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Rural Farmers in a Changing Climate: Performative Integrated Adaptation Practices in Outer Terai of Nepal

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Abstract

This paper assesses how rural farmers in the Terai region of Nepal have experienced climate change and what strategies are adapted to mitigate the effects of climate change on agriculture and livelihoods. The farmers experienced climate change effects in the form of warming temperatures, loss of agro-biodiversity, decline in agricultural yields and upsurge in diseases that exerted negativities on agriculture and livelihoods. Endorsing collective experience and cultural frameworks, farmers have developed integrated adaptation strategies, updated indigenous practices, and diversified agricultural practices by conversion of farming period, application of alternative crops, hybrid farming, dairy cooperatives and micro-credit. The performative integrative adaptive practices entrenched in environmental anthropology envisioned on indigenous environmental knowledge, assessments, and cultural responses mediated the interactions with nature and shape the ways in which farmers observe, understand, experience and respond to climate change. It is imperative to recognize a locally applicable, temporally and spatially adaptive, culturally adaptive experiential model that is shaped into integrated implementation practices in climate change policies to develop cost-effective, participatory, sustainable and effective adaptation strategies in agriculture and livelihood.

Keywords: Ethnographic, self-help groups, folk epistemology of climate, rain forecasters

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Background

As a deviation from normal climate condition, climate change is believed to be directly or indirectly caused by human actions that change the composition of the global atmosphere and add to natural variability. Human-caused global climate change or anthropogenic climate change, in contrast to natural climate change, represents not only changes in temperature but also in precipitation, humidity, haze and wind. According to NAPA (2010), geophysical and socioeconomic conditions, fragile ecosystems and global warming have left Nepal under constant threat of destruction related to the diversity of biodiversity, ecology and infrastructure. The warming is continuous and the maximum temperature rise is at an annual rate of 0.04-0.060C. Kates (2000) argues that due to limited capacity to cope with climate change-related hazards, Nepal remains more sensitive to climate change impacts. Aase et al. (2009) assert that climate change generates a great impact on rainwater dependent subsistence farmers. It affects agriculture with a direct impact on food production and livelihoods due to natural climate cycles and human activities.

The fertile plains of the Ganges make Terai (23% of Nepal's total fertile land area) a place of agricultural surplus to supply the less productive hills/mountains of Nepal. "Climate Change Impact, Adaptation and Vulnerabilities" (IPCC) Report 2007 has noted that in recent decades, Terai has experienced the worst climate change with severe droughts, severe and recurrent floods and landslides. Manandhar et al. (2011) demonstrate that due to dependence on natural resources and subsistence agriculture, the impact of climate change on the people of Terai is severe. Rural farmers in eastern Terai have observed a more intense and frequent flood, severe cold spells and the extinction of agro-biodiversity and the advent of vector-borne diseases. Aase et al. (2009) stated that the lack of rain in 2009 reduced crop yields by up to 30-50 in Terai that has threatened the food production.

Food production is central to human life hence anthropology has an interest in agriculture and climatic effects on agricultural practices and farmers' livelihood that relates environmentally, socially, politically and culturally. The prime reason accountable for anthropological interests in climate change research is the irrevocable transformations that climate change is bringing to people and places traditionally studied by anthropologists (Boko et al. 2007). Climate change researchers brought notice to anthropology's unique offerings – the agency of ethnographic and participatory methods to decipher the cognitive and cultural landscape in which farmers' understanding of climate and climate information is grounded and the

decision-making processes and environment which shape farmers' adaptation strategies (Roncoli 2006). One major contribution of anthropologists to climate change research includes the documentation of how place-based peoples observe, perceive, and respond to the local effects of global climate change (Krupnik & Jolly 2002). Despite the increase in anthropological literature (Strauss & Orlove 2003), the specific methods and praxis on climate change studies remain indistinct. Considering both the exceptional exigency and the new level of reflexivity that climate change ushers in, now anthropologists are seeking to adopt cross-scale, multi-stakeholder, and interdisciplinary approaches in research and practice revealing problems relating the specifics and multilayered complexities of local human experience to the generalities and abstractions of measurement in the global.

