Building resilience to climate change– an alternative approach to reduce vulnerability of mountain communities[1]

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Abstract:

Mountain communities have long faced challenges from a range of social, economic, political and environmental factors and the threat from these factors have only intensified due to the current climate change scenario. Climate change in fact has accentuated or reinforced existing vulnerabilities of the mountain communities by reducing their resilience to change. The work presented here is a case study from a mountain state located in the Indian Eastern Himalaya. The region is inhabited by a multitude of ethnic minorities, tribes and clans whose dependence on natural resources, including water, magnifies the risk they face due to climate change. An in-depth study was undertaken to understand the underlying factors behind weak resilience which exacerbate their vulnerabilities to any natural hazard. The study emphasizes on reducing vulnerability of the rural community by building their resilience to any unforeseen events. Increased resilience means increased resources and adaptive capacity that a community can utilize to overcome the problems that may result from change. It strengthens the inherent capacities of a community, rather than only relying on external interventions to overcome vulnerabilities.

Key words: Resilience, poverty, climate change, vulnerability

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1. Introduction

Mountain communities have long faced challenges from a range of social, economic, political and environmental factors and the threat from these factors have only intensified due to the current climate change scenario. The impact of climate change can be much greater for mountain communities, living in the more remote and ecologically fragile zones and relying directly on their immediate environments for subsistence and livelihood (UNFCCC, 2004). Climate change in fact has accentuated or reinforced existing vulnerabilities of the mountain communities by reducing their resilience to change, making it very difficult for the local communities to bounce back from ever-changing, inconsistent impact of climate change. Many have been forced to sell livestock or remove children from school, as this is the only way that could cope with the change which further increases the cycle of vulnerability. Hence climate change poses a serious threat on the poor and their livelihood. In such a background, enhancing their resilience could be an appropriate productive adaptive response to reduce their vulnerability to any natural disaster or extreme event due to climate change.

Although traditionally resilience means, the capacity of a system to 'bounce back' to its original form and structure, but in this study we define resilience as the capacity of the community to be able quickly adapt to the changes caused by an unforeseen event. It is about strengthening the inherent capacities of a community, so that they do not have to rely solely on external interventions to overcome vulnerabilities. Hence, going by this definition, enhancing resilience would mean enhancing the capacity of the community to adapt by reducing their vulnerability. This means that to enhance resilience it is necessary to have a good initial understanding of what the determinants of vulnerability and resilience are. The focus of this study was to assess the

degree of social vulnerability of rural mountain communities to the impact of climate change on water resources. An in-depth study was undertaken to understand the underlying factors behind weak resilience which exacerbate their vulnerabilities to climate change and water scarcity.

2. Vulnerability, Resilience and Climate change

The conceptual framework that has been developed in this paper revolves around the interlinkages between poverty, vulnerability and resilience. There is a strong linkage between the capacity to adapt and the baseline exposure and resilience to stresses that people posses. The paper discusses how climate change accentuates the baseline vulnerability of rural community thus reducing their capacity to absorb stress. If people have high resilience to stress then their capacity to adapt to any external stress will be high and to a large extent they will be able to bounce back to their original form or can successfully adapt to the changed circumstances without any external support. Hence interventions have to be planned keeping in mind the level of vulnerability and resilience to stress people possess. It is a well understood fact that poor are vulnerable and are less resilient to stress.

