Current Journal of Applied Science and Technology

23(6): 1-12, 2017; Article no.CJAST.35939
Previously known as British Journal of Applied Science & Technology
ISSN: 2231-0843, NLM ID: 101664541

Community Level Vulnerability to Climate Change: A Comparative Case Study between Selected Naga Tribes in India

Vimenuo S. Kuotsu[1], P. K. Pal[2*], Deepa Roy[2], Sabita Mondal[2], Litan Das[2] and Satarupa Modak[2]

[1]Department of Agricultural Extension Education, University of Agricultural Sciences, Raichur, Karnataka, India.
[2]Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya (North Bengal Agricultural University), P.O. Pundibari, Dist. Cooch Behar, PIN-736165, WB, India.

Authors' contributions

This work was carried out in collaboration between all authors. Author VSK designed the study, collected information and processed the data. Author PKP performed the statistical analysis, and revised the paper. Authors DR and S. Mondal managed the literature searches. Authors LD and S. Modak wrote the protocol, and first draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2017/35939
Editor(s):
(1) Charles W. Recha, Department of Geography, Faculty of Environment and Resources Development, Egerton University, Kenya.
Reviewers:
(1) Atrayee Banerjee, Basanti Devi College, India.
(2) Sailendra Narayan Goswami, ICAR-Central Inland Fisheries Research Institute, India.
(3) Esther, O. Owolade, Federal College of Animal Health and Production Technology, Nigeria.
(4) Lawrence Owere, University of KwaZulu Natal, Republic of South Africa.
Complete Peer review History: http://www.sciencedomain.org/review-history/21194

Original Research Article

Received 3rd August 2017
Accepted 15th September 2017
Published 2nd October 2017

ABSTRACT

Aim: To assess the community level vulnerability of two dominant Naga tribes, viz. the Angami and the Ao due to climate extremes and variability.
Study Design: Exploratory research design.
Place and Duration of Study: The study was conducted in Mokokchung and Kohima district of Nagaland, the abode of the Ao and the Angami respectively. One community/village under each district, dominated by one of the said tribes was purposively selected. The study was conducted in the year 2013-14.

**Corresponding author: E-mail: pkpalubkv@gmail.com;*

Methodology: 90 tribal households (10% of total) on proportionate random sampling basis were selected for the study. The livelihood vulnerability was assessed from exposure, sensitivity and adaptive capacity of the community and these were assessed using the methodology advocated by IPCC (2007) and aggregated as Livelihood Vulnerability Index (LVI).
Results: It was seen that the relative exposure of the Ao community was 0.24 and of the Angami community was 0.42; whereas average sensitivity value of the Ao was 0.43 and that of the Angamis was 0.34. The aggregated adaptive capacity of both the communities was same (both having adaptive capacity value=0.70) which was also statistically at par at p= .05. As a result, both the Angami and the Ao were considerably vulnerable (LVI= –0.156 and –0.120 for the Angami and the Ao respectively).
Conclusion: The Angami and the Ao Naga tribes falls under subsistence level of vulnerability and any minor change in strength of exposure or sensitivity or weakness in adaptive capacity may force the community to be vulnerable.

Keywords: Angami; Ao; livelihood vulnerability index; exposure; sensitivity; adaptive capacity.

1. INTRODUCTION

The tribal or more ethically the indigenous population is identified as the aboriginal inhabitants of India. They constitute 8 percent of the total population of India - spread over 15 percent of the geographical areas in various ecological and geo climatic conditions, varying from forest, hills, plateaus and plains [1]. They are still living with primitive agricultural practices with stagnant population, lowest literacy rates and are at the lowest rung of human index [2].

Nagaland, being one of the "Seven Sisters" commonly called as the North-Eastern Region, is a land of lush green forests, rolling mountains, enchanting valleys, swift flowing streams and of beautiful landscape. If the North-East of India represents the richest ethnic region of the world and meeting point of four major races (Aryan, Mongoloid, Austric and Tibeto-Burman) of the world, the Nagaland is known for the myriad tribes and rich culture and traditional system ranging from the autocratic to pure democracy [3]. The inhabitants of Nagaland are almost entirely tribal with distinctive dialects and cultural features. There are 14 major Naga tribes, viz. Angami, Ao, Chakesang, Chang, Khiamniungan, Konyak, Lotha, Phom, Pochury, Rengma, Sangtam, Sema, Yimchunger and Zeliang with some smaller tribes [4]. Each Naga tribe settled gradually after a course of migration occupying separate eco-environmental zones. The smaller tribes settled earlier whereas some larger tribes, such as the Angami and the Ao kept on shifting their habitats during the initial stage by encroaching into the territories of smaller tribes. Later economic compulsions forced them too to settle down in specific territories and to maintain solitary group of kins following the principles of patri-local residence and patri-lineal descent [5,6].

