Quantitative assessment of Vulnerability to Climate change of Jhum Paddy Cultivators in Mokokchung District

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Abstract - In the study area Mokokchung district about 80% of rural people depends on agriculture for their livelihood (statistical handbook of Nagaland 2017)[1] in fact in the study area the people are Traditionally dependent on agriculture and community life. The farmers depends on monsoon for their agriculture and practice the traditional, shifting cultivation known as Jhum. In Jhum slash and burning of the field is an important operations, which should be critically view because of its possible impact on land and environment. This is also one of the reasons that contributes to global warming and hence lead to climate change so it is important to study the impact of climate variability on Jhum paddy cultivators with regards to vulnerability and adaptive capacity of farming households. Thus the study examined the vulnerability of the study villages to the impact of climate change using climate vulnerability Index (CVI). Analysis of vulnerability of the villages and livelihood reveals the importance of diversified livelihoods in managing risk associated with climate hazards. These farmers adopting diversified livelihoods are more able to absorbs shocks and stresses because they are able to fall back on other strategies when crops fails. Like wise poor farmers in highly vulnerable villages are often heavily dependent on agriculture making them vulnerable to climate hazards. The CVI index also shows that vulnerability of farm households to the impacts of climate changes also depends on their adaptation actions. The results shows that changing planting dates, animal rearing and income diversification as the most commonly adopted method among farmers to compensate for their loss in income the CVI approach can be made use of for framing policies to reduce vulnerability of households the results suggest that even if the households have the highest adaptive capacity due to high sensitivity and exposure their vulnerability to climate change may rise This calls for framing policies more focused on reducing sensitivity and exposure of the households higher adaptive capacity does not necessarily imply that they are less vulnerable to the impacts of climate variability and change. The study also indicates that policies like reducing poverty, increasing crop diversity, income diversification polices can help farmers in reducing their vulnerability. Some specific polices measures like access to crop and weather insurance, proper information on climate change to marginal farmers can play an important role in increasing their resilience to climate change.

Keywords: adaptive capacity, climate change, exposure, income diversification, sensitivity, vulnerability.

I. INTRODUCTION

In Nagaland agriculture activities predominates the state economy. In fact 73% of the population depends on agriculture. In the study area Mokokchung district agriculture is the most important sector and means of sustenance and livelihood for 80% of the people living in rural areas. (statistical hand book of Nagaland 2017)[2] The traditional practices are interwoven with social religious and traditional values. Their numerous festivals, work and leisure are centered around agriculture and have their roots in cultivation practices. Jhum or shifting cultivation is a system that has been practiced overtime and revolves around an agro-eco system of cultivation based on traditional knowledge and indigenous practices. In the study area recently it is observed that rainfall and temperature pattern have changed significantly and this change can be expected to continue in the future. And since agricultural sector is considered to be one of the highly sensitive sectors to the impacts of climate change and is also the largest provider of employment any impact due to climate change either directly or indirectly on this sector

 DOI : 10.35291/2454-9150.2019.0302

would effect the lives and livelihoods of the farmers. Because the vulnerability of farm household to climate change does not only depend on yield or production but also on the ability of the households to cope with weather uncertainty. So analyzing the role of socio-economic factors is important to understand the vulnerability and adaptation actions of farm households. The study mainly focuses on the factors affecting the vulnerability of rural farm households and different adaptation actions undertaken by farm households and their determinations in six villages of Jhum cultivators. And since all farm activities are rain-fed a detail analysis of vulnerability of farmers to climate change on agricultural crops is important.

II. METHODOLOGY

The Multi-stage sampling methods was adopted to select village and the households of farmers problems were identified in relation climate change in Mokokchung district. A study was conducted on climate information, employment, productivity, income, health, education, poverty level. A micro level investigation on case study method was done to understand socio-economic and environmental constraints with 113 sample households. The important information was gathered with the help of structured questionnaires and also through participatory rural appraisal methods such as information group discussions with the senior citizen of the farming community. The primary data was collected using a structured questionnaire conducted at the household level which was collected on the socio economic characterize of the sample households, agricultural production access to basic amenities health, climate related information adaptation and coping mechanism climate variability and change and barriers to adaptation.

