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ORIGINAL ARTICLE

Local perceptions of and responses to climate change: experiences from the natural resource-dependent communities in India

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Abstract India is considerably vulnerable in the events of climate change impacts. Vulnerability and adaptive capacity among the population varies quite a lot in a country like India. This paper investigated local communities' perceptions of and responses to the impacts of climate change on their livelihoods. The study employed village-level participatory qualitative research methods in three geo-cultural zones of the Indian states of Madhya Pradesh, Chhattisgarh, and Odisha. It revealed that the local communities in those places had already visualized the impacts of climate change on their livelihoods and surrounding natural resources. Their observations corresponded to the broader scientific projections of the impacts of climate change in India. The study found that the local communities had started to adapt with the changing climate by altering their livelihoods and cultural practices. The study recommends urgent need of identifying the vulnerable communities in India and assessing their vulnerability from different perspectives that climate change might expose in the future. It also recommends implementing the present pro-poor policies of the government in an effective way to improve the socio-economic conditions of the poor and vulnerable communities in the country.

Keywords Climate change · Community perceptions · Vulnerability · India

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Introduction

People from the developing countries are often considered more vulnerable to the impacts of climate change than from the developed countries (Tol et al. 2004; Mendelsohn et al. 2006; UN-DESA 2009) as they are directly reliant on natural resources to meet their basic needs and at the same time, they have the fewest resources to cope with climate-related disasters (UNDP 2009). In India (22.00°N and 77.00°W), for example, ecological and socio-economic systems are already under extreme pressure due to rapid urbanization and industrialization processes (Greenpeace 2009). Vast regions within the country are still underdeveloped, and local people, particularly the marginalized natural resource-dependent communities, are considerably vulnerable to the potential impacts of climate change. Vulnerability has different forms, and it has been defined in various ways (see Few 2003; Füssel 2007; Hinkel 2011). Among them, the ability to withstand shocks and stresses to livelihoods is considered the most significant in the context of climate change (Adger 2000; Sokona and Denton 2001; Beg et al. 2002; Metz et al. 2002; Thomas and Twyman 2005).

About 68% of the population in India is involved in the agricultural sector. Forestry is the second largest land-use sector in the country after agriculture, and an estimated 275 million people in rural areas depend on forests for at least part of their livelihoods (World Bank 2006). Forests in India have been experiencing tremendous socio-economic pressures, and climate change will be an additional stress on the forest ecosystems and forest-dependent communities (Ravindranath et al. 2006). In addition to agriculture and forestry, about a million people depend on fisheries for their livelihoods and

women constitute a large portion of that labor force (FAO/World Fish Centre 2008). Fisherfolk largely depend for their livelihoods on natural resources whose distribution and productivity are also known to be influenced by climate dynamics (Allison et al. 2005). Climate change is also an issue of social justice particularly in the developing countries (Prasad and Kochher 2009). The rapid economic growth over the last two decades has not been able to bear its fruits in all parts of India, and the benefits seem to have bypassed the overwhelming majority of the population (NCEUS 2007). Recent development trends in India do not appear to be inclusive. People who are poor and dependent on agriculture, forests, and fisheries for their livelihoods are often vulnerable to any socio-economic changes due to natural and man-made disasters.

Socio-ecological systems cannot be adequately understood relying on science alone as these systems are so complex that adequate modeling is very difficult with such large uncertainties (Berkes 2002; Kloprogge and Van der Sluijs 2006; Laidler 2006; Van Aalst et al. 2008). In this context, local knowledge can promote better understanding of climate change and its impacts (Byg and Salick 2009). Documenting local communities' perceptions of climate change is also important from a policy point of view since such perceptions reflect local concerns, focus on the actual impacts of climate change on people's lives, influence people's decisions to act, and suggest what adaptive measures should be taken (Berkes and Jolly 2001; Danielsen et al. 2005; Laidler 2006; Alessa et al. 2008). Therefore, local observations and perceptions need to be taken into account in efforts to understand climate change, its impacts, adaptation to it, and mitigation of it (Byg and Salick 2009).