From a climate science perspective, localizing is the process of downscaling global climate models to specific locations, taking into account local perceptions of risk, experience, and vulnerability, adaptability and inability of top-down approaches to address the concerns of local farmers' livelihood security. However, in the absence of state-sponsored locally suitable adaptation plan, Terai farmers are coping autonomously to the changing climate with their available resources and sociocultural knowledge. Backwardness, resource mismanagement and high reliance on subsistence agriculture have limited the ability of Terai farmers to adapt to climate change. Barlett et al. (2010) argue that policymakers and resource managers should draft and implement adaptation plans, and for making the plan effective, it is crucial to gain a comprehensive understanding of the local institutions involved in adaptation process.

More important for sustainable adaptation to climate change is to empower the local people, organize and prioritize local efforts using local resources, arranging adaptation by themselves for the vulnerabilities. However, identifying and addressing risks, experiences, and adaptation strategies to climate change at local level in rural agriculture, biodiversity and livelihoods has not yet been fully documented sufficiently and also not well cherished and promoted by governmental and non-governmental agencies in Nepal. Given this, the objective of this paper is to assess how rural farmers in Terai have experienced climate change, the sensitivities encountered, and strategies adapted at the indigenous level to respond to climate change to reduce the impact of climate change on agriculture and livelihoods.

Data and Methods

Methodologically, the study takes a qualitative approach. Fieldwork took place in Jamuni village a part of *Badhaiyataal Gaupalika* (Rural municipality) in Bardiya district on the outskirts of Terai in province 5 in west-central Nepal. Inspired by the philosophical principles of hermeneutic tradition of analysis of works and objects as part of cultural values of contemporary society, the study uses qualitative descriptive study design in which rain water dependent farmers were selected for the study. At the first step, a list of households was made to identify eligible respondents (Household heads over 65 years old) among households that mainly depend on rainwater-based agriculture, and 620 household heads (386 men and 234 women) were considered eligible. Of these, according to purposive random sample, 145 heads of households (82 men and 63 women), one each of the 145 households, were selected for the study on the ground that as elderly farmers they are the main decision makers in the family and has a good experience of climate change and its impact. Their ethnic composition is assorted with migrant hill origin *Pahadiya* farmers' predominant population of 71%, followed by Terai ancestry *Madhesi* and indigenous *Tharu* population 29%. Only 34% household heads are simply literate and are able to read but unable to write properly.

Open-ended survey questions were used for collecting information from 145 household heads on the impacts of climate change on biodiversity, agricultural production, livelihoods and adaptation strategies and supplementing ethnic information. Additional qualitative data was collected through interviews, observations and case studies of these 145 household heads personal experiences, assessments, and responses to climate change. The field study was carried out during an arduous field study period from October 16 to November 5, 2019.

Agriculture, Livelihood and Climate Change Nexus

Bardiya district was part of Nepal before it was ceded to the British East India Company by the Treaty of Sugauli in 1816. In the mid-19th century, Bardiya was handed back to Nepal (Paudyal 2013). Before 1950, Bardiya was covered by a dense forest with a sparse indigenous population of Tharu. The district is mostly sub-tropical with summer temperatures of 40 degrees Celsius. Due to climate change, the average maximum annual temperature has changed in the district with an increasing trend, causing additional difficulties in livelihoods (AEPC 2014).

The study area Jamuni village is a backward rural settlement of Bardiya district. The total population of this village is 11,539 (Male 5,073 / Female 6,466) in 2,601

households. The median household size is 4.44 and the literary rate of the village is 61.4%. Farming is the main occupation of 1925 (74%) households in Jamuni (DDP, 2017). The average educational attainment is 9th grade and has a multi-ethnic composition including migrant hill ancestry *Pahadiya* (Chhetri 24%, Brahmin 18%, Ethnic or Janajati 14%, Low caste hill Dalit 15%), *Madhesi* Yadav 19%, and indigenous *Tharu* 10%. Pahadiya Brahmin-Chhetri, Dalit and Janajati owned land on average 1 *Bigha* (equivalent to 6772.63 m^2) per household and Madhesi and Tharu 0.4 Bigha. Flood victim people of hill ancestry from different parts of Nepal were resettled here as a part of the Resettlement Project in 1970-71.

