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Culture, Climate and the Environment: Local Knowledge and Perception of Climate Change among Apple Growers in Northwestern India

Neeraj Vedwan
Montclair State University

ARTICLES

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NEERAJ VEDWAN

Abstract

Human societies in mountainous areas have evolved specific ways of dealing with the constraints imposed by the environment. A number of anthropological studies have documented the existence of practices that can be considered adaptive in the context of mountain environments. In this paper, I present a case study of a society in transition, in the northwestern Himalayas of India, in which local knowledge—combining aspects of traditional knowledge and practice—is used by farmers to cognize and cope with the uncertainty in their environment. Focusing on the perception of changes in the amount and timing of snowfall over the last three decades, I present a non-reductionist and nested model of human-environment interaction that explains the perception and knowledge of climate as a function of micro-level livelihood practices, as well as enduring and widely shared cultural notions of risk and vulnerability. The model being proposed encompasses agency and cognition at multiple levels, ranging from the local to the regional, and is explicated with ethnographic information, which demonstrates the resilient and dynamic nature of local knowledge. The paper's major finding is that the perceptions of climate change in the region are shaped both by the local knowledge of crop-climate linkages, as well as the broader historical relationship with the environment.

Introduction

Kullu Valley in the state of Himachal Pradesh in northwestern India has experienced a number of crop failures in the last 15 years that apple growers blame on a changing climate no longer suitable for apple production. Growers' perceptions of climate correspond closely with the meteorological record in the valley (Vedwan and Rhoades 2001). Not only the aspects of climate but even the climate categories, which are perceived as having changed, are those that scientifically affect apple production the most.

How are these perceptions of climate change and the adverse impact of climate change on apple production to be understood? How do farmers think about climate, and what may be causing the climate to deteriorate as far as they are concerned? Do these perceptions of climate change facilitate action aimed at ameliorating the perceived negative effect on apple production? If this is the case, then how does this occur? This paper links these questions together and answers them by offering a nested model of the perception of climate change. The model situates perceptions of climate change within the context of both local-level practices and the broader system of human-environment interactions, ultimately facilitating growers' response to the decline in apple production. While avoiding both environmental and socio-cultural determinism, the model is dynamic and capable of accounting for change over time in the system. It demonstrates how local knowledge of risk and vulnerability combines aspects of local knowledge—which is inter-generational and related to apple growers' traditional agricultural occupation, as well as identity as **paharis** (hill people)—with the more recent understanding of climatic impact on apple. An important goal of the model is to bridge the dichotomies—thought

vs. action, natural vs. cultural realms, and practical vs. abstract knowledge—that often characterize anthropological accounts of human-environment relations in mountainous areas and elsewhere. A formulation of human-environment interaction such as the one being presented here has implications for our understanding of the cultural perceptions of risk and environmental vulnerability and their role in facilitating adaptive responses.

Situating Perceptions

In this section, I provide a summary of the literature relevant to answering the questions posed earlier. The relevant literature, mirroring the synthetic nature of the model, consists of several areas of theoretical research that are often seen as distinct and unconnected, but which must be brought together in this paper to account for the apple growers' perceptions and responses.

Societies in mountainous areas have been studied extensively for their responses to the formidable constraints imposed by the environment. A number of anthropological studies have focused on the comparison of mountainous areas around the world in order to identify common features of these societies that could be considered direct adaptive responses to their environment (e.g., Bishop 1998; Brower 1990; Rhoades and Thompson 1975). A major finding has been the existence of similar livelihood strategies geared towards concurrently harnessing a range of ecological niches that are often in close proximity. Another prominent theme in the studies of adaptive mechanisms includes similar suites of risk minimization strategies that develop independently in these widely separated regions of the world, attesting to the existence of something akin to a characteristic pattern of human-environment interaction in mountains (Kuznar 2001; Trawick 2001a; Zimmerer 1999). According to Jodha et al. (1992:25):

> In relation to mountain areas, the basic features of the resource base and production environment are referred to as mountain specificities. The important ones are inaccessibility, fragility, marginality, diversity, 'niche', and human adaptation mechanisms. These attributes have several operational implications in terms of objective circumstances, which in turn shape the pattern of activities and their linkages. When any development intervention or resource-use practice violates the imperatives of the mountain specificities, it tends to initiate the process of resource degradation and long-term unsustainability.

Jodha (2000) linked "mountain specificities" with the difficulty of increasing mountain agricultural productivity through intensification and other plains-centric strategies. In this view, the constraints associated with the topography and environment limit the application of conventional strategies aimed at achieving high growth rates. For example, improvement in transportation, which can reasonably be expected to boost economic activity, offers no such promise in mountainous areas, since the low rural population density plus construction logistics and overhead costs do not make road construction a desirable option (Jodha et al.1992:104).

Environmental conditions in mountainous areas, despite being critical, do not determine the actual livelihood strategies and practice, but rather provide the conditions for several effective possible strategies that may be attempted by imaginative rural dwellers (MacDonald 1998). An adequate accounting of risk mediating characteristics has, therefore, to include not only aspects of the environment and practice but also the broader cultural matrix. In most mountain studies that focus on the existence of sophisticated strategies for risk mediation and reduction, the cultural contexts are, at best, inadequately conceptualized. The focus on the so-called relations of production (for instance, labor arrangements and kinship), although important, does not obviate the need for greater consideration of the cultural level of the system of human-environment interaction (MacDonald 1998; Mishra et al. 2003; Trawick 2001b). One way of integrating the specific historical relationship with the environment and the political-economic factors into a coherent explanation of observed environmental perception and behavior is by focusing on the local knowledge of the system being studied.