On this pretext, this study aimed to explore community perceptions and understanding of climate crisis that emerged from the knowledge, culture, and heritage of the indigenous communities in three states of India, viz., Madhya Pradesh, Chhattisgarh, and Odisha. In these three states, more than half of the rural population is still living under abject poverty, not able to meet their necessities of food, health, and education (TOI 2009). The study aimed to capture the views of the indigenous people who still have strong faith on their knowledge to address this climate crisis. The paper is organized as follows: "Methodology" section presents the methodology (community level exercises) applied to analyze community perceptions of climate change and its impacts on their livelihoods and surrounding natural resources; "Results" section consists of the results from those community level participatory exercises; and "Discussion" section contains discussions and concludes with recommendations.

Methodology

Study area

The fieldwork for the study was conducted by the staff of Ekta Parishad (a non-profit organization) in the villages of three geo-cultural zones of the Indian states of Madhya Pradesh (23.17°N 77.21°E), Chhattisgarh (21.27°N 81.60°E), and Odisha (20.15°N 85.50°E). Data generated for this study were part of a bigger project by Ekta Parishad on preparing "community charter on climate crises". The villages were selected from each of the three geo-cultural zones based on their accessibility, variability in livelihoods practices, and their experiences with ecological and socio-economic crises. The selected villages were Badgmarwe and Ghoda from the Narmada River Valley geo-cultural zone in Madhya Pradesh; Sajatola, Majgaon, Chuhinala, Rajarani, and Machapani from the Baigachak geo-cultural zone in Chhattisgarh; and Gabkund and Moto from the Chilka Lake geo-cultural zone in Odisha. The local people of the villages in the Narmada River Valley geo-cultural zone and the Baigachak geo-cultural zone depend on agriculture and forests for their livelihoods while the villagers in the Chilka Lake geo-cultural zone depend on fishing from the nearby Chilka Lake. The study was conducted during the summer of 2009. In the following, we provide with an overview of the three geo-cultural zones in the context of the present study.

Narmada River Valley geo-cultural zone

The two villages Badgmarwe and Ghoda are in the Narmada River Valley, which is a geo-cultural zone inhabited by the two primitive tribes[1] called Bhil and Bhilala. The area is very rich in biodiversity and natural wealth. However, after construction of two large dam projects, the villages in this zone have been facing various ecological and socio-economic changes. The biggest change came in the forms of forceful displacement of tribal communities, and then gradual depletion of their resource base. They also lost their traditional agricultural practices through which they used to grow food crops, fodder, and cotton for cash earnings. The construction of the dam also severely destroyed the social fabric of those villages as the rate of migration has been constantly increasing every year. Since then, the self-reliance of those agriculture-dependent communities has been facing crisis of change as most of

[1] In India, certain communities are suffering from extreme social and economic backwardness like untouchability, primitive agri-practices, lack of infrastructural facilities, and geographical isolation, and they need special consideration for safeguarding their interests. These communities were notified as Scheduled Tribes as per provision of the Article 342 (1) of the Constitution of India.

the land converted into dry land and productivity level decreased alarmingly.

Baigachak geo-cultural zone

The primitive tribe called "Baiga" inhabits the villages selected in this geo-cultural zone. The Baigachak is in the District of Kavardha of the State of Chhattisgarh. The area is extremely rich in biodiversity and natural wealth. This is one of the most forested areas in the state with 65% of the area is under forest cover and famous for Bauxite (aluminum ore) deposit in about 2,000 km^2 area. Shifting cultivation in this region is a tradition. The area is also famous for Tiger Reserves and a Wild Life Sanctuary. This has given rise to serious problem of eviction of the Baiga community. In addition, bauxite mining in Baigachak has turned out to be a battleground for the survival of the Baiga communities in the recent years.

