihoods of rural population (Ellis, 2008; Loison, 2015, Start, 2001,). Washo *et al.,* (2021) indicated that household size, ownership of livestock and access to credit had a positive impact on farm and off-farm activities. Habib *et al.,* (2023) reported that social connection, level of education, family labour positively influenced livelihood diversification. Workie (2023) directed that on, and off-farm livelihoods had positive influences through the gender of the household head. Onuwa *et al.,* (2022) found that credit access, household size, education level and productive assets had a positive impact on livelihood actions. In Assam condition, farmers selected or preferred many livelihood options depending on their conditions (Begum & Mahanta, 2017; Chanu et al. 2023). However, in such conditions, it is difficult to give proper intervention for the desired result. The Pareto chart provides an opportunity to do such a study, however, there is a dearth of literature on Assam condition. Therefore, the present study was conducted to identify major determinants influencing farmers’ choice of livelihood options for future course of action under climate vulnerable districts of Assam through Pareto Chart analysis.

1. **METHODOLOGY**
   1. **Selection of study area**

Cross sectional survey method was adopted for the study. The study was conducted in Assam state of India. The state was selected purposively as it is one of the most vulnerable to climate change state of Himalayan region of India. The state has 35 districts out of which 15 out of 25 highly vulnerable districts in India (Express News Service, 2022). From these 15 districts, Golaghat district was selected randomly. In the district there was no normal monsoon in the last thirty years. Besides this, two adjacent districts called Jorhat and Majuli were also selected for the study since both the districts are also experiencing increased temperature, irregular rainfall and frequent flood (Ramachandran, 2022; Deka *et al*., 2024; Deka, 2025).

**2. 2 Geographic description of the selected districts**

The Majuli district is a new bifurcated from Jorhat district. It is world’s largest human habitat river island located at river Brahmaputra. It is regularly affected by heavy flood, high rainfall land erosion etc. The district coordinates between latitude 27°54'4. 97"N and longitude of 95°43'33. 72"E. The latitude of Jorhat district is 26°45'0. 00"N and longitude 94°13' 12. 00" E. The Jorhat district is topographically a level plain and has no lake, beel and marshy land. The district’s yearly average temperature is 25.67 ºC. Jorhat receives about 2262 millimetres of rainfall annually (Roy et al., 2024). The averages temperature of Golaghat district is 23. 4 °C and the annual rainfall is 3130 mm. Golaghat district is situated latitude of 26. 3185°N and longitude of 94. 0907°E(Golaghat, Assam, 2021).

**2.3 Agricultural scenario of study areas**

Agriculture is the mainstay of the Majuli District economy, providing employment to 90% of the district's population. On average, 80.63 % of the population workforce were farmers. The soil of the Majuli is fertile. Most of the farmers of Majuli are engaged in the cultivation of food grains, rice, potato, oil seeds pulses garlic, and several kinds of vegetables constitute major crops. Most of the farmers are small and marginal farmers. Rice is the stapple food grain crop cultivated by the farmers. Three types of rice viz., Sali, Ahu and Bao (Deep Water) are cultivated in the river island. Commercial vegetable cultivation is more in *Char-Chapori* areas of Majuli. *Char-chapori* are the local name of riverine areas of the river Brahmaputra and its tributaries (Directorate of Char Areas Development, Govt. of Assam, 2024). Fertiliser consumption is quite low specially in rice in the district and by default river island is organic. Total cropped area of Jorhat is 1.19 lakh ha. However, only 5. 4% of the gross cultivated area is irrigated (State profile of Assam, 2016). Paddy is generally grown as both Sali (winter) and Ahu (autumn) in kharif season. Sesamum, paddy, green gram, mustard, blackgram, chillies, lentil, pigeon peas, sugarcane, turmeric, ginger, and other minor crops are grown in the district. Generally, the crop rotations followed are paddy-pulses, paddy-fallow-paddy, or oilseeds, pulses-vegetables. Flood is a major problem in many locations of the district. Total net cropped area of Golaghat district is 1,505.61 sq. km (State profile of Assam, 2016). Agriculture plays a significant sector in the district and is a foundation of livelihood for the majority contributing to the agrarian economy. Main agricultural crops grown in the district are paddy (Ahu and Sali), vegetables, and sugarcane.

