

## Original Research Article

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

### 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.

**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. Although average sensitivity value of the Ao was more (sensitivity=0.43) than the Angamis (sensitivity=0.34), but they were statistically at par ( $p = .59$ ) with respect to community sensitivity towards vulnerability. The aggregated adaptive capacity of both the communities was same (both having adaptive capacity value=0.70) which is also statistically at par ( $p = .89$ ). As a result, the Angami community is less vulnerable than the Ao community (LVI= -0.156 and -0.120 respectively for the Angami and the Ao). However, they are statistically at par ( $p = .18$ ) in respect of community vulnerability.

**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.

**Key words:** Angami, Ao, Livelihood Vulnerability Index, Exposure, Sensitivity, Adaptive capacity

### 1. INTRODUCTION

The tribal population is identified as the aboriginal inhabitants of our country and accounts around 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 "Eight 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)

25 of the world, the Nagaland is known for the myriad tribes and rich culture and traditional  
 26 system ranging from the autocratic to pure democracy [3]. The inhabitants of Nagaland are  
 27 almost entirely tribal with distinctive dialects and cultural features. There are 14 major Naga  
 28 tribes, viz. Angami, Ao, Chakesang, Chang, Khiamniungan, Konyak, Lotha, Phom, Pochury,  
 29 Rengma, Sangtam, Sema, Yimchunger and Zeliang with some smaller tribes [4]. Each Naga  
 30 tribe settled gradually after a course of migration occupying separate eco-environmental  
 31 zones. The smaller tribes settled earlier whereas some larger tribes, such as the Angami  
 32 and the Ao kept on shifting their habitats during the initial stage by encroaching into the  
 33 territories of smaller tribes. Later economic compulsions forced them too to settle down in  
 34 specific territories and to maintain solitary group of kins following the principles of patri-local  
 35 residence and patri-lineal descent [5,6].

36 Livelihood can be defined as the capabilities, assets (stores, resources, claims and access)  
 37 and activities required for a means of living: a livelihood is sustainable which can cope with  
 38 and recover from stress and shocks, maintain or enhance its capabilities and assets, and  
 39 provide sustainable livelihood opportunities for the next generation; and which contributes  
 40 net benefits to other livelihoods at the local and global levels and in the long and short term  
 41 [7]. Vulnerability means 'the insecurity or well being of individuals or communities in the face  
 42 of changing environments (ecological/ social/ economic/political) in the form of sudden  
 43 shocks, long term trends or seasonal cycles' [8]. The extent of vulnerability relates both to  
 44 the level of external threats to a household's, individual's or community's welfare and to their  
 45 resilience resisting and recovering from these external threats.

46 The livelihood vulnerability of tribal communities emerged from their history of settlement.  
 47 Most of the tribal communities were devoted to the avocation like hunting, fishing etc. as  
 48 combined with raising of crop from their land. These areas are low populated tracts [1]. Due  
 49 to the long continued war against the frequent interruption by intruders in their former  
 50 settlements in the fertile lands, the tribal communities are said to have fled to remoter  
 51 inaccessible area. Therefore the richer resources base had been snatched from them in  
 52 remote history. Gradually, they settled, but generally in the problem areas and the resource  
 53 bases in these areas are weak [9,10]. Most of the areas are drought prone, remote with lack  
 54 of communication facilities, rocky and high degree of soil erosion due to shifting or Jhum  
 55 cultivation, forested and high hostile climate. It is also believed that those tribal communities  
 56 failed to compete with proficient peasantry and in order to save their independence and  
 57 honour, they took shelter in the areas featured by a hostile climate. Besides these historical  
 58 causes of vulnerability alike all other tribes, the Naga tribes, being the inhabitants of one of  
 59 the remotest areas in India, have to bear with some other negative livelihood forces like  
 60 geographical remoteness and inaccessibility, hilly terrain, lack of infrastructure, population  
 61 composition, and scarce resource base. The State also had to face continuous insurgency,  
 62 spending much of its resources on administration and related costs at the expense of  
 63 development. Moreover, the Angami and Ao tribes may face different levels of livelihood  
 64 vulnerability because of the differences in the ethnicity and lifestyle [11,12]. However, the  
 65 impact of livelihood forces have altered with the flow of time, and it is imperative to assess it  
 66 over time. Due to the intricate interactions between diverse components of livelihood system  
 67 along with human interventions, assessing vulnerability becomes a complicated job [13].  
 68 Nevertheless, vulnerability assessment is significant as it is an important method in  
 69 developing policies and adaptation plans for specific vulnerable groups and areas; and the  
 70 present effort may be the first ever attempt to trace out the vulnerability of these tribes with a  
 71 quantitative methodology.