To examine vulnerability to climate change at the household, the indicator based method and climate vulnerability index (CVI) was used. The CVI has been used basing on 3 components exposure, sensitivity and adaptive capacity at the household level each component in the frame work is composed of several Sub-components.

A household survey was conducted in 6 villages of the study area from January 2017 to December 2017 to examine the vulnerability of climate change among the farm households, taking households as the unit of analysis a stratified random sampling method was employed for selecting the households on the basis of number of years of farming from 10 years above with continuous years of farming. A total of 113 households Jhum cultivators were surveyed.

The proposed study is an attempt to study the impact of climate change on jhum paddy cultivators with regard to vulnerability and adaptive capacity of farming households. Thus the study examines the vulnerability of the study area to the impact of climate change using the vulnerability index. The fixed based year method is used in which the base year remains fixed. For the purpose of study since it is a numerical scale calculated from a set of variables selected for all the villages so villages are used to compare them with one another or with some reference point ie this numerical value is used in the ordinal sense ie on the bases of the index different villages are ranked and grouped to be relatively less or more vulnerable. It is constructed in such a way that it is always has value between O and I. so it is easy to compare villages sometimes index is expressed as percentage by multi plying it by 100.

Before construction of index number it should be decided the purpose for which it is needed. After selection of study area a set of indicators are selected for each of the three components of vulnerability. The indicator can be selected based on the availability of data personal judgment or previous research since vulnerability is dynamic over time, it is important that all the indicators relate to the particular year are chosen. For the study exposure is measured by the perception of respondents about decreasing rainfall, increasing temperature and increasing frequency of rainfall and the average numbers of natural disasters that they experience and perception of the people represents sensitivity. At the household level ie perception of high impact of rainfall, below poverty live, average number of dependents, indebtedness are taken as indicators of sensitivity. Adaptive capacity too has been described as a function of indicators like information on climate finance and institution resources the adoption action by farming households to deal with climate risks such as changing crops and planting dates are indicators representing adaptive capacity. The study used Iyanger and Sudarshan (1982) which was used by UNDP for constructing human development index . This method work out a composite index from multi variate data and it was used to rank the district in terms of their economic performance. This method has been chosen because it is simple and suite the purpose to develop a tool to assess differential vulnerability of the villages when the socio economic difference are less. Here CVI uses a balance weighted average approach, where each sub-component constitutes equally to the overall index score and equal weights are applied to all the major components. Since each component was measured on a different scale it was necessary to standardize each as a separate index. The same procedure of Iyenger and sudarshan (1982) for the conversion is used.

Quantitative assessment of vulnerability.

To get a clear knowledge of the method it is important for us to review some of the literature related to the construction of index.

Santiago J. Buccaram et al (2016). In their research paper "Assessing local vulnerability to climate change in Rio De la Plata Basin, Uruguay[3] states vulnerability assessments to climate change have a long history on multi disciplinary research. For assessing vulnerability to climate change they

 DOI : 10.35291/2454-9150.2019.0302

used a set of indicators and a methodology that can be applied to any developmental project vulnerability assessment was done based on the behavior of data. The application that are given to assessment and indicators range from informing decision making processes in complex environment, to allocation of funds to adaptation and mitigation strategies in at-risk regions. Among these region there may be communities that suffer of food health and environmental insecurity, gender inequalities, weak security and governments, lack of infrastructure and education and lack of access to appropriate resources and capacities to deal with extreme events. Research on vulnerability during the last 20 years have focused not only in meteorological and bio-physical factors, whose frequency and historical distributions determine the level of exposure and sensitivity of a region and are considered stress factors of a system but also research has extended to the socio-economy and political structures as well as institution that make societies vulnerable. Hence vulnerability assessment provide a starting point to determine the effective means of promoting remedial action to limit impacts by supporting coping strategies and facilitating adaptation.

