Original Research Article

Flood coping strategies of farmers in the high lands and lowlands of Kerala

ABSTRACT

The study aims to identify and describe the variety of coping strategies used by household's disaster prone highlands and lowlands of Kerala. A multi stage sampling method was adopted for data collection purpose first stage from districts of Alappuzha and Pathanamthitta, Idukki and Wayanad and at the second level, two acutely damaged panchayaths (both in terms of crop damage and area affected) The requisite data were collected through an interview schedule consisting of both open ended and close ended questions. The data collection period was from September 2021 to December 2021 and the interviews were conducted in local language. A total sample size of 520 farmers were selected. Coping Strategies Index for Floods and Landslides were developed for farmers, at individual, community and government level in the highlands and lowlands of Kerala. Results shows that to mitigate the negative impacts of natural disasters especially floods, primarily, farmers must be willing to improve their capacity to adapt by adopting new strategies and this depends upon the socio economical context of the farmers, support of the local authorities, and access to technologies. At the government level, policy makers often lack the necessary information on how farmers are being impacted by floods. The adaptive behaviour for coping strategies, varies from region to region. Absence of such critical information becomes a barrier for policy makers in addressing long term nature of climate change and in formulating effective adaptation framework at the local level

Keywords: Flood, Landslide, Coping Strategies, High Land, Lowland, Index

1. INTRODUCTION

The climate is predicted to be more erratic and extreme (Janson and Hofmockel, 2020) in the coming decades, leading to a state of climate emergency .The potential impacts of climate change includes declining health, threatened food security decline of biodiversity (Nunez *et al*., 2019) and a weakening agricultural sector as a result of significant changes in rainfall and temperature patterns (Karimi *et al*., 2018). More than 60% of the variability in crop yield can be attributed to the influence of climate change (Matiu et al., 2017) thereby creating an adverse impact on farmers income and livelihoods. Moreover, natural resources, fundamental to agricultural production such as land and water has also undergone profound changes as a result of climate change thereby leaving the sector, most vulnerable to its impacts .This holds especially true for the developing regions in tropics and subtropics (Funk et al., 2019) considering the contribution of agriculture to poverty reduction in these regions (Bandara and Cai, 2014).

India is one of the most flood-affected regions, where the frequency of floods is increasing, mainly due to its topography and socio-economic conditions (Mohanty *et al*., 2020). In addition, India is expected to experience severe climate change impacts in the form of heat waves, extreme rainfall events, erratic monsoon events and landslides as one third of the country is already flood (40 m ha) or drought prone (Krishnan *et al*., 2020), which may pose another serious threat to sustainable development and poverty reduction (Krishnan *et al.,* 2020).

Small holder farmers of Kerala, are mostly poor, experience food insecurity and sometimes lives in precarious conditions (Hunt and Menon, 2020). These populations, who are already exposed to non-climatic stressors and multi-dimensional inequalities becomes more vulnerable as a result of climate change (Kuchimanchi *et al*., 2021). Most of these farmers, experience the impacts of climate change in the form of droughts, unpredictable heavy rainfall, increased pest and disease incidence and wild animal attacks.

Moreover, in 2018 the state has suffered its worst monsoon flooding and landslides in a century which has caused around 400 deaths and damage. Moreover, climate models predict, intense impacts of climate change on small holder agriculture in future years. As a result, about 6.58 billion farmer population will be affected by loss of livelihood, and hunger as they lack access to technical or financial support that could help them invest in climate – smart agriculture (Kuchimanchi *et al*., 2021). Hence, there is an urgent need to formulate local specific coping strategies and measures to increase the resilience capacity of the small holder farmers (Schattman *et a*l., 2019) to floods and associated landslides.

Coping refers to a process through which households attempt to smooth the consequences of the disaster, and recovery includes the restoration, and improvements where appropriate, of facilities livelihood and living conditions of disaster affected communities, including efforts to reduce risk factors. According to White et al., 2004, disaster is a severe disruption to the survival and livelihood system of a society or community, resulting from their vulnerability to the impact of one or a combination of hazards and involving loss of life and/or property on a scale which overwhelms the capacity of those affected to cope unaided.

Knowledge and better understanding of the main coping strategies of households is very useful for setting the priorities for public programs and safety nets. Therefore, it becomes imperative to identify and describe the variety of coping strategies used by households disaster prone highlands and lowlands of Kerala.