72 In this backdrop, the present study has been undertaken to assess the livelihood  
 73 vulnerability in community level of two dominant Naga tribes viz. Angami and Ao.

## 74 2. METHODOLOGY

### 75 2.1 The tribes under study

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

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

### 99 2.2 Assessment of livelihood vulnerability

100 Livelihood vulnerability is the extent to which livelihoods are exposed to particular shocks  
 101 and seasonality. It is the potential to suffer harm or loss, related to the capacity to anticipate  
 102 a hazard, cope with it, resist it and recover from its impact. It implies the susceptibility to  
 103 damage or injury due to any negative impact. Vulnerability is not a static concept; it varies in  
 104 time and space [16]. As per the analysis of Intergovernmental Panel on Climate Change  
 105 [16], Livelihood vulnerability can be assessed from the interplay of different factors and is  
 106 defined as  $LV=f(\text{Exposure, sensitivity and Adaptive capacity})$  in relation to a livelihood  
 107 system. As per the IPCC (2007) [16] definition, exposure (E) is the risk like climate change,  
 108 natural and manmade disasters etc. which has a probability to impact on assets and  
 109 livelihoods. Sensitivity is the susceptibility of assets and livelihoods exposed to risk. Adaptive  
 110 capacity is the least understood concept. However, according to IPCC (2007) [16], it is the  
 111 ability to deploy social risk management strategies for reduction of risk and human  
 112 vulnerability associated with climate change. It is not well understood how it varies across  
 113 countries, regions of countries, and sectors and how it can best be strengthened. It is the  
 114 ability of a system to reduce to moderate levels, the potential effects of climate change and  
 115 variability by either taking advantage of existing opportunities or undertaking measures to  
 116 deal with its consequences. It is unequally distributed.

117 The complex relationship and interactions between these three factors have been argued  
 118 and agreed that vulnerability is still a complex subject and has many dimensions: economic,  
 119 social, demographic, political, psychological etc that can have overlapping effect induced

120 from one factor and it can be difficult to tease out precisely the cause - effect relationship  
121 [17].

122 Till date, livelihood vulnerability was assessed in respect of climate change and different  
123 authors advocated different frameworks for measurement of vulnerability [17,18,19,20,21,  
124 22].

125 The present study extracted indicators following different methods mentioned above and  
126 aggregated these with the help of Hahn *et al.*, (2009) [21].

### 127 **2.2.1 Indicator variables considered for exposure, sensitivity and adaptive capacity**

128 **Exposure:** It is operationalised as risks that have a probability to impact on assets and  
129 livelihoods and measured by frequency and severity of natural disasters over last 10 years  
130 and variability in climatic parameters over last 10 years.

131 Frequency and severity of natural disasters viz. landslide, earthquake, flood, drought and  
132 cyclone over last 10 years were measured by Disaster Impact Index (DII) (derived in this  
133 study) for each as:

$$134 \quad \text{Disaster impact Index} = \frac{\text{frequency} \times \text{severity}}{10 \times 10}$$

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

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

140 **Sensitivity:** It is operationalised as susceptibility of assets and household conditions to  
141 previous risks. The assets and household conditions which may be directly affected by  
142 climate extremes like nature of housing, sanitation, drinking water facilities and food access  
143 were taken into consideration. Literally, sensitivity creates a feeling of negative impact, but  
144 the present study in accordance with the concept of IPCC (2007) [16] measured the  
145 contributing variables with a positively directional scale; viz. more the scale value, less the  
146 sensitivity. So, the sensitivity score is obtained by deducting the aggregated score from a  
147 standard value (1.00 in present study).