Livelihood can be defined as the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term [7]. Vulnerability means 'the insecurity or well-being of individuals or communities in the face of changing environments (ecological/ social/ economic/ political) in the form of sudden shocks, long term trends or seasonal cycles' [8]. The extent of vulnerability relates both to the level of external threats to a household's, individual's or community's welfare and to their resilience resisting and recovering from these external threats.

The livelihood vulnerability of tribal communities emerged from their history of settlement. Most of the tribal communities were devoted to the avocation like hunting, fishing etc. as combined with raising of crop from their land. These areas are low populated tracts [1]. Due to the long continued war against the frequent interruption by intruders in their former settlements in the fertile lands, the tribal communities are said to have fled to remoter inaccessible area. Therefore the richer resources base had been snatched from them in remote history. Gradually, they settled, but generally in the problem areas and the resource bases in these areas are weak [9,10]. Most of the areas are drought prone, remote with lack of communication facilities, rocky and high degree of soil erosion due to

shifting or Jhum cultivation, forested and high hostile climate. It is also believed that those tribal communities failed to compete with proficient peasantry and in order to save their independence and honour, they took shelter in the areas featured by a hostile climate.

Besides these historical causes of vulnerability unlike all other tribes, the Naga tribes, being the inhabitants of one of the remotest areas in India, have to bear with some other negative livelihood forces like geographical remoteness and inaccessibility, hilly terrain, lack of infrastructure, population composition, and scarce resource base. The State also had to face continuous insurgency, spending much of its resources on administration and related costs at the expense of development [4]. Moreover, the Angami and Ao tribes may face different levels of livelihood vulnerability because of the differences in the ethnicity and lifestyle [11,12]. However, the impact of livelihood forces have altered with the flow of time, and it is imperative to assess it over time. Due to the intricate interactions between diverse components of livelihood system along with human interventions, assessing vulnerability becomes a complicated job [13].

Nevertheless, vulnerability assessment is significant as it is an important method in developing policies and adaptation plans for specific vulnerable groups and areas; and the present effort may be the first ever attempt to trace out the vulnerability of these tribes with a quantitative methodology.

Against this background, the present study was undertaken to assess the livelihood vulnerability in community level of two dominant Naga tribes viz. Angami and Ao with the following specific objectives:

(i) to assess the level of exposure to shock, sensitivity and adaptive capacity of these selected tribes; and
(ii) to assess the community level vulnerability of livelihood of the selected tribal groups of Nagaland

2. METHODOLOGY

2.1 The Study Area

The Angami is one of the major tribes of the state of Nagaland. They are one of the dominant Naga communities of Nagaland. They are people mostly depending on agriculture and livestock rearing. The Angamis are spread across four regions- Southern Angami, Western Angami, Northern Angami and Chakhro Angami. They were converted to Christianity after the arrival of British. Social stratification is not practiced by the Angamis. The property is shared or divided among children. The youngest male inherits the parental home 'Kithoki', and is responsible for the Parents' care until they pass away. The major festival of the Angamis is Sekrenyi, celebrated in the month of February after the harvest. The common language of the Angamis is "Tenyidie". The Angamis are quite popular for their woodcraft and artwork. They are the producer of bamboo work, cane furniture, beds, shawls and powerful machetes. Angamis play great music with the help of drums and flute. Traditional dancing is an important part of their culture [11,14].

The Ao is another major and dominant tribe of Nagaland. They are well known for the harvest festivals held each year. With the arrival of the British, the Ao were some of the earliest to convert to Christianity among the Naga tribes. Social stratification is not practiced among the Ao also. The eldest son inherits the parental home and is responsible for the care of the parents. Property and land is distributed and shared among the children. The Aos celebrate two major festivals- Moatsu during sowing season and Tsungrem Mong after harvest. The common language of the Ao is "Jungli". The Ao Nagas have a rich tradition in clothing. They are rich in their folk literature. The log drum is a significant part of their culture. These drums serve a variety of functions, including inter-village communication, warning a village in case of attack and ceremonial purposes [14,15].