Chilka Lake geo-cultural zone

Fishing communities inhabit the two villages (Gabkund and Moto) in the Chilka Lake geo-cultural zone. The Chilka Lake is in the District of Puri of the State of Odisha. The area is very rich in biodiversity particularly the marine flora and fauna. This is one of the richest areas in aquatic resources in the country. Historically this area is famous for ancient culture of Giant Tiger Prawn (*Penaeus monodon*) and Indian white shrimp (*Fenneropenaeus indicus*). The Chilka Lake is a world heritage site with Asia's biggest brackish-water lagoon that spreads over 1,165 km^2. However, after the disastrous plan of the Chilka Development Authority for opening an "artificial sea mouth," the natural balance between the salt and sweet water became completely spoiled and that man-made disaster affected the livelihoods of a large number of fisherfolk.

Data collection

The study applied the tools and techniques of the Participatory Rural Appraisal (PRA) method to collect data. The application of the PRA method has been found in various studies on exploring perceptions of rural communities on environmental issues that affect their lives (see Binns et al. 1997; Percy 1999; Cramb et al. 2004; Brown 2006; Humphrey et al. Humphrey and Kimberly 2007). According to Pretty (1994), "PRA initially meant an activity in which the research process was owned and initiated by the community itself, rather than by an outside organization". However, Theis and Grady (1991) defined PRA as "an intensive, systematic, but semi-structured learning experience carried out in a community by a multidisciplinary team including community members". Nevertheless, PRA enables local people to share, enhance, and analyze their knowledge of life and conditions, to plan and to act accordingly (see Webber and Ison 1995; Loader and Amartya 1999). PRA utilizes specific tools and techniques to gather information about and learn from rural people (Chambers 1990, 1994). In this study, PRA was applied to explore local communities' perceptions of the ecological and socio-economic changes under changing climatic conditions in the above-mentioned three geo-cultural zones. The PRA tools that proved most useful for the study were problem tree analysis, resource mapping, crop diversity analysis, and matrix scoring. Details of these tools and techniques have been presented in the following discussions.

PRA tools and techniques used in the study

Problem tree exercise According to Chambers (1992), "the intention of PRAs generally is not to identify or formulate problems, but rather to stimulate community awareness". The problem tree exercise was of key importance in this study. Based on the perceptions of the local communities, it aimed to explore the impacts of climate change on natural resources and socio-economic conditions. In addition, it also attempted to find out probable causes of those impacts as perceived by the local communities. In other words, this exercise was carried out with an aim to understand that the local communities in the study sites had already visualized and perceived changing climatic conditions. It was conducted in all the three geo-cultural zones. Mostly the old people and especially the women participated in this exercise. At the end of this exercise, a list was prepared elaborating the impacts of climate change that the local communities had perceived. Afterward this information was disseminated among the local communities to understand their consensus with the results. The field-workers carried out community level sensitization processes before conducting this exercise as it helped in building relationship and trust with the local communities. Active listening and focused group discussions with the community members were part of this exercise.

Resource mapping Resource maps are used to identify natural and other resources to have an overview of the socio-economic, geographic, and infrastructural conditions of a community (Song et al. 2006). Resource mapping can also be useful as an effective ice-breaking exercise as well as a tool to investigate the knowledge of the people about their own locality, their resources, and their spatial distribution (Gadre et al. 2011). In this study, senior community leaders of the villages led the resource-mapping exercises. They plotted their forgotten past and community wealth on a map. This was perhaps the most interesting exercise for them. The main idea of this exercise was not to develop an

accurate map of the resources but to explore the community perceptions of the changes in natural resources, human health, environmental, and social conditions.

Crop diversity analysis The analysis of crop diversity gave an insight into the species availability and cultivation practices done by the communities in a year. In this study, villagers in the Narmada River Valley and Baigachak geo-cultural zones performed the agricultural crop diversity analysis while the villagers in the Chilka Lake geo-cultural zone carried out the analysis of fish diversity. Senior women leaders of these villages led this process.