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

153 **Adaptive capacity:** It is the capability and situation of the community which directly or  
154 indirectly resists risks or creates resilience to risks. It is represented by the aggregated  
155 values of literacy level of the community (as the percent of household heads having at least  
156 primary education), occupational stability in the community (as the percent of families having  
157 a stable occupation), access to social organisation (as the percent of families having  
158 membership of social organisations like youth club, farmers' club, self help groups etc.),  
159 economic stability of the community (as the percent of families having surplus income i.e.  
160 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).

### 2.3 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 as because 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) of Hahn *et al.*, (2009) [21]. The LVI was measured as:

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

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].

### 2.4 Study sites and respondents

The study was conducted in Mokokchung District and Kohima District of the North-Eastern State of Nagaland. One tribal community from each District, namely Khensa and Mima villages were purposively selected. 10% of total households (60 out of 598 in Kennsa and 30 out of 293 in Mima) were selected on the basis of probability proportionate random sampling for estimation of community parameters.

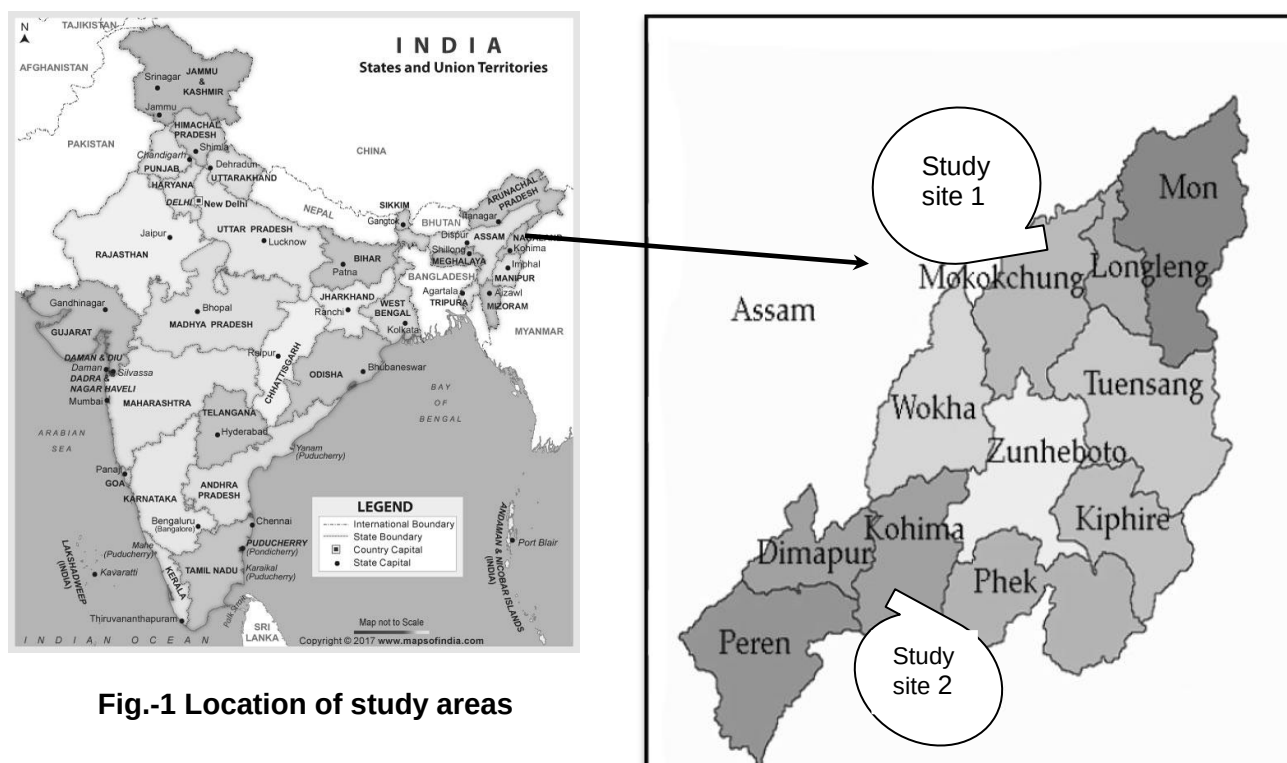


Fig.-1 Location of study areas

### 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. 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, although, it was seen that the Aos were comparatively more exposed to vulnerability (average exposure value = 0.29 and 0.38 for Angami and Ao respectively), but the level of vulnerability exposure for both the communities were statistically at par ( $p = .41$ ).