2. METHODOLGY

2.1. Location of the study and sampling technique

A multi stage sampling method was adopted for data collection purpose in this study. At the first level, districts of Alappuzha and Pathanamthitta, Idukki and Wayanad were purposively selected as they were severely affected by the flood and flood associated landslides. At the second level, two acutely damaged panchayaths (both in terms of crop damage and area affected) were selected from each district with the help of officials from Kerala State Disaster Management Authority (KSDMA). Furthermore, farmer population data of the eight selected panchayaths were obtained from the respective Agricultural offices and farmer respondents were selected. Third, using the proportionate sampling method, a total sample size of 520 was calculated. At the final level, farmer list was prepared, and data was collected through simple random sampling method.

The requisite data were collected through an interview schedule consisting of both open ended and close ended questions. The data collection period was from September 2021 to December 2021 and the interviews were conducted in local language.

2.2. Coping Strategies Index for Floods and Landslides

The focus variable in this section includes coping strategies practiced by farmers, at individual, community and government level in the highlands and lowlands of Kerala. In the case of highlands, twenty eight coping strategies were selected and arranged based on experience gained in pre-testing of interview schedule, literature review and consultation with a number of key-informants. The coping strategies were arranged in a 4-point scale in order to reveal a respondent's extent of practice of the strategies. Each respondent asked to indicate their frequency of practice of a specific coping strategy (actions and measures) before, and during flood by selecting one of the four possible responses. The responses were "frequently", "less frequently", "occasionally" and "not at all", while scores were assigned as 4, 3, 2, and 1, respectively for the coping strategies against flood.

To ascertain the comparison among the practices, Coping Strategies Index for Floods and Landslides (CSI^{FL}) was computed by using the following formula: Coping Strategies Index for Floods and Landslides (CSI^{FL}) = C4×4 + C3×3 + C2×2 + C1×1 Where, C4 C = frequency of practice 'frequently'; C3 = frequency of practice 'less frequently'; C2 = frequency of practice 'occasionally'; and C1= frequency of least practice. For the development of index, methodology developed by Sheheli and Khan (2015) has been followed.

2.2.1. CSI^{FL} at farmer level in highlands

At farmer level in highlands of Kerala, 28 location specific, and currently relevant flood coping strategies were selected. Therefore CSI^{FL} could range from 257 to 1028 where '257' indicates lowest practice and '1028' indicates highest practice of coping strategies by farmer households against floods. For the construction of index, multi-dimensional coping strategies were identified, depending upon people's cultural and socio-economic context. On the basis of real situation in the disaster prone areas, the identified flood coping strategies for all the three levels were classified into categories such as food security, housing and shelter, crop production, protection and livestock, health and sanitation and means of livelihoods.

Twenty eight (28) commonly followed flood coping strategies by farmers in highlands have been arranged (on the basis of CSI^{FL}) in Table 1. Here, lower rank such as 1 indicates more practiced and higher rank such as 28 indicates least practiced flood coping strategies by farmers

2.2.2. CSI^{FL} at farmer level in lowlands

In the case of lowlands (Alappuzha and Pathanamthitta), at farmer level, 34 flood coping strategies have been identified considering pre, during and post disaster phase, and 263 farmer respondents have been interviewed. Hence, CSIFL at farmer household level in lowlands could range from where '263' indicates lowest practice and '1052' indicates highest practice of coping strategies by farmer households against floods. Table 2 indicates the rank order of different practice of flood coping strategies by farmers in lowlands of Kerala (n=263)

3. RESULTS AND DISCUSSIONS

3.1. Coping mechanisms adopted by the farmer at individual level in highlands

In this, the different disaster coping mechanisms adopted by the farmer and his household in the different phases (pre, during and post) of the disaster are discussed. Here, the adoption of coping mechanisms depends upon the financial ability of the farmers, awareness about the disaster, and exposure to other related organizations etc. Coping Strategies Index for Floods and Landslides (CSI^{FL}) has been used to document the results. Table 1 indicates the CSI^{FL} scores and their rankings based on which the commonly adopted strategies has been identified

Table 1: CSI^{FL} scores and their rankings based on which the commonly adopted strategies has been identified