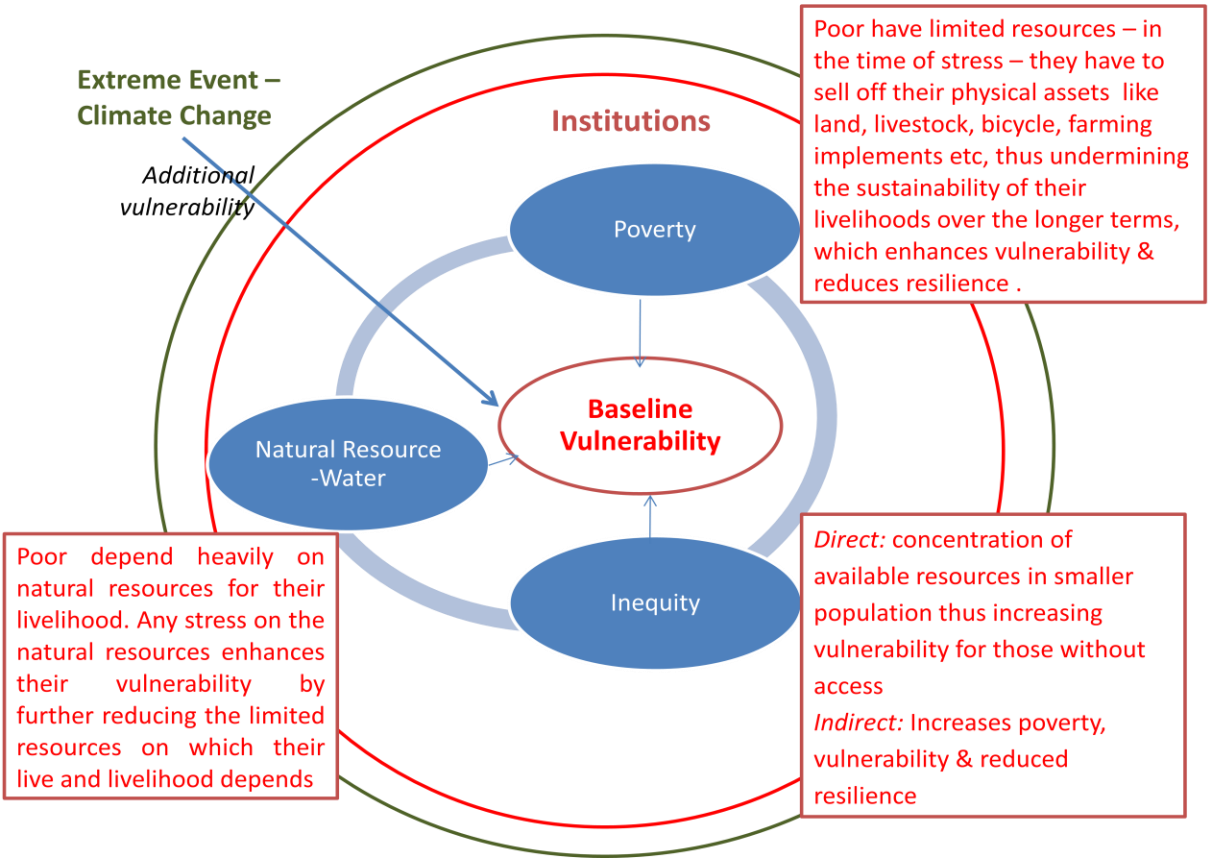

Figure 1: Link between vulnerability, institutions & climate change

Figure 1 above explains the underlying factors behind their vulnerability, the role of institutions and additional vulnerability superimposed by climate change. It shows how poverty, inequity and excessive dependence on climate sensitive sectors for livelihood (e.g. agriculture, livestock, and fishing) increase the vulnerability of the rural community. Inequity has both direct and indirect relationship with vulnerability. Inequity increases vulnerability of those who have limited resources and due to access to limited resources, inequity also increases poverty. Hence the existing baseline vulnerability has made the poor community highly sensitive to any change and their vulnerability is further accentuated by extreme events like climate change by jeopardizing

the limited resources on which their lives and livelihood depends. Institutions[2] play an important role here. Institutions can enable or constraint adaptation depending upon how responsive, adaptive and effective they are. Institution is kept outside the circle of baseline vulnerability because a responsive institution can help reducing vulnerability by reducing poverty, inequity and also by increasing livelihood option for the community. But it is kept inside the extreme event circle because even institutions have to adapt to changing conditions posed by extreme events.

Here a clarification is needed regarding vulnerability. Vulnerability could be physical and socio economic vulnerability. While physical vulnerability describes the state of exposure of a region to natural disaster which is determined by the bio physical characteristics like the topography, location, environmental conditions, land cover and other physical characteristic of the region, socio – economic vulnerability is primarily focused on the political, economic and social conditions that make human societies susceptible to damage from environmental stress (Vincent, 2004; Adger & Kelly, 1999a; Cutter, 1995; Liverman, 2001). Here vulnerability is not only a function of the physical characteristics of climate events, but more importantly an inherent property of a society determined by factors such as poverty, inequality, gender patterns, access to health care and housing etc (Books, 2003). Hence the impact of climate change on a particular region is determined by both physical and socio-economic vulnerability also called social vulnerability. Mountain ecosystems are considered vulnerable because they are exposed to both physical as well as social vulnerability.

[2] By institutions, in this study we specifically refer to those government organizations who are responsible to help poor in reducing their vulnerability through appropriate interventions

Resilience can be understood as capacity to absorb stress or destructive forces through resistance or adaptation, the capacity to manage, or maintain certain basic functions and structures, during disastrous events, the capacity to recover or 'bounce back' after an event (Twigg, 2007). In everyday usage, 'capacity' and 'coping capacity' often mean the same as 'resilience" However, it is important to understand that 'Resilience' is generally seen as a broader concept than 'capacity' because it goes beyond the specific behavior, strategies and measures for risk reduction and management that are normally understood as capacities. Resilience has therefore much broader definition than capacity. It has been defined as (1) the amount of change that a system can undergo while still maintaining the same controls on structure and function; (2) the system's ability to self-organize; and (3) the degree to which the system is capable of learning and adaptation (Carpenter & et.al, 2008). Subsequent work, both on ecosystems and societies, has identified the potential for multiple equilibria and the possibility of successfully adapting to changed circumstances by developing a new state. Thus, resilience includes both an element of recovery and an element of change. It is this latter definition that this study adopts.

Hence, going by this definition of resilience, enhancing resilience would mean enhancing the capacity of the community by reducing their baseline vulnerability so that they can adapt to climate change or any unforeseen event. However, to develop resilience we need to know the nature of community vulnerability (who and what are vulnerable, what stresses, what way and why) and what capacity exists to cope with change. Only once this is assessed, the lack of resilience of community to changes could be understood. This means that to enhance resilience it is necessary to have a good initial understanding of what the determinants of vulnerability and resilience are.

In this paper the focus has been on the social vulnerability of the community to climate change as it would reveal community's ability to prevent or cope with the impact of natural disaster and that will enable to frame appropriate strategies to enhance the resilience of the community to these unforeseen natural disasters. While looking at the socio- economic vulnerability, poverty has been kept at the centre of the discussion as the study considers poverty as an important indicator of community's vulnerability to climate extremes and climate change, as discussed above. But it is important to understand here that poverty itself is a multidimensional issue as there are number factors which lead to poverty – limited livelihood options, poor health, poor education, weak institutions, poor market access etc. Therefore to break the vicious circle of poverty (see figure 1 above), to reduce vulnerability and to enhance community's resilience to deal with climate change impacts, it is important to address the issues of poverty with a multidimensional lens. Hence in this study, a multidimensional poverty assessment tool (MPAT)[3] has been used to assess the underlying factors behind vulnerability with special focus on poverty, based on which suggestions have been made to enhance the resilience of the rural community in the study region to withstand climate hazards.