Reimbursement of the hill people, deforestation, construction of houses and population growth have led to a serious ecological imbalance in Jamuni rural settlement. The effects of climate change have been felt by a decrease in rainfall, the extinction of various plant and animal species, and a change in the nature of weather, humidity and temperature. The circumstantial pressures of climate change have affected conventional lifestyles; self-sufficiency efforts were more difficult, perceived and experienced in everyday life. Infrequent and erratic drops in rainfall, rising temperatures leading to droughts in the summer, and oddly low temperatures and cold spells in winter have affected agriculture and biodiversity. Farmers are constantly being hurt by water scarcity. Water resources are depleted with decreasing groundwater and river levels, and wetlands are becoming arid. The natural ecosystem and biodiversity have been affected severely affecting many local flora and fauna such as jute, cotton, sugarcane, bees and cranes, etc.

The frequency of summer storms has increased, causing damage to shelters and crops. Conventional rice and wheat have been replaced by new hybrid species. The significant reduction in the output of jute and sugarcane has caused economic losses and changed the agricultural model. Cotton was the main crop in the 1970s, but now the cultivation has been abandoned due to deteriorating soil quality. The yield of many crops tends to decrease continuously. Over the past 40 years, though the production of cabbage, maize and lentils has decreased; rice production has increased; thanks to the use of advanced fertilizers. Climate change triggered altering seasonal rainfall caused variation in agricultural production with complications in plantation and harvesting, threatening food security and livelihood requiring them to work harder to fulfill dietary needs.

Almost all 145 household head farmers claim that rising temperature is a result of deforestation and fading rainfall. The reduced rainfall has shortened the maturity

span of crops and the ripening of seeds. The emergence of new pests on crops and the decline of harvests often force farmers to make excessive use of fertilizers, chemicals, pesticides and insecticides. The taste of many varieties of crops has totally vanished. Recurrent drought has adversely affected the growth of delicious grass species. The slower regeneration of forage species and the scarcity of pastures have forced farmers to change their traditional farming methods. Traditional animal husbandry as a means of subsistence has decreased significantly. The appearance of dense fog in the region also forced farmers to give up grazing. Extremely cold winters and hot summers have threatened milk and meat production. The income from traditional livestock is decreasing. Not only is there a scarcity of pasture, but over the past 20 years, farmers have agonized from many new viruses and mass deaths of livestock due to rising temperatures. But, they did not get any support from government agricultural support center.

Cook (2012) confirmed that while climate change is not solely destructive, the negative impacts of global warming on agriculture and human health are even greater. The increase in temperature and the excessive use of chemical fertilizers and pesticides on crops have had serious consequences on human health in Jamuni. Tropical diseases and viruses are common in all seasons. Farmers noticed an increase in flies, mosquitoes, aphids, termites and experienced many health problems in the elderly and infants e.g. gastroenteritis, increased parasitic diseases caused by vectors transmission, malaria, Japanese encephalitis, viral flu, allergies, rashes and menstrual disorders. Foodborne illnesses had increased due to rising temperatures. Escalation of waterborne diseases and demand for additional water supplies has augmented the risk of using contaminated drinking water. A 70 years old respondent woman shares her experience:

> There were no serious problems of infectious diseases in the past, but now the increase in temperature has led to the emergence of infectious diseases in humans and livestock. It was not required to use a mosquito net, but now I use it even in the daytime. Medical costs are rising—a result of changing Mausam (climate).