Matrix scoring This exercise took place only in the villages under the Narmada River Valley and Baigachak geo-cultural zones. Young members of those villages projected the balancing attitudes of their communities after they experienced changes in the climate. The elderly women and men actively participated in the discussions. They shared their own traditional practices to the younger generations. The participating members prepared a list of crops that they used to grow and scored the crops from 1 to 10 for different value categories, that is, food value, reserved food value, medicinal value, and social purposes. Finally, the participants prepared the ranking of crops based on their significant role in their life and social needs. This exercise showed how the rural communities in those places started their adaptation process in response to the changing climatic conditions.

PRA process followed in the study

Identification of the focus issues This step was required to investigate the opinions, knowledge, attitudes, and experiences of the local communities toward various environmental changes in their areas. At this stage, literature review, community analysis, and discussions were carried out. This stage strongly supported the idea of this study and helped to conceptualize the entire process.

Site selection Three distinct geo-cultural zones were selected from the three states of India. The selected villages and the communities represented the natural resource-dependent communities particularly of those three states and the country in general (see "Study area" for details).

Selection of local facilitators After selection of the villages, local facilitators were selected from those villages. During the selection of the local facilitators, the following criteria were considered: capacity for reading and writing, ability to develop good relation and effective communication with the participants, ability to be sensitive to the feelings of individuals and groups, and be acceptable to the local communities.

Workshop for facilitators After the selection of the facilitators, a village-level 2-day workshop was organized in each of the three geo-cultural zones. The facilitators were trained in the PRA tools and techniques. They were explained about different aspects of the PRA process, particularly about the benefits of PRA. Following the workshops, different PRA teams were formed to carry out the PRA exercises in the study sites. Each team comprised of a PRA team leader, local facilitators, and a community leader.

Conducting PRA exercises The PRA teams visited the selected villages on a pre-confirmed date and time suitable for the villagers. The PRA teams conducted the PRA exercises with the spontaneous participation of the villagers. The local facilitators created an open and interactive environment. There were about 20–30 participants from different social classes in the communities including male, female, young, and old. In each village, the purpose, method, and necessity of the PRA exercises were shared in details with the local participants to solicit their involvement and ownership of the entire process. The exercise was essentially conducted in a common place so that everyone had access to participate, respond, and take initiatives through community discussions. The community leaders and local facilitators had freedom to direct the process with the consensus of the participants according to their own understanding and priorities.

Analysis of the findings The extracted PRA information and data were processed and analyzed for further interpretations.

Results

Findings from the problem tree exercise

Women, with a strong understanding of how the patterns of agriculture, forest resources, and fishing had changed over the years and how in turn those changes affected their livelihoods, guided the problem tree exercises in the three geo-cultural zones. This process elaborated the local communities' perceptions of the impacts of climate change on the natural resources and their livelihoods, and the root causes of all those impacts (Table 1). It came out that the local communities had already perceived the impacts of climate change in the forms of increasing temperature, decreasing rainfall, increasing cyclones and storms in the coastal areas, depletion of water table, drying up of rivers, spreading of diseases among people and livestock, and reducing wildlife and forest resources. According to the perceptions of the local communities, deforestation