3. A case study from Indian Eastern Himalaya

3.1 Study region

Sikkim is located in the Eastern Himalaya of India (Latitude: 27.3 N *Longitude: 88.3 E)* and it shares international boundary with Tibet, Bhutan and Nepal (see figure 2 below). It is geographically a small state as constitutes merely 0.22 per cent of the total geographical area of India. Sikkim is the main catchment area for the river Teesta (a lifeline of Sikkim, flowing for almost the entire length of the state). There are altogether 84 glaciers

[3] MPAT has been discussed in detail in section 3.2 under Methods.

covering an area of about 440 km^2 with the total extent of permanent snow fields being 251 km^2 (Space Application Centre, 2001)

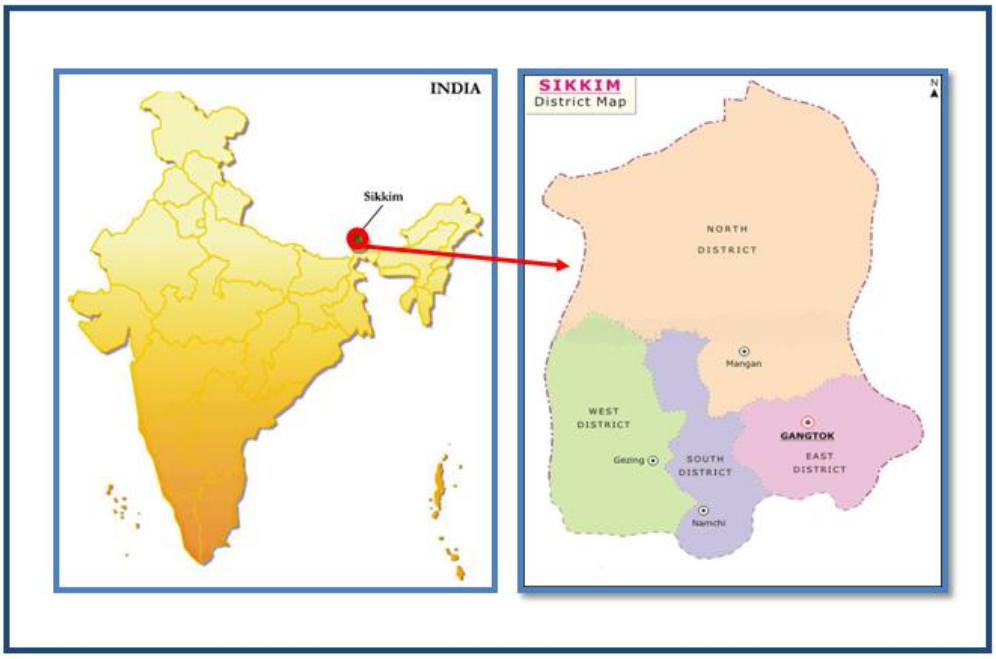

Figure 2: Map of India depicting the location of Sikkim

The total population of Sikkim as per 2011 census is 607,688, which is lowest among all Indian states and is scarcely populated with a density of 86 per Sq.km (against national average density of 382 per Sq. km). State's domestic product is Rs 1,442,900 ($27,216 approx), and its share in the GDP of India is just 0.08% (Lama, 2001). People in Sikkim are mainly employed in livelihood activities like agriculture, horticulture, tourism, & small scale industries. They mainly cultivate paddy (summer) and non-paddy (vegetable, maize, millet, cardamom, and ginger) crops. But agricultural productivity has remained stagnant, dependency on rain-fed agriculture remains high, shifting cultivation is still prevalent on a large scale, land holdings are small and dispersed and production technology is outdated in most parts (Lama, 2001).

Although a very few scientific studies have been conducted to analyze the pattern of climate change in Sikkim, mainly due to lack of climate data, but a recent analysis undertaken by Metrological Department of Sikkim reveals that between 1958-2005, there had been a change in the climate of Sikkim. As stated by the Director of the Meteorology Centre, Sikkim, the maximum temperature has been rising at a rate of 0.2^{o} C per decade, minimum temperature has been falling by 0.3^{o} C per decade and the annual rainfall has been increasing at the rate of 49.6mm per decade (Khawas, 2010). Rainfall in the region has become torrential and number of rainy days has come down.

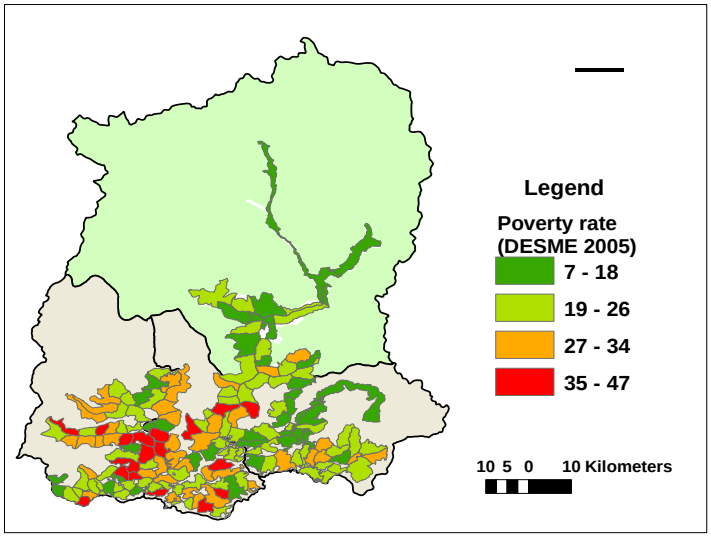

Figure 3: Rate of poverty in districts of Sikkim (2004-2005)
Source: Rural Development and Management Department, Govt. of Sikkim

The local authorities in Sikkim see change in rainfall pattern a big challenge in a region where 90 % of its population resides in the rural area and more than 75% depends on rain-fed farming as their main source of livelihood. Sikkim also faces acute poverty, with around 40% of people living below poverty line. The poverty rate within Sikkim varies from 7 % to 47% (see figure 3 above). Rate of poverty is higher in the South and West districts of Sikkim whereas the North

and the East district are comparatively better off. Main contributing factor to such high poverty rate in South and West Sikkim, as seen by local authorities, is due to water scarcity.