Kohima and Mokokchung District of Nagaland are considered as the home to the Angami and the Ao Nagas respectively. So, the study was conducted in these districts (Fig. 1). Mokokchung district lies between 94.29^0E and 94.76^0E longitude and 26.20^0N and 26.77^0N latitude. The district is agriculturally and industrially among the most progressive districts in the state. Mokokchung has a mild climate throughout the year. For ten months of the year, maximum temperature hovers in the mid twenties. The average annual rainfall is 2500 mm and temperature does not rise beyond 32℃ and average summer temperature is 27℃. However, the yearly variation in monthly minimum and maximum temperature and precipitation is higher (based on SARS weather record, Mokokchung).

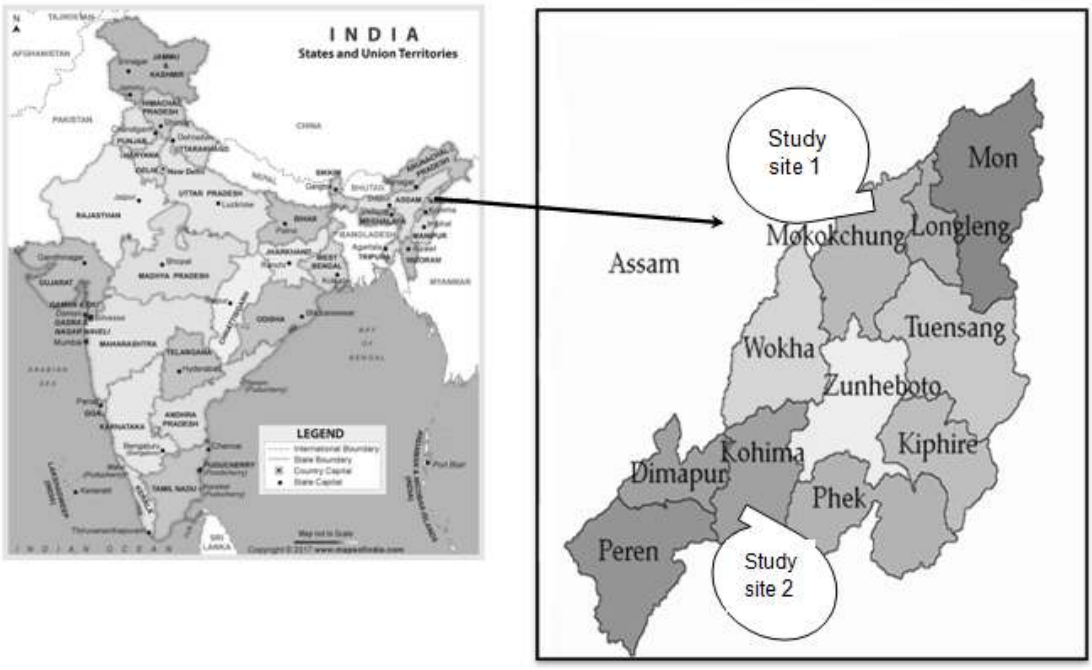


Fig. 1. Location of study areas

The physiography of Mokokchung district shows six distinct hilly ranges. These yearly variation in climatic parameters over the years and hilly terrains makes the district vulnerable. Whereas, Kohima district is located between 93.33℄ and 95.25℄ longitude and 25.10℃ and 27.07℃ latitude. Kohima is dependent mainly on agriculture and tourism industries. Kohima features a more moderate version of a sub-tropical climate. December and January are the coldest months when frost occurs in the higher altitudes, snowfall occurs occasionally. July is the hottest month. The yearly average temperature is 17.8℃. The average annual rainfall is 1863 mm. Surrounding mountain ranges are the features of the district as is typical of most Naga settlements. The yearly variation in monthly minimum and maximum temperature and precipitation is less than in case of Mokokchung (based on SARS weather record, Mokokchung).

