



Case Study

Climate Change and Livelihood Vulnerability of Rural Households: A Case Study from Doda District of Jammu and Kashmir, India

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Abstract: The study of vulnerability arising due to climate change is one of the most important aspects which requires a comprehensive discussion and understanding. The Vulnerability was originally conceived by Geographers to study calamities like hazards, famines, etc. One of the most important tools to access the vulnerability of any area is the Livelihood Vulnerability Index (LVI). This paper tries to analyze the vulnerability of rural households to climate change by constructing the LVI. Doda district is large, so for this study two blocks namely Doda and Bhaderwah were taken and the sample size was 300. The overall LVI for the whole study area out to be considered moderate in terms of livelihood vulnerability. In terms of blocks, the LVI of Doda is 0.413 whereas the LVI of Bhaderwah is 0.408. Among the capitals, households were most vulnerable in terms of Financial capital (0.448) followed by Physical capital (0.426), Social capital (0.410), Human capital (0.386) and lastly Natural capital (0.377). As per local households, livelihood vulnerability was mainly because of poor infrastructures, limited education and healthcare and inadequate knowledge and skills in income generating activities. The impact of climate change on the components has shown an increasing trend during the last decades and if proper measures are not taken, the vulnerability will increase in the future. The study will help policymakers to frame policies so as to reduce the vulnerability of rural households and provide them better living environment.

Keywords: vulnerability, rural households, capital, sub-components, components and Livelihood Vulnerability Index

JEL Codes: Q54

1. Introduction

Today's world is full of various problems which are serious and pose a threat to the existence of the earth. Of the many problems existing today, climate change is one of the most serious threats concerning each nation and every individual. The United Nations Framework Convention on Climate in Article 1 defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". Climate change and its severe impacts have become a concern for both scientific as well as political communities around the globe. It is predicted that climate change will have serious consequences for societies as well as economies.

Climate Change does not only mean that everything around us will become hotter. Instead, there will be more irregularities and extremeness in the weather events. Some places will have heavier rainfall; some will experience more snow whereas other places will suffer from severe droughts and frequent heat waves. Climate change is not local but a global phenomenon and will have its impacts on natural as well as man-made systems. Current climate shocks and stresses already have an overwhelming impact on the vulnerability of households, particularly in rural communities. As per the fifth assessment report of IPCC on climate change has clearly stated vulnerability to climate change as the tendency to be antagonistically influenced by climate impacts. It shows the powerlessness of a social or natural system to be a supporter of destruction caused by climate change (Niang et al., 2014).

Although vulnerability is still considered as an evolving subject, at the same time it is something which is highly challenged (Adger, 2006; Singh et al., 2016). Vulnerability is susceptibility to suffering damage from an environmental extreme and relative inability to recover from that damage (McCarthy, 2001). Climate change vulnerability is a function of exposure, sensitivity, adaptability and is often equated to concepts like marginalization, fragility, and risk (Liverman, 1990; Ionescu et al., 2009). Being a multidisciplinary concept, the literature on vulnerability often gets mired in a definitional debate based on the epistemological underpinning of the scholars (Adger, 2006; Füssel, 2007; Kok et al., 2016; Crane et al., 2017). Climate change vulnerability is also affected by bio-physical and socio-economic environments which in turn influences the rural livelihood strategies (O'Brien et al., 2004). The rural areas are more vulnerable to the effect of climate change due to its direct impact on the health and well-being of rural households depending on natural resources for their livelihoods (Shackleton & Shackleton, 2004) and also lack of limited access to alternative resources further intensifies the problem (Skoufias et al., 2011). Using vulnerability as a basic tool to analyze the climate change impact has increased over time (Malone & Engle, 2011). Mathematically,

$$\text{Vulnerability} = f(\text{Exposure, sensitivity, adaptive capacity}).$$

The livelihood system is composed of various aspects which include physical, economic, social and cultural aspects, wherein families live and sustain (Ellis, 2000). A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Chambers & Conway, 1991). Although all human beings are vulnerable to climate change, rural people are the most vulnerable ones. Rural household's livelihood is mainly dependent on resources which are highly vulnerable to changing climate like agriculture, livestock, land, local water supplies, etc. thus it becomes necessary to have a proper analysis of livelihood vulnerability to climate change and its impact on rural households.