A typical approach to quantifying vulnerability is to define a set of proxy indicators and assess vulnerability through their aggregation. They follow vulnerability in terms of three components namely exposure, sensitivity and

adaptive capacity. Thus vulnerability profile is constructed by combining indicators for adaptive capacity sensitivity indicators as well as indicators related to exposure to climate variables. A number of variables based on bio-physical terms and socio-economic contacts were used, in order to calculate vulnerability indicators i.e. let X_id note the value of i^{th} vulnerability indicator in the d^{th} locality i.e. (i=1,2,……m, d=1,2,……n) for normalization set.

$$Yid = \frac{Xid - \min dXid}{Max\ dXid - min\ dXid}$$

It is assumed that the indicators is positively associated to vulnerability and

$$Yid = \frac{max\ dXid - Xid}{Max\ dXid - min\ dXid}$$

and the scaled values Yid vary from zero to one such that from the matrix of scaled values y=yid, a measure of vulnerability for each locality was constructed as follows yd=w_i yid+W_2Y_2d+……+WmYmd]

Danida. Vnu.edu.vn (2019) in the research paper'' quantitative assessment of vulnerability to climate change (computation of vulnerability indices)[4] also follows the IPCC third assessment report according to which vulnerability is defined as the degree to which a system is susceptible to or unable to cope with adverse effects of climate change including climate variability and extremes. It has three components exposure, sensitivity and adaptive capacity. Thus vulnerability is potential impact I minus adaptive capacity (AC)

i.e. V = f(I-AC)

For normalization of indicators the following formula is used.

$$Xij = \frac{Xij - \min\{Xij\}}{Max\{Xij\} - \min\{Xij\}}$$

It is clear that all scores will lie between 0 and 1. The value 1 will correspond to that region with maximum value and 0 will correspond to the region with minimum value.

Assessment of the potential impacts of climate change in different parts of the world using vulnerability as a framing device has increased over the past two decades with greater emphasis on climate change research. However there is diversity in the definitions and methodologies for assessing vulnerability.

Most often it is conceptualized as consisting of components that include exposure and sensitivity to perturbations or external stresses and the capacity to adapt. One of the most widely used and the most authoritative definition in the context of climate change is provided in the Third Assessment Report (TAR) of the IPCC. It defines vulnerability as a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity. for the purpose the study followed the definition of IPCC (2001) where vulnerability to climate change has been defined as, "the degree to which a system is susceptible, or unable to cope with adverse effects of climate change, including climate variability and extremes, and vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC 2001).

Mathematically, it is expressed as

Vulnerability = f(exposure, sensitivity, adaptive capacity)

Thus vulnerability has three components exposure, sensitivity and adaptive capacity. Here exposure refers to "the nature and degree to which a system is exposed to significant climate variations. i.e the direct danger (stressor) and the nature and extent of changes to a region's climate variables (eg. Temperature, precipitation, extreme weather events).

Sensitivity is 'the degree to which a system is affected either adversely or beneficially, by climate related sitimuli', i.e. it describes the human-environmental conditions that can worsen the hazard, ameliorate the hazard, or trigger an impact.

Adaptive capacity is defined as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities or to cope with the consequences. i.e. the

 DOI : 10.35291/2454-9150.2019.0302

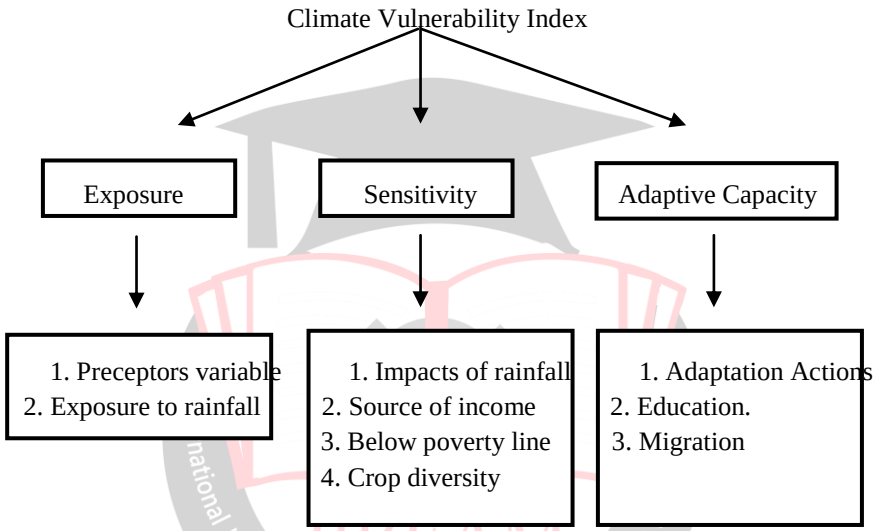
potential to implement adaptation measure that help avert potential impacts.