Local knowledge has been conceptualized in anthropological research in a variety of ways (Sillitoe 1998) because of the widely differing epistemological premises. Local knowledge of the environment consists of both 1) practices, which can be considered analogous to recipes—'how to' knowledge that is tied closely to occupation and technology, and 2) the underlying conceptual structure, which may be considered a 'way of seeing'. How are these two levels of local environmental knowledge related? Brodt (2001) considers the relationship to be hierarchical where experiential knowledge is more closely linked to specific practices and, consequentially, more prone to erosion. The "second-order concepts"—or "traditional" knowledge in the sense of having greater time depth and wider cultural purchase—to the contrary, are more abstract, independent of their application, and embedded in a variety of knowledge sub-systems, all of which ensure their longevity. The term "traditional," thus, is not equated to the immutability of knowledge; in the sense that is implied here, "traditions are not a set of directives frozen in the past but a set of principles that guide behavior even through…drastic changes…" (Hunn et al. 2003:80).

As mentioned earlier, for the purpose of this paper I will focus on a subset of human-environment relations; specifically, the apple growers' perception of and response to climate change. Ethnographies of climate-culture interactions in small-scale societies have documented the existence of in-depth local knowledge of climate (Waddell 1975). Paul Sillitoe's (1996) study of the ethnoclimatology of Wola demonstrates that even in a region with what can only be described as an undifferentiated weather regime, two distinct seasons are perceived that correspond closely to the meteorological data. Moreover, the perception of climate is structured by the distinct agro-ecological outcomes associated with different parameters of the two seasons. The study demonstrates that the perceptions of weather and weather fluctuations are tied closely to the material conditions being affected, but fails to provide a sense of the broader system of meaning and signification in which the perceptions are embedded.

Ingold and Kurttila's (2000) study of the perception of weather among the Sami, in contrast, reveals an almost seamless relationship between the people and their environment. The local people and their environment—experienced through inhabiting particular places—are bound in a mutually constitutive relationship through the simultaneous inscription of a set of meanings in the bodies of the inhabitants and the places they inhabit. Weather is experienced not through the prism of its impact on livelihoods alone, but is refracted through the human multi-sensory apparatus. The study takes a view of the organism and the environment as not two distinct entities with substantial overlap, but as parts of the same continuum and as emergent products of the process of continuous interaction.

The present paper, in its theoretical approach, tilts towards the framework used by Ingold and Kurtilla (2000) while preserving the analytical distinction between the apple growers and their mountainous environment. One of the shortcomings of the aforementioned study is that it relies too heavily, almost solely, on the individual-environment interaction to generate the layered, complex and highly distributed reality of human-environment relations. In doing so, the theoretical position comes perilously close to the approach followed in the psychometric studies wherein perception is treated as an exclusive property of individuals. Mary Douglas (1992:58), in refuting the error inherent in this position, notes that "individuals do not try to make independent choices, especially about big political issues…they come already primed with cultural assumptions and weightings."

Perceptions of climate—although proximately structured by the salience of the phenomenon in question, as well as its impact on livelihoods—are a subset of the broader relationship between the apple growers and their environment. Wynne's (1996) observation about scientific knowledge applies equally well here to local knowledge and the perception of climate, namely, that it cannot be deduced from the empirical properties of the phenomenon in question alone. Thus, it follows that instead of ascertaining the

veracity of the perceptions of climate change, as has been the focus of many studies, it would be more useful to consider the relationship these perceptions have to other elements of the complex of human-environment interactions. Local view of risk thus is not an outcome of faulty perception but instead arises from differences in the underlying epistemological and ontological premises (Lupton 1999). In other words, the disembedding of risk from its social and cultural context—often a feature of technical treatments of risk—has resulted in an overemphasis on the calculative rational-actor paradigm of decision making at the expense of the "neglect of the cultural/hermeneutic sources of the modern self" (Beck et al. 1994:200). Perceptions of risk ought to be treated as a subset of broader, more enduring set of beliefs and attitudes, or world-views, for their importance in shaping as well as selecting particular forms of risk for attention (Lupton 1999:122).

The importance of social position and the broader system of signification in shaping perceptions of risk is underscored by a study of workers engaged in hazardous occupations. Nelkin and Brown (1984) describe the perceptions of risk as being a subset of the perceptions of work, with workers holding favorable attitudes towards work less likely to be concerned about work-related hazards and vice versa. The knowledge of the system under consideration has an important influence not only on perceptions of risk, but even their selection in the first place (Lupton 1999:122).