2. Review of literature

In order to tackle climate change, Intergovernmental Panel on Climate Change (IPCC), was framed to analyse climate change and the vulnerability associated with it so as to provide adaptation strategies to tackle climate change vulnerability. A few decades ago, vulnerability studies tended to have a 'single stressor, single outcome' approach, focusing on the physical impact of a disaster and its negative outcomes (Eakin & Luers, 2006). Subsequently, scholars posited that vulnerability is not confined to only the devastations caused by the disaster to the physical environment, but also the impact on the social, economic, and political environments (Morrow & Phillips, 1999). With time, vulnerability to climate change became, the most talked about subject. Although there is a long history of vulnerability research, the methods are not uniform. Some study vulnerability through species diversity, some through, external shocks and some through agriculture yield (Poudel et al., 2010). Finally, a comprehensive view of vulnerability, taking into account exposure, susceptibility, socio-economic conditions and resilience measures of households, was considered more appropriate in understanding disaster impact (Birkmann, 2006).

Studying households' livelihood vulnerability helps in understanding the impact of physical, demographic and social actors on climate change vulnerability and providing necessary data to tackle climate change vulnerability. Household capacity to tackle climate vulnerability and livelihood is different even in the same region (Cardona & Barbat, 2000). The most important factor which determines their susceptibility to disaster is access to the resources which determine their carrying capacity (Enarson, 2000). The households also differ with respect to their absorbing

capacity to resist the damage caused by the disaster and the adjustment they do to maintain their livelihood (International Food Policy Research Institute (IFPRI), 2013). IPCC. The other main factors affecting household livelihood include exposure, sensitivity and adaptive capacity (IPCC, 2001), which together form the base of the Livelihood Vulnerability Index (LVI) given by Hahn in 2009. The central focus of the LVI (Hahn et al., 2009) is to look into various aspects of vulnerability and differences in households' efforts and adaptive capacity to maintain livelihood (Chambers & Conway, 1992; Ellis, 2000). These differences are found in accessibility to financial, human, social and physical capitals, which determine differences in households' recovery from disaster, and which further lead to adaptation and livelihood resilience (Cassidy & Barnes, 2012).

3. Study area and methodology

Doda is situated on the eastern side of Jammu province and is the largest district in the whole province. The district is located at a height of about 5000 feet above the sea level. The district shares its boundary with Anantnag on one hand and on other hand the district shares its boundary with Chamba district in Himachal Pradesh. While talking about the geographical aspects, Doda is located at 75°32'52"E Longitude and 33°08'45"N Latitude. The total area of district is approximately 11,691 sq.km. Historically speaking the district got its name from the utensils makers of Multan who were called "Deeda". It is believed that these people came all the way from Multan and settled in this part which is now called Doda. The physical map of district Doda is given in Figure 1 below:

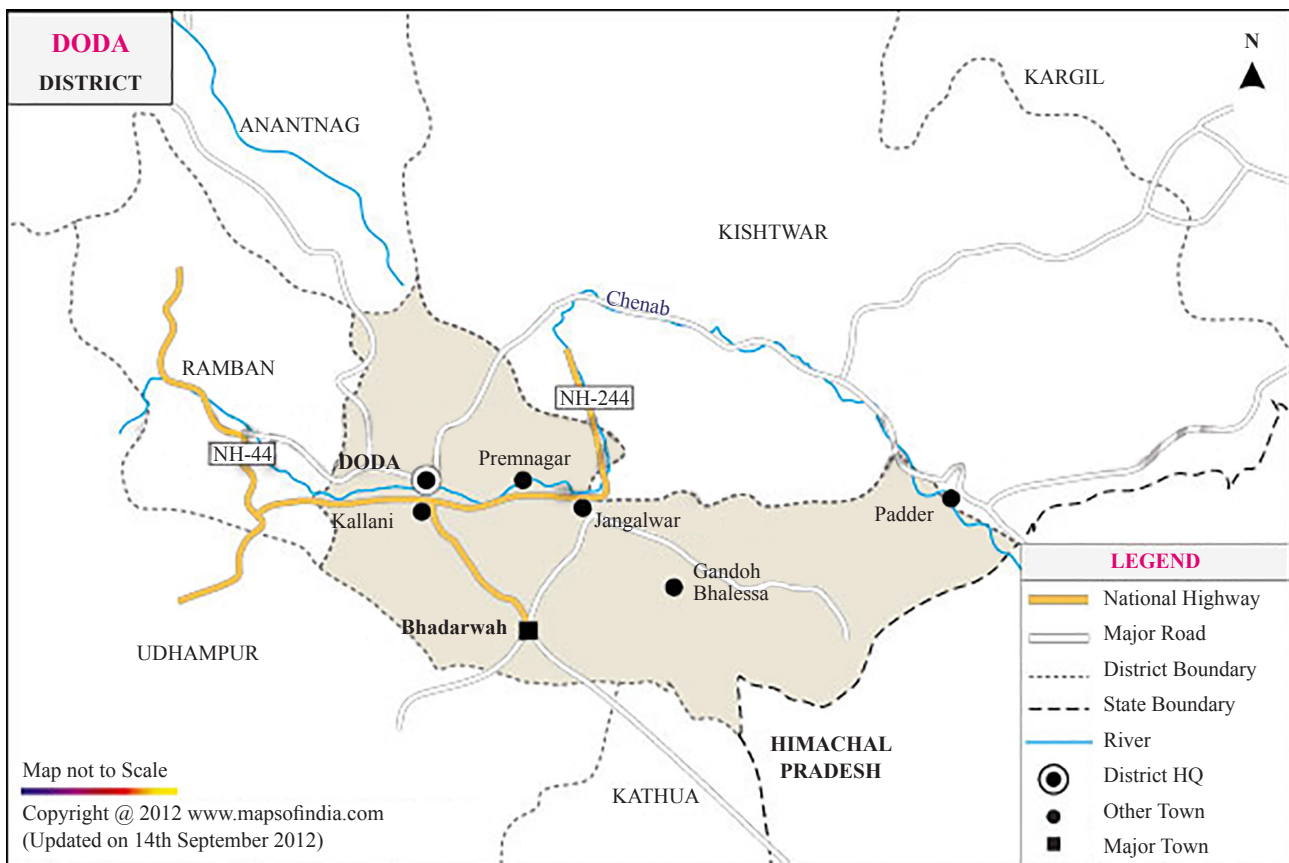


Figure 1. Map of District Doda

Source: districts.ecourt.gov.in

Two blocks i.e., Doda and Bhaderwah have been selected to analyse the vulnerability due to climate change vulnerability and access which block is more vulnerable and which is less. Stratified random sampling will be used in which the population sample is taken. Overall, 300 households have been selected using stratified random sampling, 150 from each block. The 300 households have been selected after a round of pilot surveys and these are scattered around the whole of both the blocks so that the data generated could be more diverse. It has also been kept in mind that the households selected cover all the groups i.e. women headed, literate, illiterate, government job holders, farmers, self-employed, etc. so as to make the study more relevant and logical. A structured questionnaire survey, participatory rural appraisal (PRA) and focus group discussion (FGD) methods will be used to collect primary data and information. The paper will analyze the climate change vulnerability of village households in Doda by constructing the LVI. LVI uses several indicators like exposure to natural disasters, and variability to climate; social and demographic characteristics of households which affect their adaptive capacity; food and water resources and health which determine the level of sensitivity to climate change impacts (Hahn et al., 2009). One thing worth mentioning is that while calculating the value will come between 0 to 1. So if the value is between 0 to 0.30, it will be considered as low vulnerability. If the value is 0.301 to 0.65, it will be taken as moderate vulnerability and if the value is above 0.65, it will be taken as high vulnerability.