Rainfall pattern varies across the four districts of Sikkim. South and West districts receive comparatively less rainfall throughout the year. Eight drought prone blocks (a rural area earmarked for administration and development in India) across the four districts in Sikkim have been identified by the Rural Management and Development Department (*hereafter* RMDD), Government of Sikkim, as in figure 4. Five out of these eight blocks are located in South District making the district most drought-prone and water scarce in the state. Within these blocks the regions highlighted in red as shown in the figure 5, are the area with acute water shortage (70-100% households without access to water in winter).

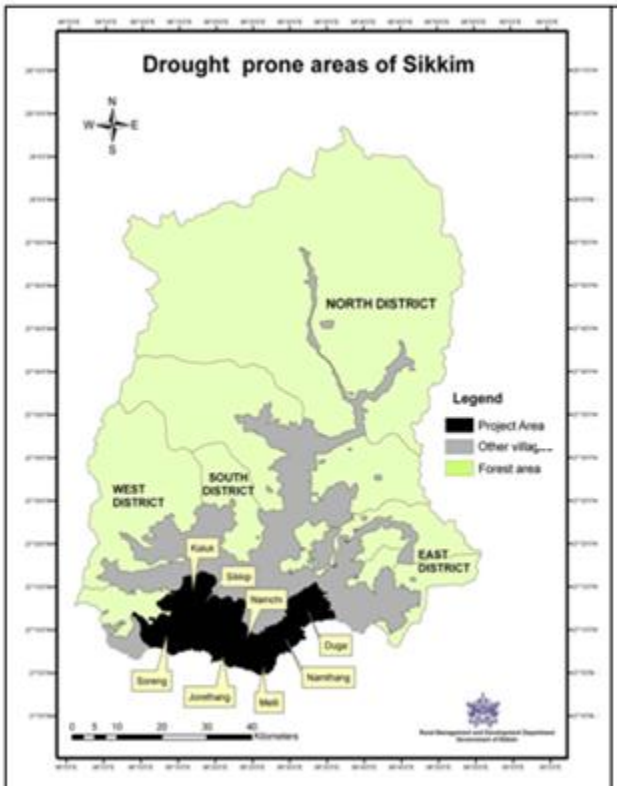

Figure 4: Drought prone areas of Sikkim

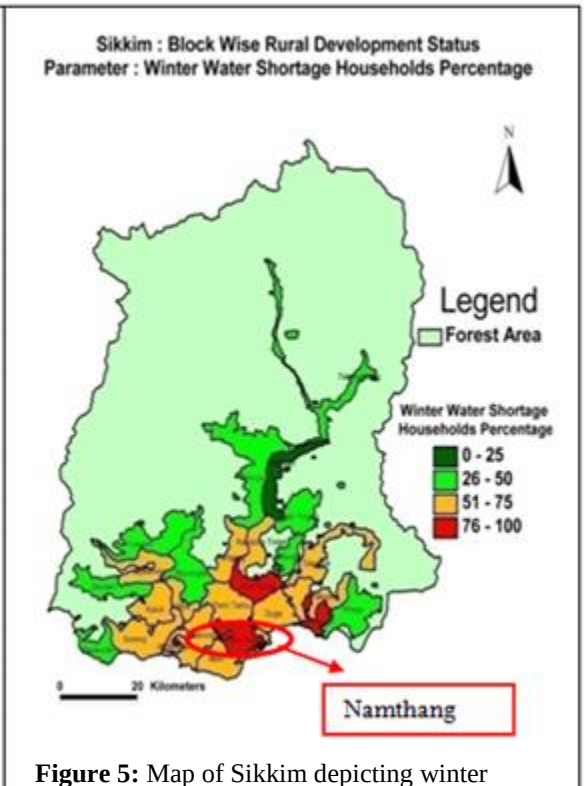

Figure 5: Map of Sikkim depicting winter water shortage households

Source: Rural Management and Development Department, Government of Sikkim

One such block is Namthang block which is located in South Sikkim, which was selected to conduct the field survey. The Namthang Block is 5817 ha in area, which comprises of 7 Gram Panchayats[4], 2,752 households comprising a total population of nearly 16,000. Namthang block was selected for the following reasons:

- It is a drought prone block and with continued climate change the rainfall patterns in this region have become erratic, monsoons are usually late and in general torrential rainfall has replaced the monsoon drizzle which has resulted in drying up of springs, making them seasonal.
- Rural households in the block depends on spring water for both domestic and as well as for livelihood related activities (agriculture, livestock rearing,) with no alternative sources of income and due to climate variability leading to further scarcity of water, there is a threat on the livelihoods of the rural households.
- Incidence of high level of poverty with poverty rate as high as 35%
- The average annual rainfall in Namthang block is only 1,370 mm which is substantially less (54%) than the state average of 2,534 mm (shown in figure 6 below)