**2.4 Selection of respondents**

Total three districts namely Golaghat, Jorhat and Majuli were selected for the study. Considering the climate vulnerability area, five villages from each district were selected purposively. The villages were regularly flood affected and most of the populations belongs to small and marginal farmers. Their main livelihood activity was farming. In selection of respondents, from each village, 20 numbers of small and marginal farmers were selected randomly based on their willingness to take part in the survey process to provide information. Finally, from each selected district, 100 samples were selected randomly making total sample size 300 in numbers. The sample design was flexible due to geographical location, time and fund constraints. So, the the findings should not be generalised for another situation.

**2.5 Selection of variables**

For the study, some farmers’ characteristics were selected as variables to determine the influencing factors for small and marginal farmers to choose the alternate livelihood option. The farmers characteristics were selected by examining various literature and situation of the study area. Only those variables had been selected, which had got relevance in the study area. Based on the objective of the study, variables were categorised into different categories as mentioned in the table-1.

**Table 1. Variables and their categories**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Categories** | **Measurement criteria** |
| Age | < 36 yrs | Resercher’s own category |
| Between 36 to 50 Yrs |
| >50 yrs |
| Educational level | Up to primary level | Formal education passed |
| Up to high school level |
| Above high school level |
| Net annual family income | ≤ Rs 46000/- | Categories were made based on the median value Rs 46,000.00 |
| >Rs 46,000/- |
| Farm size | 0.01-0.40 ha | Based on the median value of farm size of the respondents |
| 0.41-0.99 ha |
| 1-2 ha |
| Family type | Joint | The family where multiple generations lived together under one roof. |
| Nuclear | The family consists of a wife, a husband, and their children. |

**2.6 Pareto chart analysis**

In the selection of livelihood options, various factors which might influence the farmers’ decisions were selected. The researcher conducted a Pareto chart analysis to identify these determinants. A Pareto chart can be a valuable tool in analysing farmers' choices of livelihood strategies. It helps identify the most significant factors influencing their decisions by applying the 80/20 rule—where 80% of the outcomes are often driven by 20% of the causes. Pareto chart analysis depicted the factors behind the selection of enterprises. In this analysis, both bar and line diagrams were involved where the frequency of farmers was represented in descending order by bars and the cumulative percentage was represented by the line. The findings may not be precise but help extensively in focusing on the right effort. It helps in concentrating effort on 20% of farmers to get maximum results as the remaining 80% are not so prominent for giving attention. Baliyan (2009) and Fortea *et al*., (2022) also used such a method in their research study.

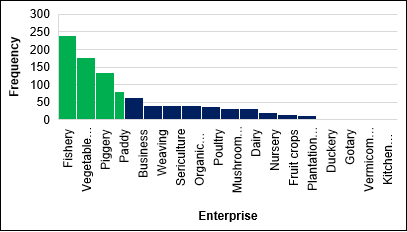
1. **RESULT AND DISCUSSION**

**3.1 Future Alternative livelihood choices by the respondents**

Pareto chart 1 reflects that the respondents chose numbers of alternate livelihood options for the future. Out of 300 respondents, 18 different options were found. It indicated that there were no dominant options available for maximum farmers. Under the situation, the Pareto chart (Chart-1) indicates a good picture for identifying the dominant options. The chart shows that out of 18 options five options were more dominant. These were: i) Paddy+Fish+Veg; 2) Pig+Veg+Fishery; 3) Integreted fish+Veg+Poultry/Pig; 4) Fishery+Field crops+Veg; and 5) Veg+Fishery+Business.If effort are given on these option for solutions then almost 80% issues will be resolved .However there are four more options which can be considered in the case.These are 6) Nursery+Business+Weaving+Mushroom; 7) Poultry+Pig+Fishery+Organic farming; 8) Paddy+Pig;and 9) Dairy+Fishery+Pig .Then with 30% effort 70% options can be solved to a greater extend which will achieve at less effort and resources.

**CHART 1: Pareto chart on smallholder farmers’ choice of alternate livelihoods**

**3.2 Distribution of farmers according to choice of enterprises**



**CHART-2: Distribution of respondents according to their choice of livelihood option**

Chart 2 shows that majority of farmers selected fishery, vegetable cultivation, paddy and piggery as their livelihood options for future. The frequency was calculated based on multiple responses of a total of 300 respondents. The chart indicates that majority of respondents preferred to add fishery, vegetables, piggery or paddy in their future livelihood option. Therefore, for these four enterprises were analysed to determine the influencing factors for their choice.