Crook (1999) describes multiple risk-management regimes, co-existing and overlapping, and shaping the perception of and the response to risk. Thus, despite the fond hopes of modernity advocates, statist risk management and its successor in many parts of the world—the neo-liberal regime for ordering and managing risk—have not completely displaced ritualized risk management. In fact, the failure of these regimes to contain a contemporary explosion of risks has only spurred the growth of neo-traditional regimes for managing risk (Crook 1999). The explanation for the resurgence of neo-traditionalism may be found in the peculiar characteristics of modernity, including modernity's disregard for culturally embodied knowledge when not marketable. Modernity places excessive demands on reflexive individuals who are seen as seeking an altogether unrealistic level of knowledge, skills and autonomy that they would use to anticipate, identify and mitigate numerous risks that they encounter in their everyday lives (Wynne 1996). In harnessing existing forms of cultural affinities and dispositions and their underlying social well-springs, neo-traditionalism creates possibilities for politicization, thereby facilitating response to perceptions of risk (Crook 1999). About non-experts, Wynne (1996) notes that their apparently fatalistic beliefs about risk are often reflections of social marginality that diminish agency, partly by rendering opaque the conditions that produce marginality. In the absence of any effective leverage on the 'other,' there is a propensity to make the inward turn.

The blame for exposure to hazard and resulting risk is often apportioned using the notion of pollution. According to Mary Douglas (1992:35-36):

> Pollution, defilement, contagion, or impurity implies some harmful interference with natural processes. It assumes something about normality because it implies an abnormal intrusion of foreign elements, mixing, or destruction…usually the dangerous impurity is attributed to moral transgression of one kind or another…

Attempts to maintain social integrity and boundaries between 'us' and 'them' thus often come to rely on observance of culturally specific notions of pollution. The moral force inherent in the concerns over pollution can serve to reinforce social rules and cultural practices that seem endangered because of rapid political-economic changes. Taking a psychosocial approach to the emotions engendered by the encounter with the other, Lupton (1999) notes that the fear of the loss of autonomy, in personal and social spheres, often drives the overriding concerns about uncertainty.

To summarize, perceptions of risk do not simply arise from their material underpinnings, nor are they merely the product of all-powerful discursive workings. Risk perceptions are a part of the broader human-environment relationship, which is cumulative and historically specific. Humans, in other words, do not encounter the environment *de novo*, but as a palimpsest of values and practices, constraining as

well as affording creative possibilities at any point in time. Local knowledge and perceptions exist in dynamic tension with the various aspects of material and discursive reality encountered by the historically situated actors. It is towards an attempt at illuminating these dialectical relationships that I now turn.

Study Site and Methodology

Kullu valley, drained by the Beas river, is approximately 60 km in length (Figure 1). The valley's altitude varies from about 1200 m above sea level at the valley floor to the upper limit of habitation and cultivation around 3000 m. Most habitation and agriculture occurs at the valley floor and along the sides to the approximate elevation of 1500 m. In the 1960s and 1970s, the economy in the valley underwent a transformation from subsistence agriculture, based on the cultivation of cereal crops, to commercial horticulture—particularly apple production. The rapid changes occurring in the valley included, in addition to the expansion of horticulture, increase in tourism, literacy rates, income levels, electrification, and other indicators of development (Verma and Pratap 1992).