2.2 Sampling Size and Procedure

One tribal community dominantly inhabited by one of the tribe group was purposively selected. Thus, Khensa village in Mokokchong district for Ao and Mima village in Kohima district for Angami were purposively selected. Khensa was inhabited by 598 of Ao households and Mima was acquired by 293 families of Angami tribes. Among these, 90 households (10% of total-60 from Khensa and 30 from Mima) were selected on the basis of probability proportionate random sampling for estimation of community parameters.

The individual household was taken interview with a pre-tested interview schedule on selected parameters. The household level information was aggregated to community level for each and every indicator considered for sensitivity and adaptive capacity (vide Tables 3 and 4).

Climatic data (monthly minimum and maximum temperature and monthly precipitation) was collected from the meteorological data records for study districts of State Agricultural Research Stations (SARS), Mokokchung, Nagaland. The extent of exposure to climatic hazards like landslide, cyclone, drought etc. were generated through participatory matrix ranking [16] methodology in groups (three groups in each study area) based on the experiences of the community members on occurrence and severity of these hazards (read with Section 2.3: Exposure).

2.3 Assessment of Livelihood Vulnerability

Livelihood vulnerability is the extent to which livelihoods are exposed to particular shocks and

seasonality. It is the potential to suffer harm or loss, related to the capacity to anticipate a hazard, cope with it, resist it and recover from its impact. It implies the susceptibility to damage or injury due to any negative impact. Vulnerability is not a static concept; it varies in time and space [16]. As per the analysis of Intergovernmental Panel on Climate Change [16], Livelihood vulnerability can be assessed from the interplay of different factors and is defined as LV=f (Exposure, Sensitivity and Adaptive capacity) in relation to a livelihood system. As per the Intergovernmental Panel on Climate Change (IPCC) [17], exposure (E) is the risk like climate change, natural and manmade disasters etc. which has a probability to impact on assets and livelihoods. Sensitivity is the susceptibility of assets and livelihoods exposed to risk. Adaptive capacity is the least understood concept. However, it is the ability to deploy social risk management strategies for reduction of risk and human vulnerability associated with climate change [17]. It is not well understood how it varies across countries, regions of countries, and sectors and how it can best be strengthened. It is the ability of a system to reduce to moderate levels, the potential effects of climate change and variability by either taking advantage of existing opportunities or undertaking measures to deal with its consequences. It is unequally distributed.

The complex relationship and interactions between these three factors have been argued and agreed that vulnerability is still a complex subject and has many dimensions: economic, social, demographic, political, psychological etc. that can have overlapping effect induced from one factor and it can be difficult to tease out precisely the cause - effect relationship [18]. Till date, livelihood vulnerability was assessed in respect of climate change and different authors advocated different frameworks for measurement of vulnerability [18,19,20,21,22,23]. So, the present study depends upon these studies to extract the indicators for exposure, sensitivity and adaptive capacity and aggregated these with the help of the method advocated by Hahn et al. [22]. The method was most appropriate in the present set of study because it had the scope to incorporate society-specific indicators to generate overall vulnerability. Moreover, the result derived from the aggregation method can be interpreted more simply than other methods for policy implications.

2.3.1 Exposure

It is operationalised as risks that have a probability to impact on assets and livelihoods and measured by frequency and severity of natural disasters over last 10 years based on the perception of the community members; and variability in climatic parameters over last 10 years or more (Standard deviation was calculated on monthly basis). Frequency and severity of natural disasters viz. landslide, earthquake, flood, drought and cyclone over last 10 years were measured by Disaster Impact Index (DII) [14] for each as:

$$\text{Disaster impact Index} = \frac{\text{frequency} \times \text{severity}}{10 \times 10}$$

Where frequency is the number of occurrence of the disaster and severity is the perceived loss; scored on a 10-point scale over last 10 years

Variability in climatic parameters viz. average monthly minimum temperature, average monthly maximum temperature and average monthly precipitation over last 10 years or more were represented by standard deviation of these indicators over last 10 years or more.

2.3.2 Sensitivity

It is operationalised as susceptibility of assets and household conditions to previous risks. The assets and household conditions which may be directly affected by climate extremes like nature of housing, sanitation, drinking water facilities and food access were taken into consideration. Literally, sensitivity creates a feeling of negative impact, but the present study in accordance with the concept of IPCC [17], measured the contributing variables with a positively directional scale; viz. more the scale value, less the sensitivity. So, the sensitivity score is obtained by deducting the aggregated score from a standard value (1.00 in present study).