[4] Gram Panchayats (GPU): Gram panchayats are local self-governments at the village or small town level in India

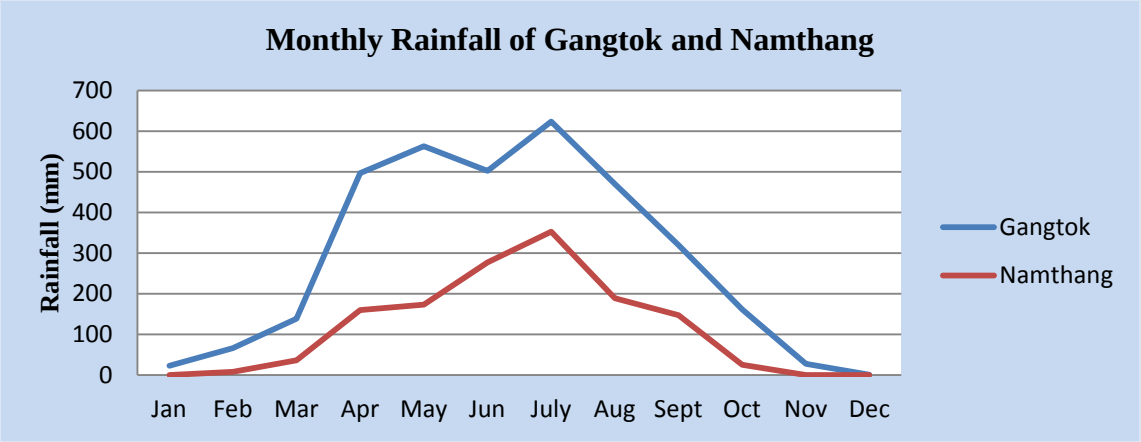

Figure 6: Comparative rainfall (in mm): Namthang, South Sikkim compared to Gangtok in 2004

(Source: *Meteorology Department, Gangtok, Sikkim*)

The local officials feel that the main reason of poverty in Namthang is acute water crises. They fear that with increasing scarcity of water due to climate change, the water based livelihood of the rural people will be threatened; this would further increase poverty in the region. To overcome the problem of water shortage, a large number of physical interventions (like roof top rain water harvesting, terraced field drainage trenches to increase the percolation of rain water for recharge of ground water, spring water storage tanks) have been undertaken by the state and the local authorities. Local authorities are also providing jobs to the people in the region through Mahatma Gandhi National Rural Employment Guarantee Act **(**MG-NREGA). This act aims at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage employment in a financial year to rural household whose adult workers volunteers to do unskilled manual work. In fact, Sikkim is the only State in India, who got a national award, for exemplary work done under MG-NREGA (Outlook, 2011). However, it is worth mentioning here that the jobs created under MG-NREGA are mostly temporary in nature, are for short durations only and are mostly unskilled manual work. Such jobs therefore do not generate a permanent or long term employment opportunity among the villagers nor thus does it help them

in developing any kind of skill. The local authority along with RMDD has been focusing mainly on increasing the availability of water to enhance livelihood (mainly agriculture). Very little effort has been made to improve the other sectors of the block, e.g education, health care, roads and communications etc., which are needed not only for the overall development of the region but also for productive usage of water. Interestingly, what the local authorities have failed to realize is that there is a physical scarcity of water in Namthang block as it falls in the rain shadow area of Darjeeling Himalaya (mountainous area on the North Western side of the state of West Bengal in India) and so it receives less rainfall throughout the year. The average annual rainfall in Namthang block is only 1,370 mm which is substantially less (54%) than the state average of 2,534 mm (Rural Management and Development Department, 2010). There is almost no rainfall in the winter months of November to March. Although, the situation has aggravated due to changing climate leading to fall in the number of rainy days, but for the rural people in Namthang scarcity of water is not a new problem as they realize that it is a drought prone area and therefore conservation has become one of the characteristics of the region.

Infact, there is a traditional belief that water comes out from the place where goddess dwells and this belief help them protect the springs as they consider it as a holy place. In many of the places fro where the spring starts they have built temples where people offer their prayers. This has also helped in in keeping the spring free from pollution as they feel that polluting the river would hurt the goddess. People consider the springs to be a community property and that no one has ownership over it. Therefore, inspite being a water scarce region there is no water conflict in the region so far. These religious and cultural beliefs of people have helped them in protecting the springs and live in harmony.

Located in a water scarce region and also due to small land holding, agriculture was never a viable option of livelihood for the rural community residing in Namthang. But because of limited skills and livelihood options available in the region, agriculture seemed to be the only choice left for them. Hence, to what extent, the water centric interventions as proposed by the state and the local authorities will be beneficial in reducing poverty of the rural community in the region is extremely doubtful. The water poverty linkage in the region seems to be far more complex and therefore an in-depth understanding is needed to know the nature and the causes of poverty in the study region in order to lift them out of poverty.

3.2 Methodology

3.2 Methods

A field study was conducted in Namthang block through focus group discussions (FGDs), key informant interviews (KIIs), household surveys, direct observations and walk-throughs. Semi-structured checklists were designed to administer the FGDs and KIIs. Likewise, a structured questionnaire was developed to administer the household survey of a representative sample of 130 households primarily belonging to below poverty status (selected from 953 households which are identified as below poverty line households), and are either small / marginal farmers or daily wage earners. But the framework used in the questionnaires and the checklist was based on the ten components of MPAT[5]. The main purpose of undertaking the field study was to understand people's perception about water-poverty in the context of climate change and what kind of interventions they feel can increase their resilience and reduce poverty.