Table 1 Local perceptions of climate change impacts in three geo-cultural zones

Perceptions of climate change impacts		
Narmada River Valley geo-cultural zone	Baigachak is geo-cultural zone	Chilka Lake geo-cultural zone
Downfall in water table, less and uneven rainfall, temperature increase, less forest products, less moisture in soil for agriculture, lesser cold, more hot winds, increased migration, more soil erosion	Downfall in water table, less and uneven rainfall, temperature increase, shortage in food availability, less forest produce, less moisture in soil for agriculture, less earth worms in paddy fields, less wildlife and birds and fishes, more diseases among human beings, lesser cold, more hot winds, shortage of medicinal plants and herbs, loss of traditional knowledge and practice, more soil erosion	Increase in temperature, more thunder storms, more cyclone, increasing soil erosion, decreasing production of prawn farming, decrease in aquatic biodiversity, increasing siltation in Chilka, decrease in number of migratory birds, uneven rainfall

appeared as an important factor in jeopardizing the livelihoods crisis in all the three geo-cultural zones along with other climatic factors such as decreasing rainfall and increasing temperature. In one aspect, this exercise revealed that the local communities held climate change as responsible for the present crisis of livelihoods and diminishing natural resources. The other aspect revealed from the exercise is that the communities, to some extent, also perceived recent man-made activities such as mining, building dams, and coastal area development as responsible for depleting natural resources and affecting their livelihoods. Impacts of these factors were perceived by the local communities in the forms of increasing migration to cities for search of livelihoods, reducing access to forests for collecting fruits and mushrooms, increasing competition for land for agriculture, increase in diseases affecting their daily labor works, disappearance of fishes due to increasing pollution in the Chilka Lake from commercial prawn farming, and increasing crime and violence.

Findings from the resource-mapping exercise

Senior community members from the villages led the resource-mapping exercises in the three geo-cultural zones. Both old and young people from the local communities participated in this exercise. The villages under the Narmada River Valley and Baigachak geo-cultural zones were re-established second and third times, respectively. The resource-mapping exercises in these two geo-cultural zones showed how their earlier practices of livelihoods and availability of natural resources gradually deteriorated over the time due to both climatic changes and man-made actions. For example, before 1980, the villagers under the Narmada River Valley geo-cultural zone used to practice shifting cultivation to produce variety of vegetables and were dependent on forest resources for their daily livelihoods. They also experienced sufficient water availability throughout the year in rivers and rivulets, which ensured irrigation and drinking water for them. However, when the Narmada River Valley dam project started in the 1980s, the government officials evicted the villagers from their earlier settlements. The villagers lost their traditional practices of livelihoods, and after migrating to new places, they started experiencing trouble in agriculture due to shortage of land. Their hardships compounded due to lack of access to forests for collecting mushrooms and other forest products, which were once essential for their livelihoods. The villagers in both these geo-cultural zones informed their experiences with the changing climate in the local areas such as increase in temperature, shorter period of winter, erratic rainfall, depleting water table, minimal soil moisture, less flowering and fruiting in forest, loss of bird and wildlife, increase in disease and disorders in human beings, and social disaggregation. In the Chilka Lake geo-cultural zone, the villagers decided to draw two maps to show how they had lost their past wealth of biodiversity as the results of climatic changes within a period of 40 years (Table 2).

Results from the crop diversity analysis

Villagers in the Narmada River Valley and Baigachak geo-cultural zones performed their traditional agricultural crop diversity analysis (see Table 3 as an example) while the villagers from the Chilka Lake conducted the analysis of fish diversity. Local communities in the Narmada River Valley and Baigachak geo-cultural zones traditionally practiced agriculture depending on the water availability in the nearby lakes and rivers and during the rainy season when temperature was not so high. The villagers explained that under the changing climatic conditions, they were no longer able to continue their traditional agricultural practices. They have been forced to grow only few crops such as maize, millet, cotton, paddy, and groundnut. This resulted into a crisis of food availability. Due to an increase in temperature and water shortage, they have been experiencing very limited options, since there is no irrigation facility and rivulets have mostly dried down. Similar findings emerged in the villages under the Chilka Lake

Table 2 Perspectives of climate changes in the Chilka Lake geo-cultural zone

Observations	40 years back from 2009	After 1990
Rainfall	Average 4 months in a year	Erratic rainfall for 1 month only
Temperature	Sufficient winter	Shorter winter
Flora and fauna	About 710 species found	Only about 366 species survive
Migratory birds	More than 5,000 in numbers	Decreased by 70%
Thunder storm	Occasionally and less casualties	17 people died in the last 10 years