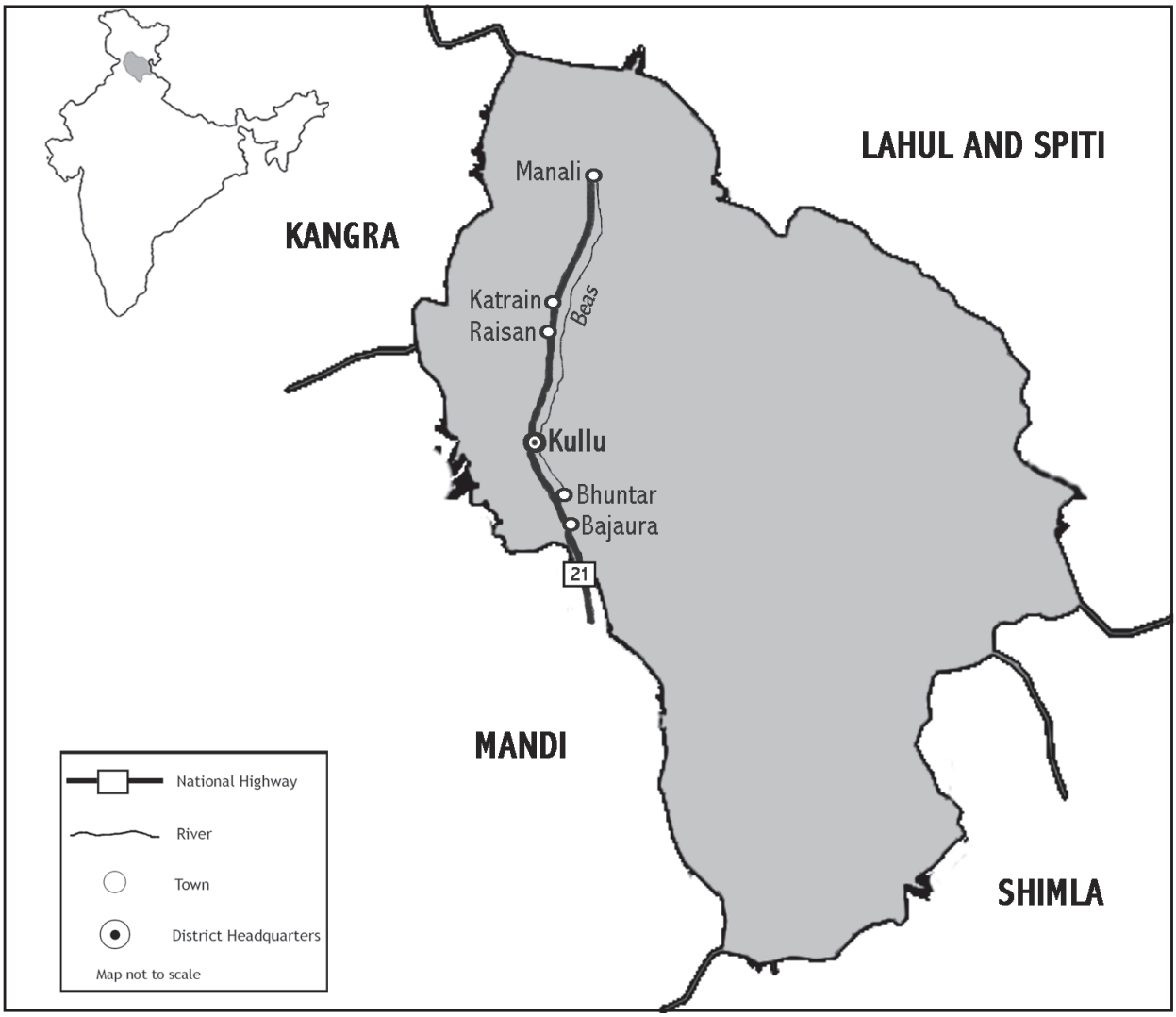

Figure 1. Map of the Kullu District.

Development in the valley, mostly an outcome of state policies, has translated into improved quality of life for a large number of people, as reflected, for instance, in the increase in female literacy level (Anonymous 2000a). Simultaneously, the increasing penetration of market forces has brought into play the usual rewards and risks associated with it. The traditional system of livelihoods, based on a diversified land use—combining irrigated and non-irrigated agriculture and animal husbandry—has declined and has been replaced with mono-cropping and input-intensive horticulture. Therefore, the traditional livelihood system has been displaced by a high returns/high risk system, engendering dependence on exogenous forces such as the markets and the state.

The research for this paper was carried out first in 1996 (two months), and subsequently in 2000 (four months) and 2004 (one month). I conducted semi-structured interviews in Hindi with 58 apple growers located across the length of the valley. Growers were asked about apple production during the last several years. Subsequently they were asked about what, in their view, explained the variability in yields. If they mentioned climate as one of the variables, they were then questioned about the ways in which they perceive climate to have changed, any reasons underlying the change, as well as their response to the change. One of the goals was to elicit, in an open-ended manner, information related to the local model of apple-climate interaction, including categories of climate that farmers perceived as having changed. I focused on the relatively clear and shared perceptions of climate and then traced the linkages to a body of local knowledge, including cultural notions of risk and vulnerability and the subsequent response of the apple growers. In addition, meteorological data for the last 40 years were analyzed and compared with the apple farmers' perceptions of climate change (Vedwan and Rhoades 2001). Also, I worked closely with the Kullu Apple Growers' Association, a voluntary and largely successful effort by the apple growers of the valley to protect and promote their interests. In-depth interviews were conducted with apple growers, horticultural scientists and policy-makers inside and outside Kullu valley to understand the evolution and expansion of horticulture in the region.

I also examined secondary sources of information such as the newspaper coverage of the impact of weather on apples, which I used as a proxy for the existence of awareness and concern about the issue. I searched regional newspapers such as *The Tribune*, *The Indian Express*, and *The Hindustan Times* for references to apple and weather interactions during the period 1998-2001. Over two hundred newspapers for the months of December, January, and February (the time period in which most snowfall occurs that is critical for apple production) were examined for references to apple-weather interaction. Twenty direct references about the extent of snowfall and its likely impact on apple crop were found. Also examined were the annual memorandums for 15 years (1985-2000) submitted by the Kullu Apple Growers' Association in support of demands for better terms for its members—data of interest included the degree to which demands appeared to be responses to environmental stresses experienced by apple growers.

Apple Growers and Climate in Kullu Valley: A Model of Human-Environment Interaction

Why are climate and climatic variability perceived relatively clearly among apple growers in Kullu valley in Himachal Pradesh? What aspects of the environment and the knowledge system of apple growers shape and influence the relatively unambiguous perception of climate change in the valley? I propose a model that, while retaining the features of hierarchy and interrelatedness between various local knowledge sub-systems, supplements it by demonstrating an active feedback between these levels. The key to understanding the perception of climate change among the apple growers lies in the characteristics of mountain agriculture. In the case of Kullu valley, mountain specificities have given rise, over time, to cultural notions of risk and vulnerability

in which ultimately the perceptions of climate change are rooted (see Figure 2). The perceptions of climatic variables, while ultimately being constrained by the finite range of their values, are proximately structured by the interplay of agriculture as an economic and cultural activity and the position of the hill farmer in the local and the regional system.