[5] Several modifications were made in MPAT to suit the local context, for instance instead of domestic water supply, water for all purposes was considered; food and nutrition security was assessed on the basis of the Recommended Dietary Allowance (RDA); the exposure and resilience to shock addresses only the climatic shocks and does not include the socio-economic shocks; and market access was added to the theme on non-farm.

MPAT is a thematic tool; therefore, the analysis of each of the ten themes / components is done individually without collating them into one value. The themes are not compared quantitatively as the analysis on such dynamic themes has to be done with caution and outcome could be misleading if not approached carefully. Hence, the themes were compared based on pair-wise comparison on a five point scale as shown in figure 7, where the households were asked to rank the components in terms of development required. Each component is compared with all the other components, as shown in figure 7, domestic water is strongly more important than the food and nutrition security. Same process was followed for comparison of the other pairs of components. Analytical Hierarchy Process (AHP) was used to assign weightage to each component. AHP is a multi-criteria decision making tool established by Saaty (2003) to conduct analysis on multiple aspects simultaneously. AHP involves four steps – pair-wise comparison; preparation of the comparison matrix; deriving the priority vector and lastly to calculate the consistency ratio.

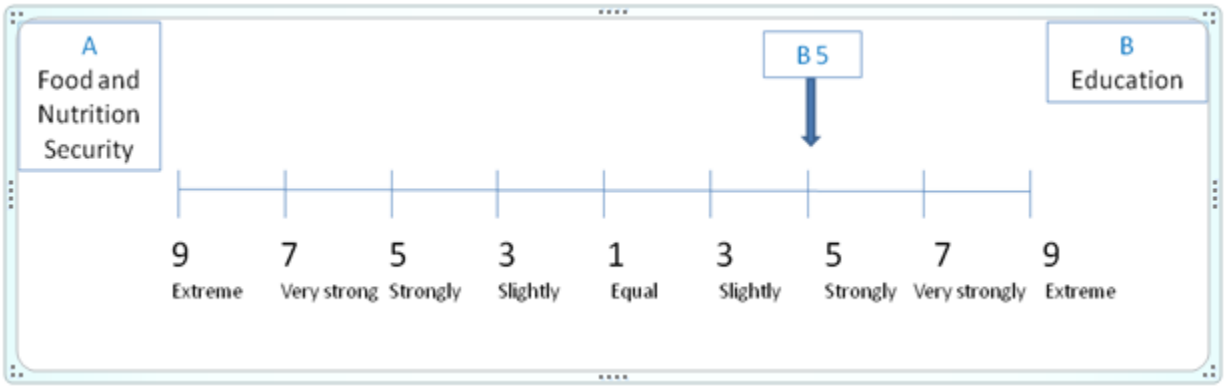

Figure 7: Scale used for conducting the pair-wise comparison (e.g. showing that the stakeholders feel education is strongly preferred over food and nutrition security for making interventions in the present context)

The responses on the relative preferences of indicators of the components from the households of the block which were outside the household survey sample were collected through FGDs and KIIs. Along with the primary data, block level secondary data were also collected so that information collected through the primary survey can be compared with the secondary data to make the analysis authentic and accurate. Following the process of AHP these were quantified and were used as relative weights. The weights were combined with the actual data collected through household surveys as per the methodology of MPAT (for details on MPAT refer to www.ifad.org/mpat/resources/userpdf). The results of the MPAT analysis were expressed as percentages where a relatively lower percentage reflected poor status of the block in that component or theme hence requiring relatively higher importance in future planning and development process.