Table 3 The traditional agricultural practice in the earlier times and its present situation in the Narmada River Valley geo-cultural zone

Month	Crops	Cultural practices before 1990	Present practices and crops availability
January–February		Intercultural operations	
February–March		Threshing	
March–April		Field preparation	
April–May	Cotton	Sowing (if irrigation is available)	
May–June			
June–July	Maize, millet, moong, chickpeas, groundnut, cotton, chili, tomato, turmeric, cabbage, watermelon	Sowing (mixed cropping)	Sowing (mixed cropping) of maize, millet, moong, groundnut
July–August	Paddy	Sowing/intercultural operations	
August–September		Intercultural operations	
September–October			
October–November		Harvesting	Harvesting
November–December	Spinach, fenugreek, carrot	Sowing/threshing kharif crops	
December–January	Wheat, gram	Sowing/intercultural operations	

geo-cultural zone where the villagers experienced gradual diminishing of fish populations, and many of the fish species had already become either extinct or endangered.

Matrix scoring findings

This exercise from the villages under the Narmada River Valley and Baigachak geo-cultural zones revealed to some extent the community responses to climate change. In both the places, the communities informed that after the recent implementation of the Forest Rights Act of India (2008),[2] some of them had received land entitlement and started re-establishing their traditional agricultural practices. They have also recently started growing crops that they expect would give better performance even in the changing climatic conditions. Since the overall rainfall has become drastically low, the senior community members have decided to educate their young generations for sowing crops, which would be drought resistant such as maize, millet, and gram. In Baigachak, the villagers have introduced a variety of rice, which could be grown in very low soil moisture condition and harvested within a period of only 60 days.

Discussion

The study used participatory methods to examine local communities' perceptions of the impacts of climate change in the three geo-cultural zones of Madhya Pradesh, Chhattisgarh, and Odisha. In addition, the study showed how the local communities had perceived various man-made activities affecting their socio-cultural and economic practices. The findings from the study indicate that the present climate crisis is not only bringing new survival challenges but also amplifying the existing livelihoods challenges of the poor and marginalized communities in India. The revelations through this study to some extent represent the climate-induced vulnerability of India's majority of the population who rely on agriculture and other natural resources for their livelihoods.

Among the different PRA tools and techniques applied in the study, the problem tree exercise revealed the community perceptions of the impacts of climate change and their root causes. It helped to understand that the local

[2] The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, recognizes the rights of forest-dwelling Scheduled Tribes and other traditional forest dwellers over the forest areas inhabited by them and provides a framework for according the same (MoEF 2006).

communities in the study sites had already visualized the impacts of climate change both on their surrounding natural resources and on their socio-economic conditions. The local communities perceived deforestation as the common cause affecting their livelihoods. According to their perceptions, deforestation had not only reduced the access and availability of forest products, it had also affected the rainfall that in turn affected the agricultural activities in those villages. Although the impact of deforestation on reduced rainfall is still an open question, a model-based study by Gupta et al. (2005) showed deforestation as the cause of reduced rainfall in many parts of India and Western Africa. Recently, Garcia-Carreras and Parker (2011) also showed that changing land-use from forest cover to cropland has reduced rainfall by 50% in many places of West Africa.

The climatic changes as experienced by the local communities in this study broadly correspond to the scientific projections of the impacts of climate change in India (see O' Brien et al. 2004; Ravindranath et al. 2006; IPCC 2007; Boomiraj et al. 2010). The study has been able to reveal two important aspects. One aspect shows that much of the present vulnerabilities of those local communities have links with the historic socio-economic changes that took place in their settlements due to various developmental projects. The other aspect shows that since those communities were already worse off due to those historic changes, the present climatic conditions are escalating their already vulnerable conditions rapidly. The study also explored that the local communities in those villages started migrating to the nearby cities in search of their livelihoods. This rate can increase in the future, as the impacts of climate change will be felt strongly at the local levels in various parts of the country. In this context, developing suitable adaptation strategies for the vulnerable communities (especially children, women, and old) and providing them adequate social protection are major challenges to the policy makers and scientific communities in India.