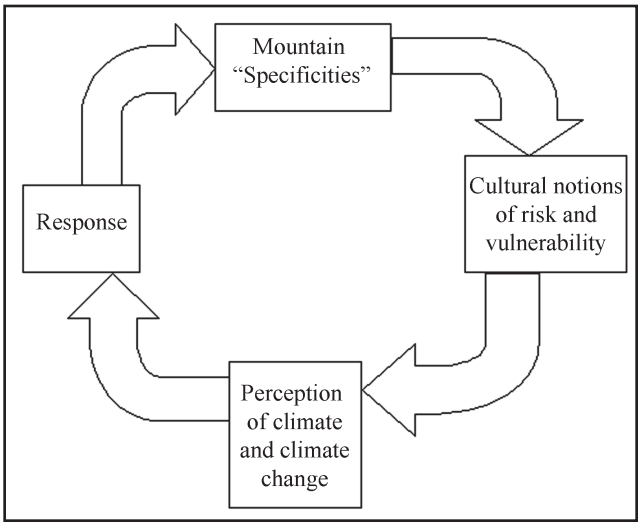

Figure 2. Conceptual Model of Apple-Grower-Environment Relationship in Kullu Valley.

Mountain Specificities

The features of mountain physiography, such as altitude, slope and aspect, interact with other characteristics such as soil type and weather to generate heterogeneity of niches, often in close proximity. Due to the traditional reliance on multiple niches involving a mix of agriculture and animal husbandry for sustaining livelihoods, farmers are highly attuned to even small variations in the various niches. In Kullu valley, this is reflected in the perception of environmental degradation, which is not that of uniform change, but that of a distinct spatial pattern. As one moves up the valley from its outer and lower limits, a perceptible decrease of temperature can be felt; farmers are not only aware of this variability, but also have detailed knowledge of the suitability of various crops for different parts of the valley. The remark that the "...apple belt has moved 30 kilometers [northwards] over the last 50 years," and that "Bajaura [a low point of the valley] was once the starting point for apple...now there is no apple below [Raisan**,** a midpoint of the valley]," is a common observation that is widely shared in the valley[1].

It is pointed out that the traditional crops are now growing at much higher altitudes and, concomitantly, lower parts of the valley like Bajaura are no longer producing apple. Farmers commonly recalled that, earlier, **makki** (corn) could not grow in Manali in the upper reaches of Kullu valley, but was now spreading into the "heights." Behari Lal[2] of Bhuntar (at the lowest point of the valley) observed that "now makki comes from Manali whereas earlier we used to supply them makki." Also, "chilli that used to stay green now turns red at heights, whereas **safed mash** [a kind of lentil] can now grow at heights." Muneeshwar Suri of Raisan pointed out that "**Gandam** [wheat] is now growing at heights where it could not grow earlier. They are even growing paddy there!" Apple growers considered hailstorms as extreme weather events because of their destructive impact on crops, including apple, but were quick to point out that they were limited to certain pockets. Most of the hail pockets were located in the heights, and acted as a barrier towards the expansion of the upper limits of apple cultivation.

Although mountain specificities are conceptualized primarily in geographic terms, an important corollary consists of their linkages with culture. For instance, marginality is not just a spatial concept—that is, the distance from the political-economic center—but a cultural condition as well, which is insinuated in almost all aspects of life in the hills. For instance, in Himachal Pradesh one of the main impulses that drove the struggle for autonomy from the former Punjab state, of which it had formed a part, was the widely shared sentiment that the state's residents had the right to "mould their destiny according to their own genius" (Parmar 1970:14). The cumulative subjective experience of mountain specificities has been to underscore the distinctiveness of mountain circumstances, vis-à-vis

the plains. The related recognition that Himachal Pradesh is not part of the mainstream has therefore come to have a wide purchase and is reflected in the discursive positions that are often taken, asserting a special claim on the state resources, whether based in the status of the Himalayas as the sentinel of India or, more recently, as the keeper of ecological balance (Vedwan 2001).

Cultural Notions of Risk and Vulnerability

As described in the previous section, mountain specificities have predisposed farmers to a close relationship with their environment. The environment in Kullu valley is popularly considered as having been knocked out of balance, as apparently indicated by the constellation of changes in the environment and the societal relationship with it. The key ingredient in the descriptions of the ongoing phase of environmental downturn is the perception of disturbance, deviation or even destruction of natural cycles, plus social mores and cultural values. The widely shared observation of a 'displaced weather cycle' among apple growers connects the recent perceptions of climate change with the more durable aspects of traditional ecological knowledge. Displacement in this sense implies disturbance or a shift away from equilibrium conditions—the ideal weather regime that, presumably, existed before the current phase of weather deterioration. In other words, the place had a particular weather wherein, as Muneeshwar Suri said, "rain used to occur in the rainy season." But now everything is topsy-turvy according to the farmers.

In the narratives that apple growers offer, empirical observations about the variability of climate and vegetation are almost seamlessly interwoven with concerns about broader changes. The people I interviewed generally see cultural defilement as arising from corruption of a lifestyle that once valorized self-sufficiency and simplicity of food habits and clothing as opposed to the ostentatiousness of modern habits and the erosion of social cohesion.