It is a known fact that different communities, sectors, regions and places or groups of people exposed to the same climate impact will differently, because of difference in other variable. There are different approaches for assessing vulnerability to climate change such as historical narratives, statistical methods, GIS and mapping techniques, comparative analysis, agent-based modeling and indicator based approach. However indicator based approach for measuring vulnerability to climate change has been widely used.

The study examined the differential vulnerability among the six village, a climate vulnerability index (CVI) is framed the CVI is based on IPCC vulnerability frame work and consisting of three contributing factors to vulnerability exposure, sensitivity and adaptive capacity each component in our frame work in composed of several sub-components of which some are based on the review to rainfall regions and based on the adaptation actions observed among the farmers CVI uses primary data from the household survey to construct the index. The major components of the index are shown in fig .1

III. VULNERABILITY ASSESSMENT FRAMEWORK

Fig – I



Each component in the primary data were quantified using the composite index approach to assess relative vulnerability of six communities. The CVI that is used is measured by perception of the respondents about decreasing rainfall, increasing temperature and increasing frequency of rainfall and the average number of natural disasters episodes that they have experienced and perception of the people represents the sensitivity at the household level, Adaptive capacity too has been described as a function of indicators like climate information, technology, finance and institutional resources, changing planting data and crops literacy level, farming experience.

In the study Iyengar and sudarshan (1982)[5] method used by UNDP for constructing the human development Index (HDI). This method work out a composite index from multi-variate data and it was used to rank the districts in terms of their economic performance. This method has been chosen because it is simple and suits the purpose to develop a tool to assess differential vulnerability of the village where the socio-economic differences are less there CVI uses a balanced weighted average approach where each sub-component constitutes equally to the overall index score and equal weight are applied to all the major components since each component was measured on a different scale it was necessary standardize each as a separate index the same procedure of Iyengar and sudarshan (1982) for the conversion is used.

Since it is formative indicators we use percentage for normalization and standardizing. After each component was standardized the sub-components were averaged using the following equation to calculate the value of each major component kh = $\Sigma_i^n = 1$ index $k^i f$

N

Where kh is one of the three components of village, exposure, sensitivity adoptive capacity under kf ^{i} represent the sub-components index by I that make up for each major component, and n is the number of Sub-components in each major component. Once the values of the exposure sensitivity and adaptive capacity for a village were calculated, the three contributing factors were combined using the following equation to obtain the village.

 DOI : 10.35291/2454-9150.2019.0302

Climate Vulnerability index (CVI) using the formula

$$CVI\ d = (ed - a_d) \times s_d$$

where CVI d is the climate vulnerability index score for the village d (obtained using the IPCL vulnerability framework) e is the calculated exposure score for the village d, a is the adaptive capacity score for the village d and s is the sensitivity score for the village d. CVI is scaled according to the results obtained from vulnerability index score ie O (last vulnerable) to 10 (most vulnerable).