4. Theoretical framework to vulnerability assesment

Hoddinott and Quisumbing (2003) in their study asserted that for vulnerability assessment five questions have to be answered. The five questions are: what is vulnerability, who is vulnerable; what are the wellsprings of vulnerability; how do households react to climate shock, and what gap exists among risk and hazard management component? Keeping these questions aside, vulnerability assessment across disciplines has concentrated more on using secondary data where Geographic Information System (GIS) or econometric models are used (Hoddinott & Quisumbing, 2003; Naude et al., 2009). Econometric models which are used for vulnerability assessment include Vulnerability as Expected Poverty (VEP); Vulnerability as Expected Utility (VEU); and Vulnerability as Uninsured Exposure to Risk (VER). These models are good when they are applied at a national level but are a big blunder when used for individual or community level (Bérgolo et al., 2012). Another vulnerability assessment method used is the Household Vulnerability Index (HVI). The HVI defines vulnerability as the “presence of factors that place households at risk of becoming food insecure or malnourished” (Moret, 2014). This is assessed on the levels of ‘external vulnerability’, which refers to exposure to external shocks or hazards and ‘internal vulnerability’, which refers to the capacity to cope with or withstand those shocks. The main limitation of this method is that it is mainly focused on food security and doesn’t pay much emphasis on livelihood vulnerabilities at the household level (Moret, 2014). Another important method used in vulnerability assessment is the Sustainable Livelihoods (SL) approach. The main feature of this approach is that it aims at the eradication of poverty (Krantz, 2001). The SL approach additionally looks at the vulnerability context, which could be trends, shocks, and stresses in which these assets exist. The main drawback of this method is that it covers the components of sensitivity and adaptive capacity but don’t consider the exposure component which is responsible for making individual vulnerable (Krantz, 2001). This led to the development of the LVI by Hahn et al. (2009) to incorporate the element of climate exposure in addition to sensitivity and adaptive capacity in analyzing the risk arising from climate change and its variability. Many other have also contributed in the development of LVI (Eriksen & Kelly, 2006), being one of them. This methodology is employed in this study so that the vulnerability can be studied in a complete way without leaving any of the important aspects in analyzing vulnerability. This methodology is employed in this study so that the vulnerability can be studied in a complete way without leaving any of the important aspects in analyzing vulnerability. The main advantage of this study is that it uses primary data collected from households and secondary data is only used in case of rainfall (precipitation) and temperature. This results in avoiding data gaps which generally occur in case of secondary data helping in appropriate results which are a better representation of households. LVI provides organizations and government tools to understand social, demographic and health factors contributing to vulnerability at the community level (Shah et al., 2013).

5. Constructing LVI

The LVI was originally built to provide policy makers and planners a practical tool so as to understand how demographic, social, physical, financial and human factors result in climate vulnerability. The main aim of the study is to calculate the vulnerability of rural household's livelihood due to variability in climate. In calculating the LVI, the study will be following Hahn et al. (2009), although there will be certain changes in variables taken based on the review of the literature and the nature of the study. The LVI is constructed by using five different categories of livelihood assets, which are Human Capital, Natural Capital, Social Capital, Physical Capital and Financial Capital. These five main assets are divided into components which are further sub-divided into various sub-components. These components are categorized into exposure, sensitivity and adaptive capacity so as to determine the vulnerability. Components like natural disasters and climatic variability are categorized under exposure; water, housing, schools, finance, health and land under sensitivity whereas socio-demographic, livelihood, knowledge and skills under adaptive capacity. The diagrammatic representation of the construction of the LVI using Hahn is given in Figure 2. It can be clearly seen that the components have been divided into three categories i.e. exposure, sensitivity and adaptive capacity.

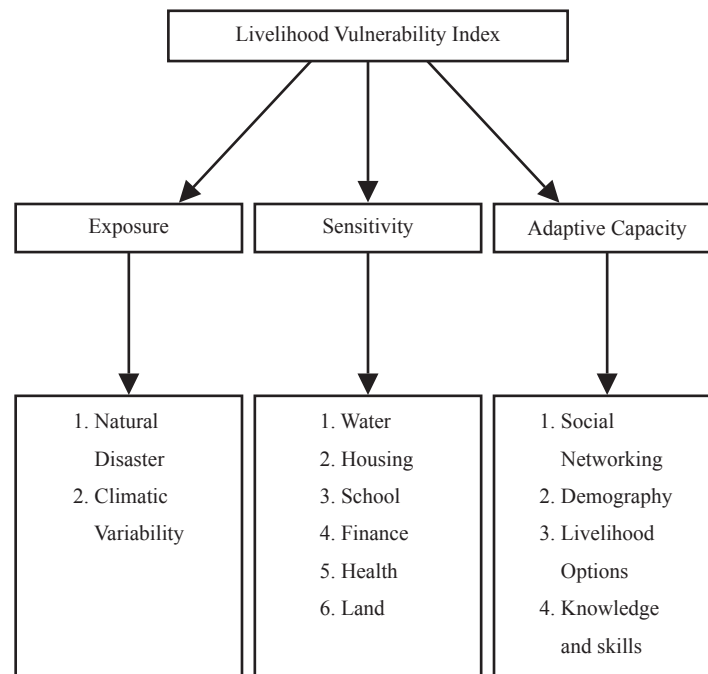


Figure 2. Framework for Constructing LVI

Source: Created by author himself

After the division of components into three categories, the next step is further division of components into sub-components so that a detailed analysis of the data can be done. In the Table 1, the components have been further classified into various sub-components which will be used during the course of the calculation of LVI. In short, overall the LVI consists of five livelihood assets, twelve components and thirty-two sub-components.