One of the important characteristics of the poor and vulnerable communities in India is that they have limited opportunities to expand their employment and enhance their earning capacity; therefore, any program for a sustained improvement of the well-being of these people will have to focus on how to expand their employment opportunities (NCEUS 2009). Adapting to climate change will have to be a central component of any comprehensive and inclusive climate agenda (UN-DESA 2009). Therefore, the adaptation to the future climate change may need to be based on two strategies in a country like India. One strategy is to develop adaptation capacity among the poor and vulnerable communities in the country, which might alter their way of living and traditional practices. The other strategy is to enhance their employment opportunities with adequate social securities that can help them to survive in the event of future climate-induced disasters. Previous studies have indicated that adaptive capacity does not only depend on ecological and technical developments alone, but also on social norms, values, rules, class, gender, health, social status, ethnicity, and cultural practices (Adger et al. 2007; Nielsen and Reenberg 2010).

In India, there are about 106,000 Joint Forest Management Committees (JFMC) managing 22 million ha of forestland (Pai and Dutta 2006). JFM is considered as a non-market community-based institution, which follows the philosophy of forest conservation and livelihoods improvement through cooperation between state and civil society (Bhattacharya et al. 2010). This inbuilt strength of the JFMCs might be important in the future to develop community-based adaptation mechanisms in India. There is also an urgent need to develop adaptation strategies for the fishing communities in India. However, there is a general lack of research in this direction in India. Future attempts to reduce vulnerability of the fisherfolk in the country can follow the broad-based actions suggested by Badjeck et al. (2009), such as risk reduction and transfer initiatives, understanding livelihood strategies to inform planned adaptation, and exploring opportunities brought by climate change and mitigation strategies such as financing through REDD[3] for which mangrove conservation is eligible.

Although the present study has been able to explore the vulnerability of the natural resource-dependent communities due to climate change in the three site-specific cases in India, it suffers from some inbuilt limitations in participatory qualitative research. Scientists are often skeptical about the observations made by lay people (see Berkes 2002). Local communities often tend to romanticize their past (Byg and Salick 2009). In this study, reflections of a better past in terms of environment and socio-economic conditions compared with the present depressive situation also emerged from the discussions with the local communities. Therefore, all these observations need further verifications. The PRA tools in this study generated purely qualitative data and therefore, their statistical analyses were not possible. It would have been of relevance if the study explored the perceptions and attitudes of the local communities to climate change and their adaptation strategies through questionnaires or other similar tools. It could have given the possibility to apply relevant statistical

[3] Reducing emissions from deforestation and forest degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (UN-REDD 2011).

measures to explore if there were significant differences among the communities in their perceptions and attitudes related to climate change and their adaptation preferences. A mixed-method of research would have been useful in this respect.

Conclusion

The study has presented climate change perspectives of the natural resource-dependent communities from nine villages in three geo-cultural zones of India. It has argued that community level adaptation strategies will be important to reduce the vulnerability of those communities from the future impacts of climate change. There is an urgent need for identifying the vulnerable communities in India and assess their vulnerability from different perspectives that climate change might expose in the future. In addition to the climate change–related adaptation strategies, the study strongly recommends developing and implementing governmental pro-poor policies in an effective way so that they could have far-reaching impacts on enhancing the socio-economic conditions of the poor in the country. It also recommends for further studies to reveal broader climate change perspectives of the local communities and developing suitable adaptation strategies for them in India. Therefore, any generalization of the findings from this study must be interpreted with caution.

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