3.3 Analysis

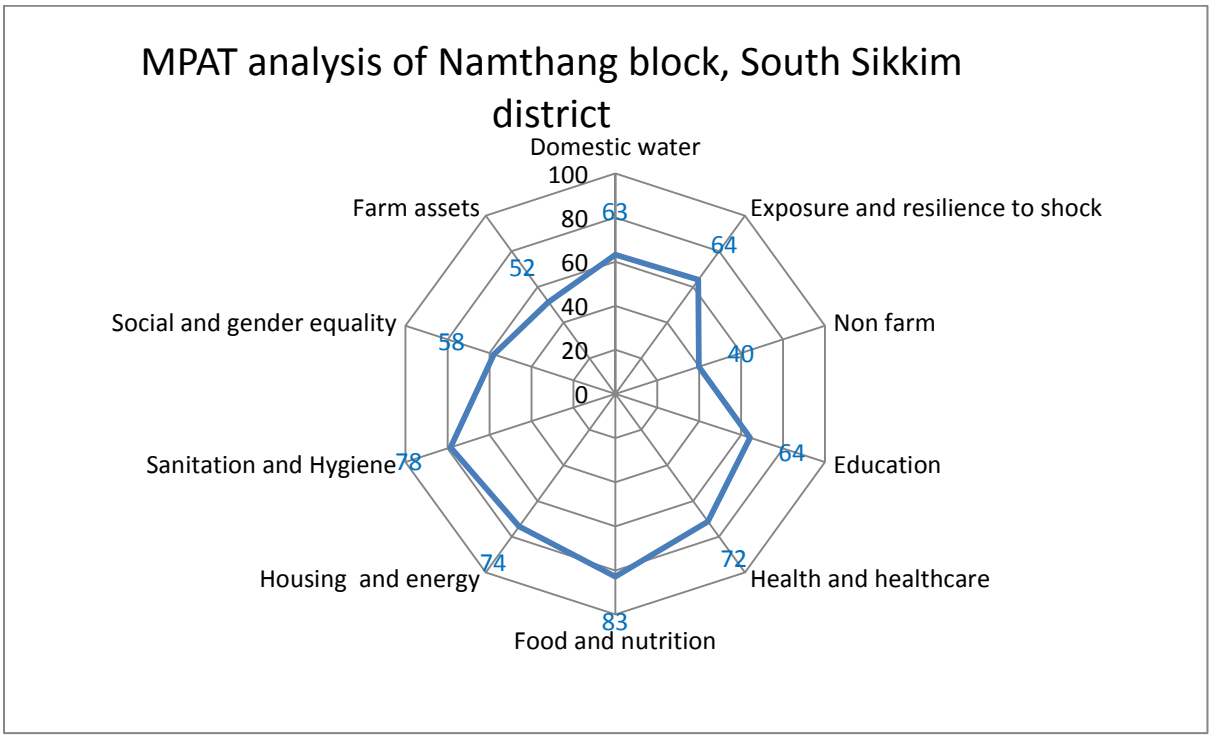

Figure 8: MPAT for Namthang Block

Figure 8 shows the status of each of the components which was derived from the primary data collected through household survey, KII and FGDs along with the block level secondary data as explained in the methodology. The ten themes of MPAT are classified in two categories which are ***fundamental needs*** and the ***rural assets, exposure and equality***. The relative preference for the intervention to be made for enhancing the fundamental needs and rural assets, exposure and equality is interspersed; the implication is that there is need for overall rural development with focus on the elements of ***fundamental needs*** and the ***rural assets, exposure and equality.*** The table below provides an analysis of the results based on their ranking of the each of the components under fundamental needs and rural assets, exposure and equality.

Components with thematic index value	**Fundamental Needs** *(Fundamental and basic needs required to be met first before addressing long-term goals)*	**Rural assets, exposure and equality** *(Beyond fundamental needs which often constraints rural people's ability to help themselves)*
Non Farm Assets (40%)		The block is performing worse or needs adequate attention is the non- farm component (40%). People in the block feel that, since there is a physical scarcity of water in the region, farming is not a viable option. Therefore development of the non-farm sector is essential as non- farm sector is relatively less vulnerable to climate change and will help in supplementing the household income which is at present

		mainly agriculture dependent. In the non-farm theme, poor access to market and low skill were pointed out as a major barrier.
Farm Assets (52%)		The next component that people perceive important for poverty alleviation and enhancing there resilience is farm assets. Although it is subsistence farming, people feel that it provides them food security as they consume what they grow. But people do not see farming as a main source of livelihood because other than scarcity of water, small landholding size, poor quality of the soil (acidic soils) and rocky and hilly terrain are the biggest hurdles in financially benefiting from farming.
Social and Gender Equity (58%)		There is a slight preference for males (40%) to go for higher education as compared to females (36%) and relatively higher percentage of males (75%) to seek treatment for illness than females (40%)[6]. In addition, there is a

[6] primary data analysis collected through household survey

		difference in the income levels of the various caste and religious categories. As the burden of ill impacts of climate change falls disproportionately on women and the poorer section of the population, the gender and social equality also need considerable attention for achieving 'growth with equality' in the block.
Water (63%)	Water did not seem to be the only concern of the people as it is ranked fourth among the other components. There are two most probable reasons to it. Firstly, RMDD has already made various provisions to enhance the availability storage and accessibility of water resources, and secondly, droughts and water scarcity in the region are a regular shock to the community due to its location.	
Education (64%)	Education in the district is poor due to inaccessibility of the educational institution and poor status of higher education. Poor socio-economic status	

	forces the people to discontinue education. Barely 21% of the people above the age of 16 in the villages have acquired higher education (comprising higher secondary, graduation and others); out of which 60% are males and 40% are females[7].The quality of education is a concern as the youth are facing difficulties in securing remunerative non-farm livelihood opportunities and uplifting the family from the poverty trap.	
Exposure and Resilience to shock (64%)		Education and exposure and resilience to shock were given equal importance by the stakeholders. Natural disasters like earthquakes, droughts, and landslides aggravate poverty and vulnerability of the poor thereby reducing the recovery ability. People felt that it requires continuous attention. They consider that resilience to extreme event as most important and they feel that the measures taken by the local community

[7] primary data analysis collected through household survey

		and the government needs to be strengthened in this regard. As per the discussions, the people felt that at present they have limited resources (financial assets, small land holdings; low diversification of income sources, poor human capital, skill etc) to even cope with the initial impacts of climate change hazards.
Health and Health care (72%)	The healthcare as stated by the stakeholders, suffers in the block due to poor accessibility, affordability and quality of treatment hence needing attention. Although overall, health component reflect good status but access to healthcare seems to be a major issue, which is due to hilly terrain and poor transportation facility connecting villages to the healthcare centers and quality of treatment is poor as doctors are not available when treatment is needed	
Housing and Energy (74%)	A high index value for this component indicates that people feel that it requires	

	lesser emphasis compared to the other components. The housing structure is appropriate to suit the high seismic activity in Sikkim; for instance, the roof top is semi permanent in nature and causes less damage when earthquake strikes. The prime sources of fuel used for cooking is LPG, for heating they use wood and all the villages in the block have electricity	
Sanitation and hygiene (78%)	Sikkim is completely open defecation free and is the first state in India to have acquired the status as per the monitoring and evaluation of the Total Sanitation Campaign (TSC)8 of Government of India. However, the availability of the toilet facility does not necessitate the regular usage of the toilet. The focus group discussion revealed that, some people do not use the toilet facility regularly due to various reasons like poor maintenance, odour, discomfort, inconvenience which can be eliminated by awareness and	

[8] TSC is a comprehensive programme to ensure sanitation facilities in rural areas with the aim of making the villages free of open defecation

	behavioral changes.	
Food and Nutrition (83%)	The food and nutrition security component captured both the quality and the quantity aspects of food. Among all the themes, this is theme where the block is performing the best. One of the reasons could be due to small land holding although farming is subsistence in nature, but it provides them with sufficient food for their own consumption. However, there is a scope of further improvement in terms of diversifying the food choices and also integrating the appropriate amount of fruits, which is culturally not consumed and is usually not affordable.	