It would be erroneous, however, to consider the preceding concerns as being exclusively cultural in content—merely a product of nostalgic sentiment triggered by rapid changes in all facets of life in the valley. The undercurrent of politics in the narratives of cultural change is unmistakable and of critical importance here. The loss of autonomy is a recurring motif in which external cultural influences, the state's often unwelcome signature in everyday life, and the subversion of community norms are all seen as being the cause as well as evidence of increasing disorder in the social and moral lives of the residents.

As part of the traditional suite of livelihood strategies, a variety of ecological niches were exploited as a hedging strategy against the ever-present risk of crop failure due to environmental variability. Thus, most families owned land along the valley floor that was irrigated (called **ropa**) and used for growing rice. The land at higher elevations, which was non-irrigated and tended to be steeper, was used for grazing or for gathering fodder. With the increasing commercialization of agriculture and the spread of market-oriented horticulture, most of the irrigated terraces have been converted into apple orchards, thus deepening the dependence of farming households on apple[3]. Although economically more remunerative, the frequent failures of apple crop have made growers highly sensitive to the risks inherent in horticulture. In addition to climatic variability, dependence on markets has added another layer of risk to the livelihoods of apple growers. The sense of insecurity is compounded by the lack of control of apple growers over the marketing process, most of which occurs in faraway towns and cities in the plains—the principal centers for consumption of apple.

The belief that livelihood risks have increased manifold over the last two to three decades has to be seen against the backdrop of a host of changes that are perceived as having taken life from being "natural" to "artificial." The transition encompasses not only the domain of climate and the environment, but the society-nature interface, and even social relations. This shift from a more natural way of life—comprising self-reliance in matters as disparate as food and clothing to a lifestyle that is

dependent on buying from market—is seen as the corruption of culture itself. An elderly respondent, expressing his disapproval of the dietary changes over time, declared that "even cow milk used to be more nutritious as they grazed in alpine pastures rather than eating the fodder they are given nowadays." The cows are not the same, with the traditional hill variety replaced by hybrid cattle for which stall-feeding is recommended.

Bhagat Ram of Ghurdaur noted:

> Nowadays we live in the age of artificiality. We buy our food from shops. Look at the increasing diseases because of all the spicy food people are eating. And this food doesn't provide any real nutrition. There is all-round decline of quality. Top soil, which used to be eight to ten inches, is now only two to seven inches. The government by giving **nautor** [village commons] land has really made the problem worse.

> These people [the landless and the poor, mostly from the lower castes] do not know how to cultivate the land. They are trying to grow crops on steep slopes, causing erosion. We have poisoned our environment. Honeybee population has declined. For pollination, we have to rent bee hives now from the government. Even butterflies, of which I remember numerous beautiful varieties, have declined a lot. Soil is no longer the same. These synthetic fertilizers drain nutrients from the soil and produce a lot of heat.

In the accounts provided by people of the changes in the valley, the cultural and the natural worlds are often described not as dichotomous, or even distinct entities but as one single sphere subjected to the workings of the same forces, whether sacred or secular. In the excerpt above, the degradation of the environment is caused by the disruption of a way of life, which includes proliferating harmful practices, affecting both the natural and the social worlds. An example of the latter, for instance, includes the traditionally non-farming, lower castes, engaging in cultivation, causing soil erosion. When quizzed about extreme weather events in the valley, several respondents, especially elderly people, mentioned the massive floods that ravaged the area in 1947, the year of India's independence. A direct connection was perceived between the bloodshed and the divine wrath it provoked in the form of floods that washed away bridges and houses, and caused tremendous loss of life and property.

The 'unnatural' changes in life perceived in Kullu valley extend to the changes brought about by the construction of roads and dams. Before the construction of the principal road that runs through the valley, Kullu was considered a remote part of the country, largely off-bounds to the average tourist. No sooner had the road been constructed that Kullu emerged as one of the tourism hotspots for visitors—domestic as well as foreign. The resulting influences are often described by the local residents as pollution. The valley has gained a reputation for being a source of cheap and freely available drugs, an important consideration for foreign tourists flocking to the region. The construction of Pandoh Dam on the outskirts of the valley is also seen as having contributed to the degradation of the environment. The dam, over 60 m high and constructed mainly for generating power, is built on the Beas river, which flows through Kullu valley. Dharam Veer of Seobagh complained:

> [the] Pandoh dam created the problem [of climate change]. An expert who was doing research here once told me that the water body interferes with the climate by affecting cloud formation. The government should have to pay compensation for destroying the livelihoods of so many people by building that dam.

The destructive impact of increasing government interventions is not just restricted to the construction of dams and roads. Chaman Lal of Raisan felt that:

> The **chil** (pine) plantations by government [that were part of the afforestation drive] have caused a marked change in weather. **Chil** tends to suck underground water. Moreover, it flowers at the same time as apple and produces a lot of pollen. This pollen interferes with the pollination process in apple….

Perception of Climate Change

Most of the apple growers, when asked about the role of climate in apple production, attributed poor production to reduced snowfall and its changed timing. Snowfall in the valley is widely perceived to have decreased in amount, as well as to have been displaced in time. When asked about the change in climate, respondents most often began their response by describing the changed pattern of snowfall. Recollection of memorable events, like the largest snowfall event in a decade, was the most common method individuals used to discuss reduction in the amount of snowfall. These salient events were almost always recalled and described in conjunction with other meaningful activities and occurrences, typically journeys undertaken, family affairs, and individual life history. A woman orchardist in Seobagh recalled:

> Once in early 1970s, when I was in sixth grade, it snowed so much all of a sudden that the school had to be canceled. Children played with snow and made figures out of it. I remember it was one of the heaviest snowfall I have seen; it went on for three days without stopping.