**3.3 Pareto chart analysis to identify the determinants of small and marginal farmers’ choice of paddy as livelihood strategies**

In case of determinants of small and marginal farmers’ choice of livelihood strategy, Chart 3 shows that in case of paddy, in choice of alternative livelihood option farmers having above high school passed education, income group of ≤Rs 46000, farm size having 0.41-0.99 ha , joint family, age of head of family were the 70% dominant over other characteristics. It might be because paddy as staple crop of the respondents. Respondents who were in joint families and nuclear families preferred paddy as traditionally they did not wish to purchase stapple crop. Respondents of all categories of income chosen paddy as an option. Farmers whose farm class size was 0.41-0.99 ha, they also chose paddy. The chart indicates the determinants which were most dominant over others. If development agencies, policy makers, and extension agencies will give focus on these determinants then with 30% effort they will be able to deliver about 70% result. Though Pareto principal is concerned with 80/20 rules, it has some flexibility in interpretation (Lipovetsky, 2009). It depends on the context.

**CHART 3: Pareto chart depicting dominants characteristics of smallholder farmers’ choices on paddy as alternative livelihood option**

**3.4 Pareto chart analysis to identify the determinants of smallholder farmers’ choice of fishery as livelihood strategies**

In case of selecting fishery as a future option, all total five determinants viz. average annual net income ≤ Rs. 46,000.00, education above high school passed, age group between 36-50 years, family having any members, and farm size 0.41-0.99 ha were more dominant than other factors (Chart-4). The findings show that low-income groups having low farm size and above high school farmers should be focused on fishery to include livelihood options. These 20% of factors are more dominant than the remaining 80% factors. It will achieve with 20% effort as per Pareto analysis or 80/20 ratio rule.

**CHART 4:** **Pareto chart analysis to identify the determinants of smallholder farmers’ choice of fishery as livelihood option**

**3.5 Pareto chart analysis to identify the determinants of smallholder farmers’ choice of vegetables cultivation as livelihood option**

Chart 5 shows that all total five determinants were responsible in selecting vegetable cultivation as a future option. From the figure, it can be concluded that age between 36-50 years, average annual income ≤ Rs 46,00.00, educational level above high school passed, farm size of .01-.99 ha, family size of ≥ 5nos. and all types of family types (Joint and nuclear) were dominant over other characteristics in selection of vegetables as a livelihood option. It will provide 70% achievement by making effort on these determinants. Instead of giving effort to all factors only 30% effort will get the desired result.

**CHART-5: Pareto chart analysis to identify the determinants of smallholder farmers’ choice of vegetables cultivation as livelihood option**

**3.6 Pareto chart analysis to identify determinants of smallholder farmers’ choice of piggery as livelihood option**

Likewise, in the case of selection of piggery as a future option, five determinants were responsible like average annual income ≤ Rs.46,000.00, education level above high school passed, farm size of 0. 01-0. 04 ha, age group of 36-50 years and all types of family (joint and nuclear) and family size ≥5 .These 20% factors dominant over rest factors. If effort will give on the farmers having these characters, then 80% result will achieved with 20% effort.

**CHART-6: Pareto chart analysis to identify the determinants of small and marginal farmers’ choice of piggery as livelihood strategies**

The Pareto analysis shows that it can be able to identify the important determinants of choices of livelihood as found by various past studies. The findings of the study may be utilised for the study location for planning and extension activities.

1. **CONCLUSION**

The study was conducted to determine the major determinants in choice of alternate livelihood option of smallholder farmers in climate vulnerable situations of three districts of Assam. The study adopted Pareto Analysis to determine the dominant factors. It was found that though farmers had many choices, only a few are dominant. Therefore, instead of giving full focus to all the choices only the dominant choice should be intervene properly. The pareto chart in this case suitably shows where effort should be made to get maximum results. It will ultimately save resources and farmers will also benefit from them properly. The study also suggests that in such a type of study Pareto analysis can be used, which is generally not practiced in agriculture.

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