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**Table-1: Climatic hazards contributing to exposure to vulnerability**

| Climatic hazards | Hazard Value |      | Statistical implication                                                                                        |
|------------------|--------------|------|----------------------------------------------------------------------------------------------------------------|
|                  | Angami       | Ao   |                                                                                                                |
| Landslide        | 0.63         | 1.00 | <u>Average Hazard</u><br><br>Angami=0.29; Ao=0.38<br><br>Wilcoxon signed rank test (Z)<br><br>= 0.813; $p=.41$ |
| Cyclone          | 0.31         | 0.25 |                                                                                                                |
| Drought          | 0.38         | 0.55 |                                                                                                                |
| Earthquake       | 0.09         | 0.06 |                                                                                                                |
| Flood            | 0.02         | 0.05 |                                                                                                                |

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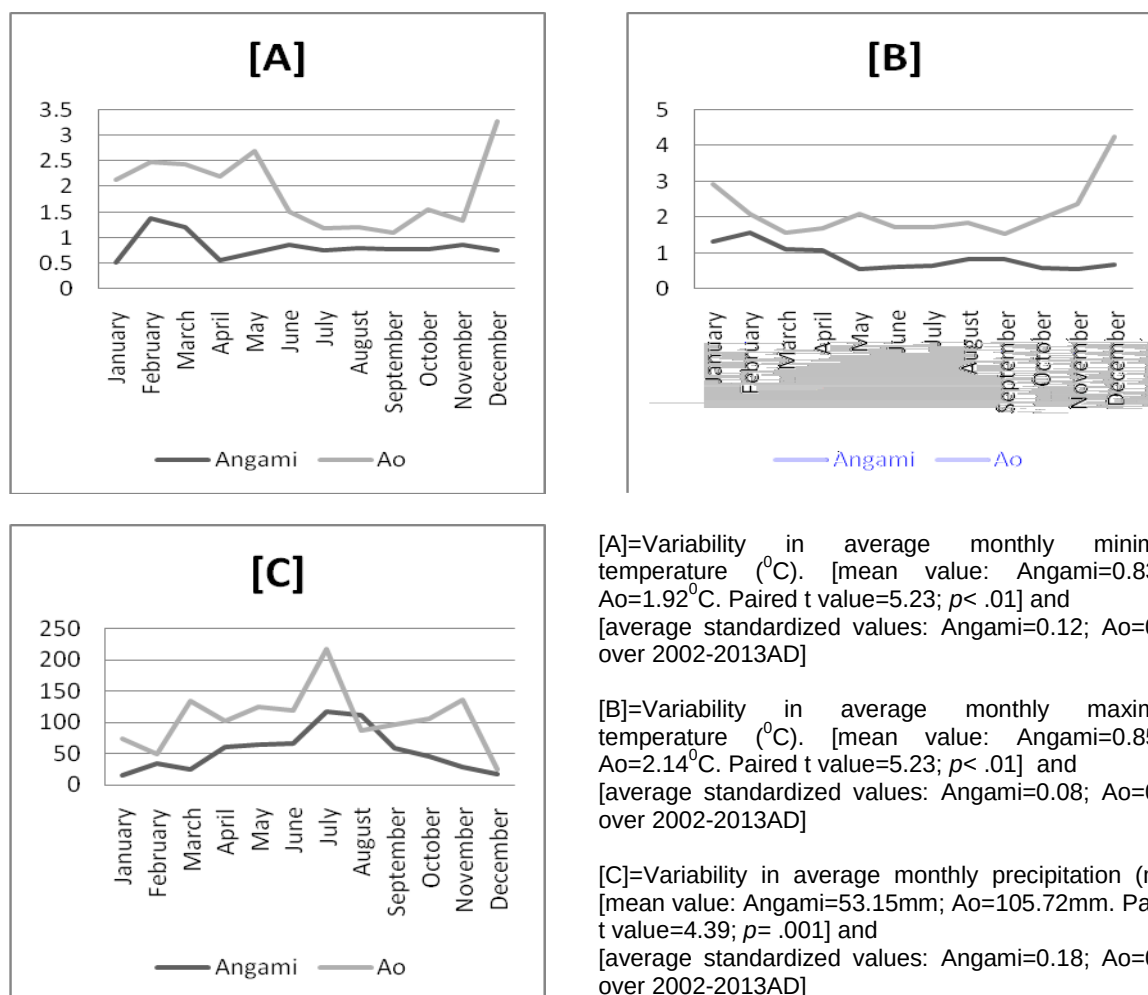