Table 1. Capitals, major components and sub-components comprising the LVI

Capitals	Major components	Sub-component/indicator
Human	Health	Average time taken to reach nearby health center Percentage of households having at least one ill member Percentage of children suffering from various climate related diseases
	Knowledge and Skills	Percentage households' heads who just have studied upto primary level Percentage households not having TV at home Percentage households not having radio at home
	Livelihood options	Percentage of HHs depending on agriculture as a major source of income Crop Diversification Index Percentage of HHs depending on livestock as a major source of income Livestock Diversification Index Percentage of households having non-farm income as a source of livelihood
	Land	Percentage households having small lands (0.1 to 1 acre) Percentage of landless households Percentage households whose land has got degraded due to climate related events.
Natural	Natural Disasters	Average natural disasters during last 20 years Percentage of households recording deaths or injuries due to these disasters
	Water	Percentage households who don't have regular have regular water supply Percentage of households who are dependent on springs, ponds for meeting water needs Average time taken to fetch water
Physical	Climate Variability	Mean standard deviation of average temperature by month Mean standard deviation of average precipitation by month
	Housing	Percentage households having pucca houses Percentage households whose house has been damaged due to climate related disasters (flood, cloud burst)
	Schools	Average time taken to reach nearest school Percentage of schools not having proper infrastructure
Social	Demography	Total dependency ratio Percentage households headed by females
	Social Networking	Percentage of household who are poor Percentage households whose women don't belong to any social group Percentage households who received help from government during disaster
Financial	Finances	Percentage households who are under debt Percentage households without any savings

Source: Author

5.1 Calculating LVI

After constructing the LVI, the next step which needs to be done is the calculation of the index using simple statistical tools. The data will be calculated out of the sub-components which are discussed above. The method that

will be used is the balanced weighted average approach (Hahn et al., 2009). Symbolically Vulnerability index of each component is calculated as:

$$\text{Index} = \frac{\text{Observed value} - \text{minimum value}}{\text{Maximum value} - \text{minimum value}}$$

Finally, the Livelihood vulnerability index (LVI) can be calculated as:

$$\text{LVI} = \frac{\text{sum of all values of all indicators}}{\text{Number of indicators}}$$

Or simply we can say that

$$\text{LVI} = \text{average of the value of all the given individual indicators}$$

For calculating inverse index like crop diversification and livestock diversification, formula which will be used is:

$$\text{Index} = \frac{1}{1 + \text{observed index}}$$

6. Results and discussion

Using the above formulae, the LVI has been calculated and the results are mentioned in the Table 2 below. The results have further been discussed so as to understand the vulnerability of the study area.

As far as the Health vulnerability index is concerned, it is seen that in Doda the index is 0.497 or 49.7 percent whereas in Bhaderwah its value is 0.487 or 48.7 percent. Thus with the given data, it can be said that in terms of health Doda is slightly more vulnerable than Bhaderwah in terms of health vulnerability index and vulnerability is moderate. Although there is moderate vulnerability, the fact remains that the vulnerability is close to 0.50 or 50 percent which is a matter of concern. It can be easily concluded that health wise the study area is at risk and needs immediate attention. Children are the worst sufferers as they get easily attacked by diseases carrying viruses and bacteria. Similarly, in terms of the knowledge and skill vulnerability index, it can be clearly seen that in Doda the index value is 0.406 or 40.6 percent whereas in Bhaderwah its value is 0.362 or 36.2 percent population indicating moderate vulnerability. One fact which comes out of the table above is that radio is still the main source of information and entertainment as T.V. is costly and can't be afforded by low-income households.

With regards to the livelihood option, the vulnerability index for Doda is 0.290 or 29 percent and for Bhaderwah block the value is 0.273 or 27.3 percent indicating low vulnerability in both blocks. The Human Capital Vulnerability Index for Bhaderwah is 0.374 or 37.4 percent and for Doda it is 0.397 or 39.7 percent indicating more vulnerability in Doda than in Bhaderwah.