Change in Agriculture and Livelihood in Response to Changing Climate

Indigenous communities in rural Nepal have used indigenous knowledge and practices to adapt to climatic and non-climatic changes (Helvetas 2011). Pelling (2011) argues that local communities around the world have shown adaptations of crop production

to mixed crop systems, farmers use breeding livestock for greater tolerance and productivity, use their indigenous knowledge for climate variability and mode of production. Ajani et al. (2013) describe indigenous adaptation strategies practiced in sub-Saharan Africa and the benefits of integrating indigenous knowledge into formal climate change adaptation strategies. By exploring challenges and opportunities to integrate, combine and supplement indigenous practice with modern scientific knowledge and technology, Karki and Adhikari (2015) argue that the integration of indigenous knowledge with modern knowledge for sustainable ecosystem conservation and management has been largely successful in Nepal.

With an integrated approach (indigenous and updated), Jamuni farmers followed two steps, first realizing the impact of climate change, then deciding to adopt a specific measure. The premises on which they make basic adaptive decisions are diverse and arise from direct stimuli from the environment, sociocultural position, and ideological sociocultural norms. Using their knowledge, they made assessment of what they knew about the overall meaning and perception of climate change and individual and collective responses. They experimented, used indigenous knowledge, methodsand experiences, improved on conventional techniques and applied integrated approaches to deal with the threat of climate change. They have developed the ability to adapt themselves to changes using limited technical and monetary methods. Though rural crofters with little knowledge of climate change adaptation techniques, they are aware and feel the impacts on agriculture and livelihoods and are striving to adapt. A 72 years old Madhesi respondent narrated his story:

> We use indigenous knowledge in two dimensions: Indigenous knowledge content, response strategies, tools/techniques; and the processes by which that knowledge is communicated and put into action, including social learning, knowledge sharing, and up-to-date feedback. The connection between indigenous scientific practice and reality (how we observe, interpret and construct knowledge from our interactions with the environment) and our culture in which we anchored, is inseparable. Adivasi (indigenous) and updated practices are our integrated strategy.

For the farmers, survival is a concern, adaptation is an interaction with nature regenerated through preferred practices that are socially construed and culturally/ pragmatically meaningful and built through coercive coping practices to support agricultural and livestock production for greater productivity. Their knowledge and skills of environment and its relationship to social systems are key elements in updated and revised adaptive culture, capacity and identity to deal with the effects of climate

change. Understanding the interaction of culture and climate, as well as the meticulous role of perceptions, knowledge and values as elements of the interaction, has led farmers to focus on adaptive responses. The technologies, environmental knowledge and climate adaptation adopted by Jamuni farmers are based on what Richards (1993) calls 'performative implementation knowledge', a skill inherent in ancestral experience, a competence rooted in farmers time-honored and place-based experience embedded with modernity rather than predefined in abstract principles.

Farmers' responses to climate change include an iterative succession of improvised strategy adjustments. Based on expectations of what the climate might be like, farmers take farming measures. In moderation, they acquire their behavior by scanning the environment in the weeks and months before the onset of rain, and continue to do so until they could plant trees, a process that depends on the combination of sensory understanding, accumulated experience, study skills and information communication. During normal rainy times, it is easy for farmers to keep track of their farming schedule by following their traditional agricultural schedule. However, during the delayed monsoon season, they modify the normal farming schedule and follow a new cultivation sequence by experimenting with modified planting and harvesting times, short-term hybrids innovation, diversify agriculture, drought and temperature tolerant crops, make efficient use of available water resources and grow a wide range of crops, thus reducing the risk of total crop failure.

Seed banks, savings and seed sharing among self-help groups are widespread. Along with the use of organic (dung) fertilizers, the use of complete NPK fertilizers (nitrogen and potassium) has increased. These adjustments aim to increase yields addressing existing climate conditions by drawing on farmers' agricultural knowledge and experience. They are also experimenting with social and agroforestry activities such as planting hybrid forage species and grass species. As part of the adaptation strategy, farmers have turned to improved hybrid livestock breeds. With a small number of crossbred cattle, no additional pasture is needed. Pet insurance is getting popularity. After the establishment of dairy cooperatives, selling milk has become a new business. These diverse adaptive practices are made on the basis of local cultural experience and skills.