Dimensions	Flood coping strategies	CSI^{FL}	Ranking
Food security	Storage of food items	391	20
	Collection and storing of drinking water	502	8
	Rely on less preferred items, and on food items received during relief	523	7
	Reduction in the frequency of meals	480	10
	Mean	**474**	
	Standard Error	**29.02585055**	
	Standard Deviation	**58.05170109**	
Housing and Shelter	Resorting to shelters and evacuation centers	572	5
	Daily observations	427	16
	Taking shelters at relatives houses	473	12
	Shifting from endangered homes	489	9
	Transferring of valuables to safer places	571	6
	Belting the slopes	279	26
	Mean	**468.6**	
	Standard Error	**44.53363273**	
	Standard Deviation	**109.0846766**	
Crop production, protection and livestock	Crop diversification is practiced by planting different types of crops on a single area	627	3
	Vegetables are grown in the homesteads and their seeds are preserved for the next season	661	2
	Cultivation of short duration crops	431	15
	Planting across the slope	417	17
	Transferring of livestock and poultry to warm & safer place	398	19

	Change in cropping pattern	326	24
	Increased dependence on chemical farming	581	4
	Construction of farm ponds and drilling bore well	373	23
	Field mulching	552	6
	Mean	**485.11**	
	Standard Error	**40.44524572**	
	Standard Deviation	**121.3357372**	
Health and sanitation	Traditional medicines are used	304	25
	A first aid kit is prepared in advance	257	27
	Arranging essential medicine	478	11
	Mean	**346.33**	
	Standard Error	**67.21689602**	
	Standard deviation	**116.423079**	
Means of livelihoods	Livestock is sold for money	386	22
	Borrow from moneylenders, commercial banks, private banks and friends	669	1
	Engaging in meagre work to earn	468	13
	Spend money from savings	389	21
	Migrate to city or other area	467	14
	Diversifying income sources through new enterprises	415	18
	Mean	**465.6**	
	Standard Error	**43.26019469**	
	Standard Deviation	**105.9654032**	

In the case of highlands, the most commonly adopted coping strategy comes under the component means of livelihoods. In the post disaster phase, most of the farmers suffer from huge economic losses either due to loss of harvest, livestock or due to damage for homes, and other entities. As a result, there could be an increasing tendency among the farmers to borrow money from informal and formal sources. That would be the reason behind this strategy getting ranked one in CSI^{FL}. This finding is consistent with the results of He (2019) who reported that, during the post disaster phase in Nepal, poor farmers borrow money from wealthy people in other villages to cover their cash expenses for many years, even at interest rate ranges as high as 24%, generating an inexorable growth of indebtness for poor households. Second most commonly followed strategy includes the increased adoption of homestead gardening among the respondents. In the case of highlands, the commonly grown crops in the pre- disaster phase included cultivation of Banana, Nutmeg, Coffee, Rubber, Cardamom and Tapioca. However in the post disaster phase, may be to ensure food and nutritional security, the number of households adopting homestead gardening has increased considerably. This is in line with the results of Alam et al., 2017 and Alam and Rahman, 2013 who conducted studies in the flood prone regions of Bangladesh and reported that homestead vegetable gardening as a major coping strategy in the pre and post disaster phase.

Furthermore, mean, standard deviation and standard error has been calculated to find out which component has the highest number of strategies above the mean value. As per the results of the table, in housing component and crop component has the maximum number of strategies higher than the mean value. This is on par with the results of Mathew *et al*., 2018 who documented the adoption of maximum number of coping strategies under the areas of housing, crop production and food security.

3.2. Coping mechanisms adopted by the farmer at individual level in lowlands.

The following Table 2 depicts the Coping mechanisms adopted by the farmer at individual level in lowlands

Table 2: CSI^{FL} at individual level in lowlands

Dimension	Statements	CSI^{FL}	Ranking
Food Security	Storage of food items	536	9
	Collection and storing of drinking water	702	3
	Storage of grains in structures (Pathayam)	374	20
	Rely on less preferred items, and on food items received during relief	651	5
	Reduction in the frequency of meals	437	13
	Mean	**540**	
	Standard Error	**61.9**	
	Standard deviation	**138.52**	
Housing and Shelter	Increased plinth height of the house	463	11
	Placing of sandbags around the house at the onset of monsoons	357	21
	Resorting to shelters and evacuation centres	652	4
	Taking shelters at relatives houses	560	7
	Construction of house on pillars	305	27
	Construction of houses with materials like hollow bricks	323	25
	Increase the storey of the house or add a roof to the terrace	425	16
	Transferring of valuables to safer places	550	8
	Mean	**451.89**	
	Standard Error	**39.0499838**	
	Standard deviation	**117.1499514**	
Crop production, protection and Livestock	Crop diversification is practiced by planting different types of crops on a single area	464	10
	Vegetables are grown in the homesteads and their seeds are preserved for the next season	464	10
	Cultivation of short duration crops before floods	326	24
	Cultivation of flood tolerant varieties	265	31
	Livestock and poultry sheds at a height	319	26