As far as the land vulnerability index is concerned it can be clearly seen that in Doda the index is 0.368 or 36.8 percent indicating moderate vulnerability but on the lower side, whereas in Bhaderwah the value is 0.326 or 32.6 percent indicating low vulnerability. It can be said that in terms of land most of the rural households possess land although the size varies and those who are landless are very less in number. Talking about the natural disaster vulnerability index it can be said that in Doda the index is 0.206 or 20.6 percent indicating low vulnerability whereas in Bhaderwah its value is 0.280 or 28 percent which means low vulnerability. It indicates that disasters are not that frequent in the area. Although one might agree with the fact that although disasters are less, whenever they occur damage is high.

Table 2. Livelihood Vulnerability index of Sub-component, Major Components and Capitals

Sub-Component	Value		Major Component	Value		Capital	Vulnerability Index	
	Doda	Bhaderwah		Doda	Bhaderwah	Human	Doda	Bhaderwah
Time taken to reach nearby health centre	0.518	0.536						
Percentage of households having at least one ill member	0.486	0.467	Health	0.497	0.487			
Percentage of children suffering from various climate related diseases	0.493	0.460						
Percentage households heads who just have studied upto primary level	0.506	0.506						
Percentage households not having TV at home	0.473	0.440	Knowledge & Skills	0.406	0.362			
Percentage households not having radio at home	0.186	0.140					0.397	0.374
Percentage households dependent on agriculture as major livelihood option.	0.547	0.587						
Crop diversification index	0.20	0.167						
Percentage household dependent on Livestock as major livelihood option.	0.220	0.186	Livelihood strategies	0.290	0.273			
Livestock diversification index	0.250	0.20						
Percentage household who are having non farm income as major source of livelihood	0.233	0.227						
Percentage households having small lands (0.1-1 acre)	0.607	0.547					Doda	Bhaderwah
Percentage of landless households	0.086	0.073	Land	0.368	0.326			
Percentage households whose land has got degraded due to climate related events	0.413	0.360						
Average no. of natural disasters during last 20 years	0.232	0.306						
Percentage of households recording deaths or injuries due to these disasters	0.18	0.253	Natural Disaster	0.206	0.280	Natural	0.385	0.369
Percentage households who don't have regular water supply	0.464	0.430						
Percentage of households dependent on springs, ponds for meeting water needs	0.360	0.386	Water	0.403	0.380			
Percentage of households who get bad quality water	0.385	0.325						
Mean standard deviation of average temperature by month	0.645	0.613						
Mean standard deviation of daily precipitation by month	0.483	0.371	Climatic Variability	0.564	0.492			
Percentage households having pucca houses	0.526	0.580					Doda	Bhaderwah
Percentage households whose house has been damaged due to climate related disasters (flood, cloud burst)	0.230	0.343	Housing	0.378	0.462			
Average time taken to reach nearest school	0.433	0.504				Physical	0.386	0.465
Percentage of schools not having proper infrastructure	0.350	0.431	School	0.391	0.467			

Total dependency ratio	0.613	0.546				Doda	Bhaderwah	
Percentage households headed by females	0.116	0.190	Demography	0.365	0.363			
Percentage households who are poor.	0.353	0.226				Social	0.417	0.402
Percentage households whose women don't belong to any social group	0.583	0.517	Social Networking	0.472	0.463			
Percentage households who received help from government during disasters.	0.480	0.566						
Percentage households who are under debt	0.246	0.32				Doda	Bhaderwah	
Percentage households without any savings	0.686	0.54	Finances	0.466	0.430	Financial	0.466	0.430
Overall LVI							0.413	0.408

Source: Author

The water vulnerability index value for Doda is 0.403 or 40.3 percent indicating moderate vulnerability. In the case of the Bhaderwah block the value is 0.380 or 38 percent again indicating moderate vulnerability. The main reason for the low vulnerability in Bhaderwah is the availability of natural springs in the Bhaderwah which make the supply of water in rural areas throughout the year as compared to Doda where there are interruptions in the water supply. A look at the table also reveals that one-third of the population is not satisfied with the quality of water supplied, so it also needs a deeper look as unfit water can be the main cause for the number of diseases. With regards to the climate variability vulnerability index for Doda is 0.564 or 56.4 percent indicating moderate vulnerability but on the higher side. In the case of the Bhaderwah block the value comes out to be 0.492 or 49.2 percent indicating moderate vulnerability. Thus it can be easily concluded that in both in Doda and Bhaderwah blocks the climate vulnerability is more and that can be easily concluded that overall the average temperature has risen in the last few decades.