By recognizing and acknowledging the power of the trajectory of change, farmers see alternative solutions that help them in their quest to understand how the world works. Savings and microcredit initiatives based on local experience have been

replicated and are aimed at protecting farmers from high interest rates of landlords. Farmers have invested credits in small businesses, raise goats and poultry, and manage agricultural inputs (seeds, tools, fertilizers, pesticides), etc. Modern beekeeping has become popular. These initiatives have helped reduce the risk of crop failure and shocks from extreme weather. With the decline of forest resources, farmers value locally processed briquettes (rice husk/dry manure mix) for fuel. Alternative technologies of Biogas, solar home systems and innovative stoves have been used to cope with the thinning of forests. Farmers are using local organics viz. mustard oil, organic *Neem* (Azadirachta indica) extract and a variety of local plants to control mosquitoes. All in all, climate change is an increasingly important issue in strengthening and changing the position of farmers, helping them better understand and adapt to climate change to manage it effectively for the betterment of self and society.

Indigenous Cultural Adaptation, Collectivism and Social Solidarity

There is fundamental tension in forecast dissemination between scientific forecasts and local climate prediction practices (Ajibade and Shokemi 2003; Pennesi 2007). While most anthropologists focus on the differences between traditional environmental knowledge and scientific knowledge, some research shows important points of congruence (Orlove, et al. 2002). Nabhan (2002) describes how indigenous inhabitants of the arid American Southwest and of northwestern Mexico note with delight that after rare rainstorms, the desert smells like rain. Body's senses and mental models are chief avenues through which farmers get to know their local weather in its particular manifestations e.g. rain, hail, snow, wind, and temperature. Orlove et al. (2010) exemplify that Ugandan farmers might see clouds in the sky and, based on their color and shape, know whether it will rain; they may feel the wind and, based on its direction or strength, recognize whether it will bring rain or chase it away; they may hear thunder and see lightning flashes on the horizon and, based on their orientation, predict whether the storm will head their way; they may feel heat at night, and, based on its intensity and the time of year, discern whether planting time is approaching.

Tschakert (2007) exemplify that in many parts of the world, trees, wind, and birds are the subjects of attentive scrutiny by local farmers who rely on them to predict seasonal rainfall. As indigenous culture of prediction ingrained in environmental anthropology, farmers in Jamuni were using the indigenous environmental knowledge

on rain forecasting. Amid unusual rainfall pattern, the farmers comprehend the rainfall pattern by using their visual and sensory perceptions, mental models, indigenous environmental knowledge and experiences concurring to Strauss and Orlove's (2003) argument that visual and sensory perceptions are key elements of the folk epistemology of climate. In indigenous Tharu community of Jamuni, based on collective experience and cultural framing based on folk narratives of climate change (passed on between generations), the indigenous knowledge of rain forecasting is proving effective in comprehending the rainfall pattern.

Elderly Tharu farmers predict rainfall when the house sparrows play in the dust on the ground and when black ants come out from the cleft carrying their eggs and seeking elevated place. Likewise, when numerous fire-flies revolve around trees at night, Tharu farmers predict the possibility of rain. Farmers believe that when the eastern wind stops blowing in the month of August and western wind start to gust, this wind will bring rain. Ribbit of frogs signify that there will be a heavy rainfall. If there is eastern wind in the month of November-December, clouds may form but with no rain. Rain may occur when the evening sky appears red in the east. It is a belief that a distance smoky halo around the sun will bring early rain and vice-versa. Cattle will be contented and lope when it is about to rain. Formation of elephant trunk shape cloud below the rainbow is an indication of heavy rain in near future. The predictions of these rain forecasters urge the farmers for agricultural preparation which is an indigenous adaptation strategy against the changing climate. Pahadiya and Madhesi farmers have also emulated this culture of rain prediction. An old Tharu respondent of 85 years revealed a strange ritual performed during a summer drought.