**Fig.-2: Variability found in climatic parameters in the study sites in last 12 years (2002 to 2013)**

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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 ( $0.83^{\circ}\text{C}$  and  $1.92^{\circ}\text{C}$  for Angami and Ao respectively which differed significantly at  $p < .01$  level), monthly maximum temperature ( $0.85^{\circ}\text{C}$  and  $2.14^{\circ}\text{C}$  for Angami and Ao respectively which again differed significantly at  $p < .01$  level) and monthly precipitation (53.15mm and 105.72mm 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).

**Table-2: Community exposure to vulnerability**

| Exposure indicators                                                    | Actual values |        | Transformed values |             |
|------------------------------------------------------------------------|---------------|--------|--------------------|-------------|
|                                                                        | Angami        | Ao     | Angami             | Ao          |
| Climatic hazards                                                       | 0.29          | 0.38   | 0.29               | 0.38        |
| <i>Variability in min. temperature (<math>^{\circ}\text{C}</math>)</i> | 0.83          | 1.92   | 0.12               | 0.51        |
| <i>Variability in max. temperature (<math>^{\circ}\text{C}</math>)</i> | 0.85          | 2.14   | 0.08               | 0.43        |
| <i>Variability in precipitation (mm)</i>                               | 53.15         | 105.72 | 0.18               | 0.45        |
| Variability in climate                                                 | -             | -      | 0.19               | 0.46        |
| <b>Vulnerability exposure based on transformed value</b>               |               |        | <b>0.24</b>        | <b>0.42</b> |

### 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, although, it was seen that the Ao community was more sensitive (sensitivity=0.43) than the Angamis (sensitivity= 0.34), but they were statistically at par ( $p = .59$ ) with respect to community sensitivity towards vulnerability.

### 250 3.3 Comparative adaptive capacity to vulnerability

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

254 **Table-3 Sensitivity to vulnerability of study communities**

| Sensitivity indicators                                     | Percent families |        | Transformed values |      | Sensitivity value<br>(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        |
| <b>Community sensitivity</b>                               |                  |        |                    |      | <b>0.34</b>                                | <b>0.43</b> |
| <b>Wilcoxon signed rank test (Z)=0.535; <i>p</i> = .59</b> |                  |        |                    |      |                                            |             |

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**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        |
| <b>Community adaptive capacity</b>                        |                  |        | <b>0.70</b>        | <b>0.70</b> |
| <b>Wilcoxon signed rank test (Z)=0.135; <i>p</i>= .89</b> |                  |        |                    |             |

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259 From table-4, it is seen that the Ao community was more educated (100% of the Ao against  
260 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 ( $p= .89$ ).

### 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., (2009) [21]. From the table, it is seen that the Angami community was less vulnerable than the Ao community (LVI=  $-0.156$  and  $-0.120$  respectively for the Angami and the Ao) of Nagaland. Although there were minor differences in exposure and sensitivity between these two communities but they were statistically at par ( $p= .18$ ) and falls under subsistence level of vulnerability.

**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 | <b><math>-0.156</math></b> | <b><math>-0.120</math></b> |
| <b>Wilcoxon signed rank test (Z)=1.34; <math>p= .18</math></b> |      |                   |      |             |      |                            |                            |

### 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 developing 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.

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