It is evident from the table that the natural capital vulnerability index for Doda is 0.385 or 38.5 percent again indicating moderate vulnerability whereas for Bhaderwah it is 0.369 or 36.9 percent indicating moderate vulnerability but on the lower side.

Talking about the housing component vulnerability index it can be seen that in Doda the index value is 0.378 or 37.8 percent indicating moderate vulnerability whereas in Bhaderwah its value is 0.462 or 46.2 percent which means moderate vulnerability. The vulnerability is more in Bhaderwah than Doda. The main reason for the high percentage in Bhaderwah is more frequency of landslides and rainfall which results in more damage to houses. In the case of the school component vulnerability index it can be seen that in Doda the index value is 0.391 or 39.1 percent whereas in Bhaderwah its value is 0.467 or 46.7 percent which means moderate vulnerability. Thus in terms of no. of schools and the infrastructure available in them, Doda is comparatively better than Bhaderwah. Although from the above table it becomes obvious that schools in rural areas are in very bad condition as most of the schools lack proper infrastructures like desks, buildings, office rooms and manpower. Lack of infrastructure will have a negative impact on the quality of education received and resulting in children who are not properly educated thereby affecting their efficiency and ability to contribute to livelihood. An overall physical capital vulnerability index for Doda is 0.386 or 38.6 percent and for Bhaderwah the value is 0.465 or 46.5 percent.

Talking about the demography vulnerability index it can be seen that in Doda the index value is 0.365 or 36.5 percent indicating moderate vulnerability whereas in Bhaderwah its value is 0.363 or 36.3 percent which means vulnerability is just approaching moderate level. Thus it can be concluded that the index is low for both blocks but it should not be misjudged as the demography vulnerability index is a matter of concern. The low value of indexes is because the percentage of the women heading the households is very less thereby decreasing the overall index value. With regards to social networking vulnerability, the index for Doda is 0.472 or 47.2 percent indicating moderate vulnerability. In the case of the Bhaderwah block the value comes out to be 0.463 or 46.3 percent indicating moderate vulnerability but on the higher side. From the above table two prominent observations can be derived: Firstly, some have very less role in decision making. They are not taken into consideration while making decisions which add more to

the vulnerability because they are the one who works at the grass root level and thus suffers more due to changes in the climate. Secondly, the government provides support during disasters but it doesn't reach all. A look at the above table suggests that the benefits of government support systems during a disaster have reached to only just only about fifty percent of the households, indication that the rest of about fifty percent has not gotten the benefits of these government support policies, thereby increasing their vulnerability.

If we look at the overall social capital vulnerability index it is clear from Table 2 that Bhaderwah is less vulnerable with 0.408 or 40.8 percent whereas the vulnerability index of Doda is 0.416 or 41.6 percent. The index values indicate that socially the people of this area are vulnerable and climate has quite an influence on the social aspect but this thing needs to be taken proper care of as in the future the index can rise resulting in an increase in vulnerability. One important aspect which needs much attention is the low participation rate of women in a social setup. Women are more closely associated with the basic aspects of rural livelihoods and thus their participation in decision making can help in providing better results w.r.t livelihood. It will help in decreasing vulnerability and also helps in improving livelihood.

As far as financial capital vulnerability is concerned, the Bhaderwah is having index value of 0.430 or 43 percent whereas Doda is having index value of 0.466 or 46.6 percent. The overall financial capital vulnerability index for the whole district i.e. sample area is 0.448 or 44.8 percent indicating that the district is moderately vulnerable in terms of financial capital. Thus what is required is an urgent need to tackle financial capital otherwise this vulnerability which is moderate and will continue to rise up leading to an increase in financial problems for the rural people which will have a more severe impact because of climate change. Financial stability will make adaptation more effective and in absence of this stability the adaptation tends to be less effective. Less finance will further limit the option of rural households to diversify their livelihoods. In order to diversify livelihoods, they will further have to take loans or borrow money thereby increasing their debt which will ultimately lead to an increase in the financial capital vulnerability index.