Percentage of houses made of wood or brick-concrete, percentage of families having latrines, percentage of families having safe drinking water (connected with pipeline or deep tube well) and percentage of families having square meal per day throughout the year were the indicator variables for housing sensitivity, sanitation sensitivity, drinking water sensitivity and food sensitivity respectively.

2.3.3 Adaptive capacity

It is the capability and situation of the community which directly or indirectly resists risks or creates resilience to risks. It is represented by the aggregated values of literacy level of the community (as the percent of household heads having at least primary education), occupational stability in the community (as the percent of families having a stable occupation), access to social organisation (as the percent of families having membership of social organisations like youth club, farmers' club, self-help groups etc.), economic stability of the community (as the percent of families having surplus income i.e. saving after expenditure) and community skill on disaster/climate risk management (as the percentage of families of which at least one member has undergone a training on disaster/climate risk management).

2.4 Data Processing and Aggregation

The present study used index-based approach of measurement of vulnerability which requires the development of indices with the help of many sub-indices and variables. This method requires processing of data. Different variables were measured with different types of scales (in percentage, numbers or scores). So, different scale values were transformed to unitary value (out of 1 scale), wherever necessary by the following formula:

$$\text{Transformed value} = \frac{\text{Obtained value} - \text{Minimum scale value}}{\text{Maximum scale value} - \text{Minimum scale value}}$$

So, the transformed value will lie between 0 and 1.

Value of exposure, sensitivity and adaptive capacity were taken as the average of transformed values of all the indicator variables under each component.

Livelihood vulnerability was calculated by Livelihood Vulnerability Index (LVI) [22]. The LVI was measured as:

$$LVI = (E\text{-}AC) \times S$$

Where E = Exposure; AC = Adaptive Capacity and S = Sensitivity.

The value of LVI varies from -1 (least vulnerable) to +1 (most vulnerable) and grouped as: Sustainable (LVI ranges from – 1 to – 0.34), Subsistence ((LVI ranges from –0.33 to 0.33) and Vulnerable ((LVI ranges from 0.34 to 1),

The findings were treated with appropriate inferential statistics [non-parametric Wilcoxon Signed Rank (Z) test for comparison and generalization of results].

3. RESULTS AND DISCUSSION

3.1 Comparative Exposure to Vulnerability of the Study Communities

Nagaland is by default exposed to different natural hazards. The study communities are vulnerable due to their geographical positions [24]. The meteorological data also depicts variability over last twelve years (2002-2013). The community exposure is derived from these two sets of indicators.

Table 1 depicts the relative exposure to various natural hazards on livelihoods of Angami and Ao community. Households of both the Angami and the Ao people had higher exposure to landslide (0.63 and 1.00 respectively). Probable reason was that the place had a strange topography with higher probability of landslides. There had been a noticeable increase in the frequency of landslides. Nagaland had recorded 80 major landslides in the last six decades upto 2010.

The table further reveals that except landslide, Aos were comparatively more exposed to drought but Angamis were more exposed to cyclone, whereas in case of other natural hazards, they were more or less at par in exposure.

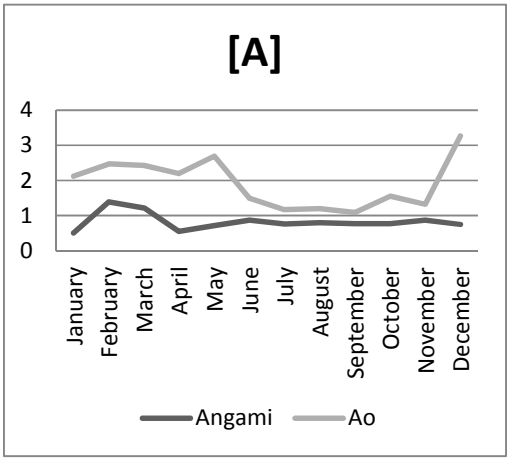
Aggregating all the hazards, it was seen that the average exposure value for the Ao was 0.38; whereas that for the Angami was 0.29. Wilcoxon (Z) value (0.813; p = .41) which is not significant. It means that both the communities were exposed to similar band of threats of climate variabilities and adversities.