TABLE 1 SUB-COMPONENT VALUES FOR INDICATORS

Major Components	Sub-components	Units	Mekuli	Akhoya	Yajang	Watiyi-m	Longjemi-ang	Mapon-chuket	Max value	Min Value
Exposure	Percentage of house holds believing that rainfall is increasing	Percent	100	75	40	38.5	100	100	100	0
	Percentage of households perceived that temperature is increasing	Percent	100	73.7	95	91.7	100	100	100	0
	Percentage of households that perceived increasing frequency of rainfall	Percent	100	100	90	66.7	100	100	100	0
Sensitivity	Percentage of people that perceived high impact of rainfall	Percent	100	95	90	61.5	100	100	100	0
	Percentage of households reporting agriculture as the only source of income	Percent	35	5.3	57.9	100	60	85	100	0
	Percentage of households below poverty Line (BPL)	Percent	70	100	80	69.2	100	100	100	0
	Average no of dependents	Number	2.15	2.60	2.45	3	2.10	3.05	12	0
Adaptive capacity	Percentage of households who changed paddy crop variety	Percent	35	90	10	30.8	-	25	100	0
	Percentage of households reported as having changed the crop planting dates	Percent	100	95	80	76.9	90	95	100	0
	Percentage of households who increased their non-farm income sources	Percent	30	90	20	69.2	15	45	100	0
	Percentage of households using early maturing	Percent	25	90	0	46.2	0	30	100	0
	Percentage of household undertaking water conservation practices	Percent	0	85	95	69.2	100	30	100	0
	Percentage of households using information on weather & climate for farming	Percent	25	95	0	76.9	0	40	100	0
	Percentage of People having membership in SHG	Percent	5	60	0	23.1	0	20	100	0
	Percentage of households head having below primary education	Percent	80	45	95	15.4	5	10	100	0
	Average year of farming experience	Percent	20.81	19	24.72	20.83	22.65	16.17	55	10

Source : Author's calculation from primary data using SPSS

 DOI : 10.35291/2454-9150.2019.0302

TABLE 2 INDEXED SUB-COMPONENT VALUES FOR THE SIX VILLAGE

Sub Components	Mekuli	Akhoya	Yajang	Watiyim	Longjemdang	Mopongchuket
Percentage of households believing that rainfall is increasing	1	.75	.4	.385	1	1
Percentage of households perceived that temperature is increasing	1	.737	.95	.917	1	1
Percentage of household that perceived increasing frequency of rainfall	1	1	.9	.667	1	1
Percentage of households reporting high impact of rainfall	1	.95	.9	.615	1	1
Percentage of households reporting agriculture as the only source of income	.35	.053	.579	1	.6	.85
Percentage below poverty line (BPL)	.7	1	.8	.692	1	1
Average number of dependents	.179	.216	.204	.25	.175	.254
Percentage of people who changed paddy crops variety	.35	.9	.1	.308	-	.25
Percentage of households reported to change crop planting dates	1	.95	.8	.769	.9	.95
Percentage of households who increased non-farm income activities	.3	.9	.2	.692	.15	.45
Percentage of household using early maturing varieties of paddy	.25	.9	-	.462	-	.3
Percentage of households undertaking water conservation practices	-	.85	.95	.692	1	-
Percentage of households using information on weather and climate	.25	.95	-	.769	-	.4
For farming						
Percentage of farmer having membership with SHG	.05	.6	-	.231	-	.2
Percentage of households heads below primary education	.8	.45	.95	.154	.05	.1
Average year of farming experience	.378	.345	.449	.378	.411	.294

Source : Author's Calculation from primary data

TABLE 3 INDEX MAJOR COMPONENT VALUES FOR THE SIX VILLAGE

Major Components	Mekuli	Akhoya	Yajang	Watiyim	Longjemdang	Mopongchuket
Exposure	1	.829	.75	.656	1	1
Sensitivity	.557	.554	620	.639	.639	.776
Adaptive Capacity	.375	.760	.383	.495	.279	.327

 DOI : 10.35291/2454-9150.2019.0302

Calculated value using table 2 and applying $\frac{\Sigma_i^n = 1 \text{ index } k^i f}{N}$

Table VB 4 Major Component Values and the CVI values for the six villages.

Major Components	Mekuli	Akhoya	Yajang	Watiyim	Longjemdang	Mopongchuket
Exposure	1	.829	.75	.656	1	1
Sensitivity	.557	.554	.620	.639	.693	.776
Adaptive Capacity	.375	.760	.383	.495	.279	.327
CVI	.348	.038	.227	.102	.499	.522

Scale : 0 to 10 Author's Calculation CVI Using CVId = (ed - ad) xsd

Table VB: 5. Vulnerability of Climate change and livelihood at the village level.