> Our women perform a bizarre ritual of plowing up their yards in the middle of the night stark naked singing songs to appease the rain god. No male is allowed to watch the dance and if anyone is caught they will be punished for offering food to Devta (god). This ceremony ties our people together and reaffirms our belief in female primacy, collectivism; promoting social solidarity that help us cope with drought. For me, climate change is nature's worst but best for our unity.

A conventional but interesting approach to preserving soil fertility is favored by Pahadiya and Madhesi farmers in Jamuni. It is believed that if Bhumi Devi (the earth goddess) is appeased through consultations and puja rituals, the mother earth (symbolizing female fertility) will produce bountiful crops. Based on indigenous epistemology, seeing and knowing local youth have learned and appreciated different

practices by passionately observing and practicing elders. Elderly people are invested in reliable knowledge because they have socio-cultural experiences, have seen things and suffered, including climate events, changes and impacts. Local traditions and practices have generated a system of meanings and relationships based on exotic experiences, cultural and ritual patterns that reconcile people's participation in natural phenomena and processes, structure the way they observe, understand, experience and react and the factors of the world they live in. Through indigenous knowledge systems integrated with up-to-date integrated versions, farmers have developed and implemented extensive adaptation strategies that help them reduce their vulnerability to climate change. However, this knowledge is rarely taken into account by policymakers when designing and implementing modern mitigation and adaptation strategies on climate change impacts on agriculture and livelihood.

Conclusion

Unjustified depletion of natural resources, subsistence agricultural production, deforestation and extension of new settlement made Jamuni farmers more vulnerable to aberrant problem of climate change impacts that impinged on their interactions with environment not only through its impact on biodiversity, agricultural practices and livelihood wellbeing, but also as a dimension of collective narratives and the uncertainties for future. The locally fashioned "performative integrated adaptation practices" ingrained in environmental anthropology of the broad interrelationship between culture and ecology mediated the engagements with natural phenomena and processes and framed the way farmers observed, understood, experienced, and adapted to climatic variations with a set of responses in crop selection, livestock management and livelihood. Farmers as innovators, creative sociocultural technical actors responded in changed environmental circumstances; adjusted their adaptation behaviour that depicts how adaptive agricultural performance is entrenched in sociocultural, technical and ecological contexts. Adaptation is noticeably a sociocultural-technical and a 'go-ahead process' that is socially-culturally ingrained, and adaptation as a set of modeled responses to the conditions, and adaptive processes as sociocultural phenomena going up beyond changing climate conditions and agriculture as performance for survival simply more than the hackneyed farmers approach.

Climate change is the nastiest of the nature but preeminent for solidarity bringing farmers together, reaffirming collectivism, promoting solidarity to cope climate change effects reconciling natural phenomena; processes structuring ways in observing,

understanding, experiencing and responding. But with financial constraints, low education and poor knowledge on modern adaptation techniques of climate change, adaptation mechanisms are insufficient, compelling many farmers to shift from agriculture to foreign job, business etc. Consequently, the unused barren agricultural land is increasing which is creating threat of food security. As effective adaptation not only needs to be technically effective in reference to climate and ecology, but needs to be effective in reference to the social-cultural needs of the individuals and collectivities that perform them, at the policy level, it is requisite recognizing time and space bound locally suitable adaptation experience model shaped into integrated knowledge based performative practices in climate change policies to develop cost-effective, participatory, sustainable and effective adaptation strategies on agriculture and livelihood. There are challenges related to human dimensions of climate change as well as the ideological and sociocultural nature of climate science.

Notes:

1. The term *Dalit* is used for so-called low-caste Indo-Nepalese people in Hindu caste hierarchy, whereas the term *Janajati* is used for ethnic groups of Tibeto-Nepalese Mongolian origin.
2. *Pahadiya* is a term used for hill ancestry people of Nepal.
3. *Chhetri* and *Brahmin* are the so-called high caste Hindus of Indo-Nepalese ancestry.
4. The term *Madhesi* is used for the people of Indian ancestry residing in Nepal Terai. *Yadav* is a *Madhesi* Hindu caste group of Terai whereas *Tharu* people are an ethnic group indigenous to the Terai.

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