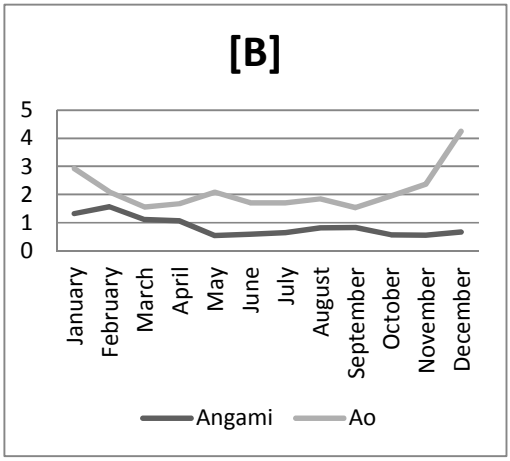
Fig. 2 [A, B & C] presents the climate variability as a potential exposure to livelihood which is expressed as the average standard deviation of the reading of monthly minimum temperature, monthly maximum temperature and monthly precipitation. It is found that climate variability for all the three parameters were more in case of the Ao than the Angami over last 12 years (2002-2013). The average standard deviation of

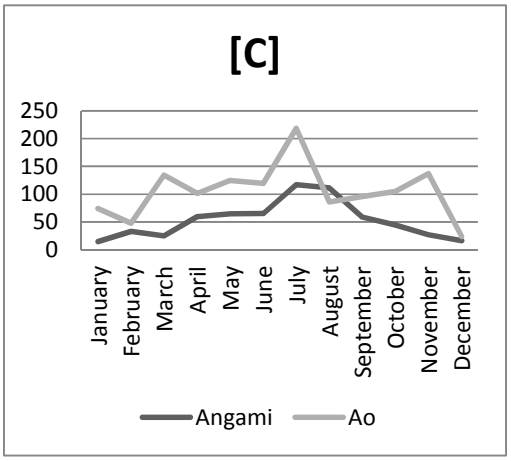
monthly minimum temperature (0.83℃ and 1.92℃ for Angami and Ao respectively which differed significantly at $p< .01$ level), monthly maximum temperature (0.85℃ and 2.14℃ for Angami and Ao respectively which again differed significantly at $p< .01$ level) and monthly precipitation (53.15 mm and 105.72 mm for Angami and Ao respectively which differed significantly at $p= .001$ level too) were more in the Ao community. The average values of climate variability over all parameters calculated from standardized values were 0.46 for Ao and 0.13 for Angami which denoted that the Aos were more exposed to climate variability than Angami as seen also in case of climatic hazards.

Table 2 summarises the overall exposure of the Naga tribes to climate vulnerability factors and reveals that the Ao community was more exposed than the Angamis to climate change vulnerability (0.24 and 0.42 of exposure values for the Angami and the Ao respectively).

Climate change is being the serious concern over the years worldwide. Nagaland is not also exception in this regard. It is also situated in one of the most vulnerable landscapes in India, which aggravating the impact of climate change more severely. Moreover Mokokchang (the home of Ao) is more vulnerable than Kohima (habitat of Angami) so far the geographical position is concerned [24]. So, the exposure value for the Ao is more than the Angami.







[A]=Variability (SD) in average monthly minimum temperature (^{0}C). [mean value: Angami=0.83^{0}C; Ao=1.92^{0}C. Paired t value=5.23; $p< .01$] and [average standardized values: Angami=0.12; Ao=0.51 over 2002-2013AD]

[B]=Variability (SD) in average monthly maximum temperature (^{0}C). [mean value: Angami=0.85^{0}C; Ao=2.14^{0}C. Paired t value=5.23; $p< .01$] and [average standardized values: Angami=0.08; Ao=0.43 over 2002-2013AD]

[C]=Variability (SD) in average monthly precipitation (mm) [mean value: Angami=53.15mm; Ao=105.72mm. Paired t value=4.39; $p< .01$] and [average standardized values: Angami=0.18; Ao=0.45 over 2002-2013AD]
[SD=Standard Deviation]

Fig. 2. Variability found in climatic parameters in the study sites in last 12 years (2002 to 2013AD)

[Source: Calculated based on data of SARS, Mokokchung, Nagaland]

Table 1. Climatic hazards contributing to exposure to vulnerability Source: Generated through participatory matrix ranking