Indicator	Mekuli	Akhoya	Yajang	Watiyim	Longjem-dang	Mopong-chuket
Percentage of people depending only on agriculture for livelihood	35	5.3	2.3	100	60	85
Percentage of households who increased their non farm income sources	30	90	20	69.2	15	45
Percentage of households living below poverty	70	100	80	69.2	100	100
Average no. of dependents	2.15	2.60	2.40	3	2.10	3.05
Average no. of livestock	18.75	13.25	13.05	17.07	21.55	16.90

Source :- Authors calculation from primary data using SPSS

1) From table 4 CVI index the most vulnerable villages are Mopongchuket (.522) and Longjemdang (.499) followed by Mekuli (.348), Yajang (.227), watiyim (.1020 and the least vulnerable is Akhoya (.038)

2) One of the important findings of the study is that village with the highest adaptive capacity is the least sensitive and also the least vulnerable but is moderately exposed. The reason for least vulnerability might be due to the higher adaptive capacity to climate change.

3) At the household levels, the results suggests that among the sensitivity indicators the first three vulnerable villages are characterized by high level of poverty, more number of dependents in the family and high dependency on agriculture.

4) The most vulnerable villages are also involved in various adaptive actions to deal with the climate risks but still remain highly vulnerable.

5) The highly vulnerable villages are differentiated by low levels of non-farm income activities, high dependency on agriculture and low level of crop insurance, which serves as a risk reduction mechanism to deal with climate risks. Thus lack of access to crop insurance in the study region has contributed to the high vulnerability of farmers.

6) Comparison of vulnerability of villages and livelihoods reveals the importance of diversified livelihood in managing risks associated with climate hazards. Results indicate that households in less vulnerable villages are those who practice a range of different livelihood strategies. They are consequently more able to absorb shocks and stresses because they are able to fall back on other strategies when crops fail. Poorer households in highly vulnerable villages are often heavily dependent on agriculture, with few alternatives available, making them particularly vulnerable to climate hazards.

 DOI : 10.35291/2454-9150.2019.0302

In the study the indicators for constructing the CVI were based on primary data and the location of that particular study village. It is also important to note that the major components i.e exposure, sensitivity and adaptive capacity components did not take into account any indicators of meteorological parameters like rainfall and temperature due to the lack of data at the village level and therefore the study solely depend, on the perception of households on the climate variability and change.

Another important objective of the study is the CVI approach can be made use of for farming policies to reduce vulnerability of households. The results suggests that even if the households have the highest adaptive capacity, due to high sensitivity and exposure, their vulnerability to climate change may rise. This calls for farming polices more focused on reducing sensitivity and exposure of the households instead of focusing only on increasing their adaptive capacity. Higher adaptive capacity of the communities does not necessarily imply that they are less vulnerable to the impacts of climate variability and change. A single component cannot influence the reduction of vulnerability among the households. Even if households are practicing various adaptive options the effectiveness of their efforts to reduce the vulnerability might be limited quite often.

IV. SUGGESTIONS :

The impact of climate change is projected to have a great influence on agriculture and eventually on the food security and livelihoods of a large section of the rural population. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes and heat waves are known to negatively impact agricultural production and the livelihood of the farmers. Further, the climatic changes will affect agriculture through their direct and indirect effects on crops, soil, livestock and pests under the changed climate scenario. The following approaches and tools should be part of climate. Smart agriculture policy to adapt to and mitigate the changing climate.

1. Research should be strengthened of adverse climate tolerant genotypes and land use systems to ensure adequate food production.

2. Climate risk management services should be provided to farmers in the farm of reliable weather forecast and associated agro-advisories for the farmers in different agro climatic regions. Establishment of early warning system for emerging climatic risks such as droughts, floods, heat and cold waves, etc.