Table 1 Analysis of the ten themes of MPAT

The above analysis reveals that the challenge as seen by the people in the region is not only water scarcity; there are lists of other challenges which need attention too. Some of the challenges are not related to water scarcity at all like equity, access to health care, education, non farm sector etc. Strengthening of these additional components is very important if the purpose is to make the community resilient to change.

Although there is scope of improvement, but the fundamental needs of the people in the regions seem to be in a better status compared to rural assets, exposure and equality**.** The most crucial finding of this study was the need to create a demand driven livelihood opportunities in the non-farm sector which have potential market linkages to ensure a sustainable income. This is mainly because people do not see farming as a viable option, even if water is made available to them for factors discussed above. However, there are various additional barriers in acquiring non-farm assets in the villages, such as lack of skills, education, access to information, and capacity to undertake risks, which are usually the feature of all agriculture based systems (Namara et al., 2010). Investment in these components is essential in the block to develop the non farm sector, or else there is a possibility that people, particularly youth, may leave the village and move to nearby towns and cities in pursuit of better economic opportunities. Sikkim being a small state, Gangtok (capital of Sikkim) is the only major urban sector, which is already overcrowded and local authorities are under tremendous pressure to provide basic amenities like shelter and water to all. Hence such rural – urban migration will further worsen the situation in the state. Development of non farm sector will create employment opportunities in the region and will also arrest the rural urban migration.

Even though, people did not consider investment in farm assets as productive investment it is crucial to maintain agriculture to meet the basic requirement of food and nutrition, maintain good health and keep a check on the food prices in the region. Improvement in the access to water is crucial as it is an indispensable input in agriculture, reliable access to it encourages farmers to use complementary inputs to increase farm income and alleviate poverty (Namara et al., 2010).

Therefore, RMDD's intervention on water resource development is definitely necessary but the fear is such investments only in agriculture water management may aggravate inequality benefitting those who have relatively larger land holding size. In the block larger section of the households either owns small cultivable land or is landless laborers and may not benefit as much from this intervention as diversifying the income source by being engaged in non-farm livelihood activities. Therefore, creating new opportunities for rural poverty reduction and economic growth requires a broad approach to rural development, which includes the rural non-farm economy as well as agriculture (International Fund for Agricultural Development, 2010).

Adequate attention needs to be given to develop the rural markets and infrastructure. Existing roads are of poor quality, and the block gets often disconnected to the other parts of the state as the roads are not passable in bad weather. Due to small land holding sizes, poor quality of land, poor access to market, even if land is irrigated or intensively cultivated, cannot support levels of consumption above extreme poverty without other sources of income. Poor access to market also prevented the rural households from adopting diverse livelihood strategies like agro-processing, trading and other off-farm occupations. Infact, rural poor people often say that one reason they cannot improve their living standards is that they face difficulties in accessing markets. Since farming is not able to provide sufficient income to the households to keep them out of poverty, investments in other interventions such as education and access to markets are needed to enhance nonfarm earnings in the region. However, this requires a shift in the focus from water centric to poverty centric interventions.

One of the advantages of such an elaborate framework (MPAT) is that it enables a holistic understanding of the underlying factors behind poverty, so that appropriate interventions can be prioritized, planned and monitored which will reduce poverty as well as enhance resilience. Rural poverty results from lack of assets, limited economic opportunities and poor education and capabilities, as well as disadvantages rooted in social and political inequalities (IFAD, 2010). Hence, as discussed earlier, there is a strong linkage between water and poverty in rural context and it exists in the study site too, but it is a complex relationship and therefore interventions need to be broad in its focus so that there could be an overall development of the region. The findings of this study have been shared with the Rural Management and Development Department (RMDD) of Sikkim. This study has been an attempt to bridge the communication gap between RMDD and the rural households and we hope RMDD will be able to take adequate step in the future to increase their resilience by shifting the focus of the interventions from water to interventions which will lead to overall socio-economic development and eradication of rural poverty along with water resources development. This is more important in the present context as Government of Sikkim is implementing "Mission Poverty Free Sikkim – 2013" to eradicate poverty in Sikkim and to achieve the Millennium Development Goals ahead of the global deadline of 2015.

4. Conclusion

For any climate change research it is very important to identify the factors which reduce resilience of the community and enhance their vulnerability by increasing their exposure. A shift in research focus from climate to society brings in all kinds of non-climate issues. Poverty is one such dynamic issue. As this study highlights that apart from physical exposure, exposure of the people in the study region has been increased due to their poor socio- economic conditions,

which are non - climatic. Resilience as discussed in the beginning refers to the capacity (ability) to absorb (withstand) disturbances (for example climate change and its impacts) while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change. This is possible only when the indicators of increasing resilience – better access to education, market access, alternative sources of income (non- farm) – are also enhanced since there is a direct link between these indicators and poverty. Once poverty is eradicated it will build resilience of the community to climate change and increased resilience will facilitate adaptation by reducing vulnerability of communities from unforeseen natural disasters.

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