Climatic hazards	Hazard value		Statistical implication
	Angami	Ao	
Landslide	0.63	1.00	Average Hazard
Cyclone	0.31	0.25	Angami=0.29; Ao=0.38
Drought	0.38	0.55	
Earthquake	0.09	0.06	Wilcoxon signed rank test (Z) = 0.813; *p* =.41
Flood	0.02	0.05	

Table 2. Community exposure to vulnerability

Exposure indicators	Actual values		Transformed values	
	Angami	Ao	Angami	Ao
A. Climatic hazards	0.29	0.38	0.29	0.38
b1.Variability in min. temperature (°C)	*0.83*	*1.92*	*0.12*	*0.51*
b2.Variability in max. temperature (°C)	*0.85*	*2.14*	*0.08*	*0.43*
b3.Variability in precipitation (mm)	*53.15*	*105.72*	*0.18*	*0.45*
B. Variability in climate (Average of b1, b2 & b3)	-	-	0.13	0.46
Vulnerability exposure based on transformed value			**0.24**	**0.42**

3.2 Comparative Sensitivity to Vulnerability Factors of the Communities

Sensitivity is the susceptibility of assets and livelihoods exposed to risk. From Table 3, it is seen that the Angami community was more resistant to exposure than the Ao community, although the Aos had encouraging sanitation facilities (90% of families having safe sanitary status). Food security status of the Angamis although were up to the mark, but it was very poor in case of the Ao community. However, both the communities were highly sensitive in respect of housing facility (only 17.50% and 15% were having safe housing facilities). Aggregating all the sensitivity factors, it was seen that the sensitivity value of the Ao community was 0.43, against that of 0.34 for the Angami community. But statistical treatment suggested that both the communities were statistically at par at p = .05 level of significance in respect of community sensitivity.

Aos are more sanitised and having drinking water facilities up to the mark which may in turn resist them from exposure to adversities of natural disasters and disease epidemics. Contrarily, they are very much food insecure and have poor housing facilities, therefore less resistant to hit of climate change. On the other hand, Angamies are although having highest ring of food and drinking water security but very poor in housing and sanitation facilities which will aggravate the adverse effects of climate change.

3.3 Comparative Adaptive Capacity to Vulnerability

Adaptive capacity of the Naga communities was assessed through their education level, surplus income (saving), occupational stability, climate risk management skill and organisational membership.

From Table 4, it is seen that the Ao community was more educated (100% of the Ao against 65% of the Angami) and they also had more organizational membership than the Angami (90% against 85%) whereas the Angamis were having more saving (72.50% against 45.00%), stable occupation (100% against 97.50%) and risk management training (25% against 17.5%). However, the aggregated adaptive capacity of both the communities were same (both having adaptive capacity value=0.70) which was also statistically at par (Wilcoxon Z = 0.135; p= .89).

Nagaland is one of the Indian states where literacy rate is very high. However, the Aos although reflect the picture, but Angamies failed to show it. Aos were considerably poorer than the Angamies and also geographically more vulnerable. Christian Missionaries and other development organizations were more active in this area and so, they were having more organisational participation. These factors

increased their capacity to respond against climate change vulnerabilities. Angamies were more stable in occupation which in turn increased saving (surplus income). They were nearer to state headquarter which may give them opportunity to undergo training on disaster management. These situations altogether make them more adaptive to vulnerability. However, both the communities were having strength and weaknesses in different adaptive factors which consequently made them at par in respect of adaptive capacity.

3.4 Assessment of Livelihood Vulnerability

Aggregating all the previous factors, viz. exposure, sensitivity and adaptive capacity, Table 5 calculated the livelihood vulnerability of these communities through Livelihood Vulnerability Index (LVI) advocated by Hann et al. [22]. From the table, it is seen that the Angami community had an LVI value of –0.156 and the Ao community was having it as –0.120; both of which indicates a subsistence level of vulnerability.

From the value of Wilcoxon Sign Rank Test (Z=1.34; p = .18), it can be concluded that both the communities were statistically at par at p = .05 level of significance in respect of community vulnerability.