3. Ecosystem based approaches for building resilience to conserve and protect bio-diversity, improve economic livelihood and human well-being, sustainable restoration, conservation and management of ecosystems, utilization of traditional knowledge of local people and recognizing the importance of ecosystem services and integrating them to cost-effective management of natural resources.

4. Adaptation of techniques for restoring soils protection of natural drainage through soil profiles, increasing water storage capacity, naturally improving soil nutrients status.

5. Financial incentives should be provided to farmers for resource conservation and efficient use. Cost of cultivation is continually increasing and farm profits are decreasing. If agriculture has to provide environmental services, which may require farmers additional time, energy and resources, government should provide financial incentives to farmers. The study shows households are undertaking various adaptation actions to deal with climate risks still they remain vulnerable. So policies to promote more access to crop insurance among farmers in the region and providing awareness on water conservation practices, provide rain resistant varieties of crop and increase access and availability of information on weather and climate can increase the adaptive capacity of farmers to deal with new risks posed by climate change.

6. Promotion or research and development for climate smart agriculture such as crop-residue management, micro irrigation methods, modern agro forestry practices and community-based natural resources management.

7. The Climate smart village (CSV) concept of research programme on climate change is a good example of making synergies interventions as well as raising the awareness of the farming community. For climate literacy, using a community based approach can be used for accelerated adoption of climate smart agriculture.

8. The study shows that Longjemdang, Mopongchuket poverty (100%) so if policies are addressed on the issues of reducing poverty, increasing the crop diversity among farmers, income diversification policies can help farmers in reducing their vulnerability to climate variability and change.

9. Right use of farming practice could be a solution for climate change. So climate change mitigation combine with climate adaptation research and practice in agricultural sector is necessary. Such practices could be organic agriculture, terrace farming, planting alder trees, manure management, agro forestry practice, carbon farming etc.

So identifying the significant relation of climate change and agricultural sector should be acknowledged for addressing food security and tackling climate change in the district.

V. LIMITATIONS OF THE STUDY

The present study has some limitations and scope for further research. The following are some of the important limitations of the study:

1. The Primary data collection covers only 2017 (one harvest) the time involved and the resource required for

 DOI : 10.35291/2454-9150.2019.0302

collection of primary data did not permit to undertake repeated surveys to understand the dynamics of vulnerability to climate variability and change could not be done. The farmers of the study area is still not self sufficient in rice production. It would be good if we could make distinction between adaptation options that increase or decrease yields respectively. If policy markers take care about improving adoption in ways that increase yields, it could improve food security situation or at least self sufficiency of the region.

2. A study on comparing other vulnerable region of the state to the present study area would helped in strengthening the policy implications.

3. If the soil and conservation or related department will keep a proper record of the metrological data at the village level than we can make a detail analysis of the change in climatic conditions.

VI. CONCLUSION :

The study shows that the farmers in the study area resorted to different adaptation and coping actions to tackle heavy rainfall and climate variability, the most notable of which are changing planting dates, using early maturing variety of seeds, changing paddy crops varieties, increasing non farm income activities or income diversification, such as cultivation of vegetable, animals rearing, petty business, deity wages, labour etc water harvesting was the least adopted options among farmers. The adaptation and coping strategies reported by farmers are of two types first by adoption of farming practices which have the effect of increasing yield in the face of climate change ie changing planting dates, changing crops variety climate information reducing dependence on rain water and water conservation practices the 2nd types of adaptation practices is aimed at improving welfare of farmers when expected production decreases due to climate change this measures generally have to do with income diversification of farmers such as increasing non-farm activities, ie relying more on other income sources eg. Animal rearing petty business, vegetable farming wage labour, handicraft, handlooms etc. So that vulnerability to climate shocks is lessen both these measures improve yield which allow overall income of farmers to increase in the face of changing climate. For policy purposes both measures should be taken into account it is suggested that if subsidies are given to provide hybrid seeds than certain types of major local crop or traditional varieties of crops which are climate resilient can lead to extinction, so the best suggestion is the scope of crop insurance measure needs to be remarked in the light of climate adaptation.

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