7. Livelihood Vulnerability Index

After calculating the vulnerability index of each component and sub-components and also showing the vulnerability radar diagram, the final thing left is to calculate the overall LVI. Overall LVI can be calculated by first Livelihood vulnerability of both blocks and then averaging the LVI of both blocks, which will give the LVI of the whole study area as given below:

$$\text{LVI of Doda} = \frac{\text{HCVI} + \text{NCVI} + \text{PCVI} + \text{SCVI} + \text{FCVI}}{5}$$

$$\text{LVI of Doda} = \frac{0.397 + 0.385 + 0.386 + 0.417 + 0.466}{5}$$

$$\text{LVI of Doda} = 0.413$$

$$\text{LVI of Bhaderwah} = \frac{\text{HCVI} + \text{NCVI} + \text{PCVI} + \text{SCVI} + \text{FCVI}}{5}$$

$$\text{LVI of Bhaderwah} = \frac{0.374 + 0.369 + 0.465 + 0.402 + 0.430}{5}$$

$$\text{LVI of Bhaderwah} = 0.408$$

$$\text{Overall LVI} = \frac{\text{LVI (Doda)} + \text{LVI (Bhaderwah)}}{2}$$

$$\text{Overall LVI} = \frac{0.413 + 0.408}{2}$$

$$\text{LVI of study area} = 0.411$$

Thus the overall LVI for the whole area is 0.411 or 41.1 percent indicating moderate vulnerability. Thus it can be concluded from the index that the vulnerability is still moderate and below fifty percent but if it is not properly looking into the vulnerability can increase and thereby making the conditions of rural households tougher.

A general analysis shows that there is not much difference as far as the vulnerability index of both the blocks is concerned, the vulnerability index is almost similar but a closer look into the various sub-components reveals that there are certain components whose vulnerability index is high and if not looked into they can have a severe repercussion on the livelihood options of the rural households. For the study area as a whole, the component which requires serious attention includes health, climatic variability, schools, social networking and finance. All have high vulnerability indexes and if no immediate action is taken, it can result in problems as far as rural livelihood is concerned. It doesn't mean that other components are to be ignored but the components mentioned above need more and immediate action. Secondly, the component of climatic variability is something which requires a deeper look as both blocks show high values in terms of climatic variability with Doda 0.564 and Bhaderwah 0.492 indicating that there has been a change in climate over the period of time. In fact, during the discussion, households agreed on the fact that over the past few decades there has been a noticeable change in the pattern of climate and especially during the last two decades the change is more pronounced. It is not far that these data will go higher and vulnerability will increase in the future resulting in tougher and hostile conditions for rural households which will cause a severe impact on livelihood options of rural households and thus make their survival a tough and challenging task.

8. Conclusions

This paper has tried to test the relevance of the LVI to understand the vulnerability of local households to climate variables. The indicators that have been used are very relevant and important in the calculation of livelihood vulnerability in the given study area. The study has given an in-depth analysis of factors contributing to vulnerability and their main reasons. The LVI for household vulnerability analysis which is built around these indicators is a very powerful tool for understanding the diversity of vulnerability. This study has revealed general as well as specific factors which contribute to various components of vulnerability i.e.; exposure, sensitivity and adaptive capacity and can be instrumental in reducing vulnerability and enhancing adaptive capacity. Furthermore, consultation with different groups has brought out the fact that various asset categories are being impacted by climate change and thus there is an immediate need to address the issue, which requires identification of the areas which are being affected the most and thus work comprehensively to narrow the impacts in these areas by making better policies. Thus, what is required are strong measures so as to break the barriers of various factors causing vulnerability which can be done by policy intervention which aims at looking at various aspects of vulnerability like unpredictability and instability so that they can be tackled properly.

The policy implication which comes out of the research suggests policy measures which aims at reducing the sensitivity of households, improvement in the resilience power of society and in increasing the stability of households in order to address the problem of livelihood. Government intervention at the basis levels is required. There are scheme setups by the government to address issues related to rural livelihood but they don't yield results. The main reason is the lack of proper implementation because of the fact that the opinions of the households suffering due to climate change are not considered. If the government through their agents directly takes control of the various schemes and inducts into decision making those who are being affected, the results of these schemes will be much better and would lead to the

path of sustainable development.

Conflict of interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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