More than 85 percent of the informants (n=58) felt that the timing of snowfall had undergone a change (Vedwan and Rhoades 2001). People have a finely tuned perception of the changes in the amount of snowfall that takes into account the topographic variations within the valley. When talking about decreasing snowfall, for example, they will compare amounts of snowfall at several places to indicate a pattern. They felt the frequency of early snow events in December and January had decreased over time with snowfall now often occurring in February and March. To apple growers, the impact of change in snowfall over time is more than the result of a simple reduction in the amount, since it is early snowfall that is particularly beneficial for agriculture. Raju of Katrain claimed that "early snow is more long lasting and resistant to melting than late snow. Besides contributing nitrogen for plant use, it also replenishes soil moisture and prevents the buildup of humidity in late March and early April." Late snow, on the other hand, is thought to lead to high humidity levels in March and April and thus is conducive to diseases like the dreaded Apple Scab.

Broadly, perceptions of change in snowfall are influenced by both the visual salience of the phenomenon itself and the knowledge that apple growers have of apple-weather interaction (Vedwan and Rhoades 2001). Please see the Appendix for a graphic representation of apple growers' cognized model, or "the model of the environment conceived by the people who act in it" (Rappaport 1982:237-238). Briefly, the amount of snow is understood to determine the number of chilling hours[4] and thereby the time of bud-break in apple. Early snow is regarded as durable and 'full of nitrogen'; late snow, on the other hand, is described as watery, transitory and understood as adversely impacting pollination and fruit-bearing (see Appendix for graphic model). Both the amount and the distribution of snowfall are utilized as benchmarks for assessing the effect of snowfall. Next to the chilling-hour requirement of apple and its dependence on snowfall, the most commonly mentioned aspect of the biophysical environment was soil moisture. Snowfall was considered to be critical for maintenance of proper levels of soil moisture. Chaman Lal laments that:

> The thick and durable snow of December and January that used to recharge soil moisture no longer occurs…insufficient moisture prevents apple from attaining good size…there is a drought period in June that can cause the plant to die and sometimes there is a dry and very hot period in April that can dry the pollen.

The traditional weather calendar in the valley—conceptualized not only in terms of the distinct seasons that comprise the weather but also characteristic activities like harvesting rituals—provided convenient cues to discern transition from one season to the next (Vedwan and Rhoades 2001). For example, harvest of paddy in October marked the transition to winter and was accompanied with rituals and festivities. It appears that these activities reinforced the notion of a weather cycle and provided a basis for people to discern long-term trends and notice the occurrence of atypical weather events.

Scientists' and Apple Growers' Views of Climate and its Impact: Differences and Similarities

From interviews of five key government agricultural scientists engaged in research and extension in the valley, I discovered that they recognized the decline in apple productivity, but emphasized technical solutions. For instance, it was iterated time and again that one of the causes of the present crisis was the lack of pollinizers (the official recommendation is that pollinizers should cover about 20 percent of any orchard). Blaming poor management of orchards for the decline in production, one of the scientists working at the local center of Indian Agricultural Research Institute (IARI) in Katrain explained:

> People have cut down pollinizers and planted Red Delicious for commercial reasons. Those who are managing their orchards well still get good crops. Has weather not changed for them? Also, there is a lot of herd mentality. People have sprayed excessive amounts of pesticides and killed pollinators like honey bee. They should no longer expect to get good crops without making any effort.

The growers, however, responded by saying that the decrease in number of pollinizers had preceded the decline in apple performance. Jimmy Johnson of Raisan elaborated:

> Due to climate change there is gap between the flowering periods of males and females [leading thus to ineffective pollination]. In fact, Golden Delicious is no longer a pollinizer, as it flowers either before or much after Royal Delicious. Scientists and local farmers were clearly not looking at the problem through the same set of eyes. Farmers believe that the 'disturbance' in climate is at the heart of a series of interrelated and fundamental changes, which are adversely affecting the performance of apple. Scientists, on the other hand, tend to emphasize interventions and management techniques that can be implemented by farmers to offset the impact of the downturn.

Perception, Public Discourse and Action

In 1996, when I conducted the first interviews, the perception of climate as changing was almost totally limited to apple growers who were facing the brunt of increasing crop failures. In 2004, climate change was acknowledged by a broad cross-section of people, including scientists and policy-makers. The reasons for the change in attitude include, firstly, mounting evidence of crop failures, in some cases spectacularly low production (as in 1999) on account of abnormal weather conditions. Secondly, there is an increasing acceptance of the idea or concept of climate change, perhaps because of the increasing pervasiveness of the discourse on global warming. In conversations and sometimes in the print, the observed weather changes are understood as part of the global trend towards warming with pollution, deforestation and increase in population as factors forcing the change.