The study assessed the vulnerability of major Naga tribes' livelihoods to the impacts of climate variability and hazards using locally relevant indicators of exposure, sensitivity, and adaptive capacity. The tribe groups under study were very much exposed to landslides due to their geographical position. The area although having abundant water resources but there is a well-known scarcity in water usage [25] which created moderate level of drought (Nagaland tribes face high level of drinking water scarcity which results in occasional community conflict). Similar case was in case of cyclone; and present worldwide scenario of fluctuation and irraticity in climatic parameters [26] were also experienced in these tribal communities. But it is a notable fact that although, Indian North-Eastern states falls under high seismic-sensitive zone, but the study communities did not recognised earthquake as a

Table 3. Sensitivity to vulnerability of study communities

Sensitivity indicators	Percent families		Transformed values		Sensitivity value (1-transformed value)	
	Angami	Ao	Angami	Ao	Angami	Ao
Sanitation status	47.50	90.00	0.48	0.90	0.52	0.10
Food Security status	100.00	22.50	1.00	0.23	0.00	0.77
Drinking water facility	100.00	100.00	1.00	1.00	0.00	0.00
Housing facility	17.50	15.00	0.18	0.15	0.82	0.85
Community sensitivity					**0.34**	**0.43**

Wilcoxon signed rank test (Z)=0.535; p = .59

Table 4. Adaptive capacity of study communities

Adaptive capacity	Percent families		Transformed values	
	Angami	Ao	Angami	Ao
Education status	65.00	100.00	0.65	1.00
Surplus income	72.50	45.00	0.73	0.45
Stable occupation	100.00	97.50	1.00	0.98
Organisational membership	85.00	90.00	0.85	0.90
Skill training	25.00	17.50	0.25	0.18
Community adaptive capacity			**0.70**	**0.70**

Wilcoxon signed rank test (Z)=0.135; p= .89

Table 5. Livelihood vulnerability Index of Angami and Ao communities

Exposure		Adaptive capacity		Sensitivity		LVI	
Angami	Ao	Angami	Ao	Angami	Ao	Angami	Ao
0.24	0.42	0.70	0.70	0.34	0.43	**–0.156**	**–0.120**

Wilcoxon signed rank test (Z)=1.34; p= .18

potential hazard. It is because the communities had not experienced any severe quake or loss in last 10-15 years.

The Angami and the Ao of Nagaland were having very fragile housing facilities. The geographical position of these tribes did not allow them to make very safe housing which are very prone to cyclone or land slide also. It made them more vulnerable. Food security is enhanced by stable occupation and surplus income. The Aos were less stable in these aspects because they had lass saving (surplus income) and so were more food vulnerable which is reflected in the study. The shifting cultivation followed in Nagaland may also be more uncertain in fluctuating climate situation.

The web of Government and non-Government development activities are satisfactory in North-Eastern states in India [27]. These activities directly and indirectly enhance adaptive capacity of the community members of the state. Higher moderate level of adaptive capacity was the result of this web of development activities.

The Angami and the Ao communities were exposed to vulnerability in various levels, they had different levels of sensitivity but had same level of adaptive capacity; and it is seen from other studies that those who are most exposed are not necessarily the most sensitive or least able to adapt [23,28]. So, although the two tribal communities had same level of adaptation to climate change and adversities; but they had different levels of socio-economic inequalities to make them unequally sensitive, and had unequal spatial distribution of exposure to climate change. Consequently, the two communities faced the similar levels of livelihood vulnerability. Understanding how these components and indicators influence the vulnerability of livelihoods provides an important starting point for directing future research and climate change coping and adaptation initiatives in developing countries [23], particularly those with such tribe groups of India.

The results of the study are in consistence with many previous studies on vulnerability analysis on different geographical regions and human groups [20,23,28,29].

4. CONCLUSION

The study reveals that both the communities fall under subsistence level of vulnerability class, which means any minor change in strength of exposure or sensitivity or weakness in adaptive capacity may force the community to be vulnerable. Although the Ao communities of Naga tribes are slightly more vulnerable than the Angami tribes, but statistically they both are vulnerable at the same level. Based on the findings of the present case study, it can be said that both the communities are although having satisfactory level of adaptive capacity but extra impetus should be given to reduce sensitivity by safe housing infrastructural development, food security and sanitation development. Efforts to reduce livelihood vulnerability in Naga tribal communities by the development agencies should be initiated/strengthened so as to simultaneously tackle exposure, sensitivity, and adaptive capacity for the well-being of these communities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/21194