	Managing dry feed for cattle and poultry	339	22
	Transferring of livestock and poultry to warm & safer place	402	18
	Change in cropping pattern	429	15
	Increased dependence on chemical fertilizers for higher yield and pesticides against pests	776	1
	Mean	420.44	
	Standard error	39.05	
	Standard deviation	117.15	
Health and sanitation	Traditional medicines are used	294	29
	A first aid kit is prepared in advance	302	28
	Storing 'oral saline' to control outbreak of diarrheal disease	263	32
	Arranging essential medicine and water purifying tablets	587	6
	Keeping carbolic acid in room to prevent snake	263	33
	Mean	**341.8**	
	Standard error	**56.425024**	
	Standard deviation	**138.2125175**	
Means of livelihoods	Livestock is sold for money	395	19
	Borrow from moneylenders, commercial banks, private banks and friends	712	2
	Engaging in meagre work to earn	410	17
	Spend money from savings	448	12
	Migrate to city or other area	282	30
	Diversifying income sources through new enterprises	335	23
	Mean	430.3333333	
	Standard error	61.21038401	
	Standard deviation	149.9342078	

According to the results of Table 2, the most commonly adopted coping strategy among lowlands comes under the component Crop and livestock production and protection. Under this component, increased dependence on chemical fertilizers for better yield and crop protection has scored the highest value (776) and the highest rank. Farmers of lowlands, mainly of Kainakari and Ambalappuzha are reported to have huge losses in paddy farming due to floods and heavy rainfall. There are even padashekharams such as *Kanakasseri* padashekharam which could not harvest their paddy fields since 2018. Moreover, many farmers also reported heavy incidence of

diseases such as sheath blight and attack of pests such as leaf minor and mealy bug. Such a situation in the post flood phase might have made the farmers to depend more on chemical fertilizers and pesticides to overcome the losses and to obtain better yield in the next season. Osei *et al*., 2020 conducted an assessment in the flood prone farm lands of Tarkwa mining areas of Ghana and reported that 42.59% of the farm lands under study area were highly prone to flooding and farmers resorted to high usage of chemical fertilizers to increase yield , which further leached into nearby rivers, streams, lakes and groundwater during flood occurrence. Second most commonly adopted is the higher rate of borrowing of money to cope with the desperate situations. This is similar to the case of highlands.

When mean, SD and SE was calculated for each component, it was found that higher mean value, low standard error and higher number of strategies with value greater than the mean value was found for the components namely crop and livestock production and Housing and Shelter. These results are similar to the case of highland regions.

Moreover, an ANOVA test (Table 3) has been performed to find out the significant difference between the different coping strategies adopted by the farmers among the four panchayaths of highlands and lowlands respectively.

Comparison of coping strategies among the four panchayaths of highlands and lowlands	
Region	**p- value**
Highland	2.04E-10
Lowland	2.17392E-14

Table 3. Comparison of coping strategies among the four panchayaths of highlands and lowlands

The results of ANOVA shows that there is significant difference among the strategies adopted by the farmer households among the regions under study. This might be due to the differences in age, gender, family size, farm income, and farm size across different households. This is in line with the results of Bate *et al*., 2019 and Marie *et al*., 2020 who claimed that farmer's decision to coping strategies is influenced by age, gender, family size, farm income, market access and access to market information.

4. CONCLUSION

To mitigate the negative impacts of natural disasters especially floods, primarily, farmers must be willing to improve their capacity to adapt by adopting new strategies and this depends upon the socio economical context of the farmers, support of the local authorities, and access to technologies. At the government level, policy makers often lack the necessary information on how farmers are being impacted by floods, local adaptation initiatives and the factors which are influencing the selection of adaptation techniques as the adaptive behaviour for coping strategies, varies from region to region, it is imperative to understand the factors which regulate the choice of strategies at regional level for effective policy development .absence of such critical information becomes a barrier for policy makers in addressing long term nature of climate change and in formulating effective adaptation framework at the local level.

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