The increasing incidence of failure of the apple crop has led to the diversification of cropping pattern in many areas. In some areas of Himachal Pradesh, increasing area has been put into crops like cherry, almonds and other temperate fruits. But as one farmer remarked, "the other fruits are mainly for support. There is nothing that exceeds the profitability of apple, especially keeping in view its shelf-life."

The Apple Growers' Association of Kullu is discussing growers' concerns about climate change. The issue of climate change and the need for better, more adapted cultivars have found their way into the annual memorandum that is submitted by the Himachal Pradesh Fruit and Vegetable Growers' Association to the Chief Minister of the State. Following is the text of a memorandum submitted to the Chief Minister on September 13, 1995:

> Due to ferocious floods a number of people lost their lives. In addition, substantial damage to land and other property has occurred:
>
> 1. National Highway-21 [the main transport artery in the valley] should be handed to the Border Roads Organization [for better maintenance].
> 2. Affected orchardists whose property has been damaged should be compensated as soon as possible.
> 3. Essential commodities should be provided.
> 4. Culled apple should be procured by government on an emergency basis.

Apple has come to be identified with prosperity and well-being not only of growers, but also of the whole state of Himachal Pradesh. One indicator of this is the coverage of apple-related issues provided by the media, especially the regional newspapers. An analysis of the media reports about horticulture reveals presence of discussions and news related to weather, budget, prices and yields. "Himachal heads for a 40 percent rise in apple yield" is how the record production of 1998 was described by the media (Ahuja 1998). Also, note the persistence of uncertainty regarding weather, almost until the harvest:

> Himachal Pradesh will reap a bumper apple harvest this season thanks to the favorable weather this time, the rise in yields is estimated to be around 40 percent…Initially, the growers were apprehending a poor crop due to the erratic weather…But now the crop has crossed the flowering stage and unless the weather turns hostile: Himachal is surely headed for a record bumper crop….

The aspects of weather that are covered most relate to moisture, specifically drought-like situations and snowfall. "Heat destroys apple crop" (Sharma 1999) was the title of a news item that described the effect, thus:

> Once again, the vagaries of weather have spelt doom in the apple-isle of Himachal Pradesh. Apple trees, which used to shower prosperity on growers, have this year become barren. The apple crop is just five percent this year….

In a story titled "Snow delights apple growers" (Anonymous 2000b), the importance of snow for apple production is underscored:

> The two days of heavy snowfall has brought cheers for the apple growers of Himachal Pradesh, who were upset over their crop prospects. The interior areas of the [Shimla] district had over 40 cm of snow since last evening. With this the snow recorded during the current season has touched 98 cm…Dr S.P. Bhardwaj, Additional Director of the Fruit Research Station, Mashobra, told that 54 cm of snow was recorded last year, which resulted in a poor yield of apple crop…1,200 to 1,600 hours of chilling period are required for the apple plants and so far over 1,100 hours of requirement has been met.

The level of discussion is quite sophisticated and assumes an understanding of the common processes and stages involved in apple growth and maturity. It is interesting to note that the news of these abnormal weather conditions appears almost simultaneously with the occurrence of these phenomena. Also, weather deviations from that which is normal for other crops receive almost no coverage.

Conclusion

The relationship between perception and climate appears to be governed by what Ingold (1992) described as the dialectical relationship between the affordances of the environment and the effectivities of the social actors. Thus, perception of climate change is structured on one hand by apple farmers' activities in terms of the knowledge and intentions they possess, and on the other by parts of the landscape, (i.e., affordances) that, even though pre-existing, make sense only in light of the activities (in this case, apple growing). The environment, or more specifically, the climate, is not just encountered as a *tabula rasa*, but as embodying a set of constraints and opportunities for apple growing (Zimmerer 1999).

The research in this paper helps to advance our understanding of perception of environmental risks as a function of the characteristics of the system of human-environment interaction. The perceptions of climate change, embedded in the traditional notions of risk, serve to politically legitimize the claims of the apple growers, which might otherwise be dismissed by the dominant institutions. Risk perceptions create possibilities for the emergence of new forms of agency capable of harnessing their culturally specific and historically contingent content for redressing the failure of the state, especially its scientific-technical apparatus, and the market to address the apple growers' problems. The shared notions of risk, arising out of the experience confronting similar environmental and other constraints over a long period have given rise to specific forms of social solidarity which, in turn, constitutes the basis for collective action, such as the Apple Growers' Association in the region.

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Neeraj Vedwan, Department of Anthropology, Montclair State University
vedwann@mail.montclair.edu

Notes

[1] The area in vegetables in Kullu has grown steadily over the past two decades, mostly at the expense of apple.

[2] This is a real name, as are others used throughout the paper. The respondents agreed to have their names used in publications resulting from the interview data.

[3] A similar process involving replacement of a traditional agro-pastoral system with monocropping, as a sequel of incorporation in regional and national markets, has occurred in the nearby valley of Spiti. According to Mishra et al. (2003:306), "this change has affected the traditional risk mediating practice of polyvarietal planting."

[4] For the Delicious varieties of apple that predominate in the valley, a minimum of 1,200 to 1,300 hours below an average daily temperature of 4 degrees Celsius is considered optimum to help apple trees break out of their winter-induced dormancy.

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Appendix 1. Cognized Model of Apple-Weather Interaction.