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Original Contribution

Understanding Land Use, Livelihoods, and Health Transitions among Tibetan Nomads: A Case from Gangga Township, Dingri County, Tibetan Autonomous Region of China

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Abstract: Tibetan nomads in the Tibetan Autonomous Region of China have experienced profound transitions in recent decades with important implications for land use, livelihoods, and health development. The change from being traditional nomads to agropastoralists engaged in permanent agriculture, a sedentary village life (known as “sedentarization”), has been associated with a remarkable change in diet and lifestyle, decline in spatial mobility, increase in food production, and emerging infectious and noncommunicable diseases. The overarching response of the government has been to emphasize infrastructure and technological solutions. The local adaptation strategies of Tibetan nomads through maintaining balanced mobile herding, reindeer husbandry, as well as off-farm labor and trade could address both the cause of environmental degradation and improve the well-being of local people. Drawing on transdisciplinary, preliminary field work in Gangga Township of Dingri County in the foothills of Mt. Everest, we identify pertinent linkages between land use and health, and spatial and temporal mismatch of livelihoods and health care services, in the transition to sedentary village life. We suggest emerging imperatives in Ecohealth to help restore Tibetan livelihoods in transition to a sedentary lifestyle.

Keywords: Tibetan, nomads, ecosystem, health, transition

INTRODUCTION

Living in a harsh environment, pursuing water and grassland, and living on a staple diet of barley flour (tsampa) and butter tea, the Tibetan nomads strive to use, nurture, and sustain the arid landscape for their livelihood and to maintain a cultural identity that has endured through the millennia (Goldstein et al., 1990; Miller, 2000; Manderscheid, 2001). Like other

parts of the world, changes in land cover (biophysical attributes of the earth’s surface) and land use (human purpose) occur in the Tibetan Plateau at an unprecedented pace and magnitude (Lambin et al., 2001; Du et al., 2004; Yan et al., 2005). Among the most powerful, contemporary forces shaping local land use are various government policies that aim to settle, standardize, and upscale rural production to meet the increasing demands of the local population and expansion of the market economy (Oi, 1999; Yeh, 2003, 2004; Xu et al., 2005; Yan et al., 2005). Land-use changes as a result of human activities, such as deforestation, agricultural

practices, habitat alteration, and urbanization, have long been known to influence human health (Patz and Norris, 2004; Carlos et al., 2005; Chhabra et al., 2006; Xu et al., 2008). Most emerging human diseases are driven by human activities that modify ecosystems through changing land-use practices (Taylor et al., 2001). Such changes facilitate the spread of pathogens, such as avian influenza H5N1 (Robertson et al., 2006) and foot and mouth disease (Morgan et al., 2006), into new ecological niches associated with migration of wildlife species and their contacts with livestock, and cause the reemergence of other infectious diseases between humans and animals, such as tuberculosis (TB) (Cosivi et al., 1998). Such changes also determine, in part, the vulnerability of ecosystems and people to climatic, economic, or sociopolitical perturbations (Kasperson et al., 1999). With localized threats to human health, it is essential to not only understand land-use and livelihood transitions (Kuznets, 1995), but also, most importantly, to articulate the policy implications, as well as enhance the capacity of indigenous people to strengthen their evolving ecological knowledge, innovations, and practices to adapt to changes in the environment and society, and improve human health (Reid et al., 2006; Carlos et al., 2005).

Land-use decisions, however, are often political and economic decisions (Blaikie and Brookfield, 1987; Yeh, 2003). The Chinese government saw itself to be playing an important development and welfare role. Since the 1950s, it argued that it was facilitating the long-term transition of a backward region into a modern global economy and empowering Tibetans to participate on an equal footing with other Chinese citizens. Such great efforts at poverty reduction and economic development, however, have had little impact. Rangeland degradation and social poverty are still predominant in most parts of the Tibetan Plateau (Fratkin, 1997). Overstocking, overgrazing, and nomadic ways of herding are often blamed for rangeland degradation. In the 1980s, the government decreed that local communities must reduce their livestock numbers and change their grazing practices (Goldstein et al., 1990; Yan et al., 2005).

An increase in health issues related to poverty is presumed to be due to poor access to modern health-care systems. Other perspectives give more and more attention to examination of the ecosystem, health, and poverty nexus in fragile environments (Woodward et al., 2000). A recent study (Xu et al., 2008) suggests that people's health and that of ecosystems in the Himalayas are affected negatively by environmental change, particularly land-use and land-cover changes.

The ecosystem and human health nexus has long been a focus for research and development, but the critical linkage between them is inadequately addressed. The "Ecosystem Approaches to Human Health (or EcoHealth) Programme" launched by Canada's International Development Research Centre (IDRC) is an innovative response to human health problems resulting from local and global transformations of ecosystem, environment, and human health (Lebel, 2003). The critical linkage between land-use changes and human health risks on the Tibetan Plateau, however, has not been well understood. In this article, we examine both the nexus between land use and environmental degradation and that between land use and human health among Tibetan nomads on the Southern Plateau; we seek explanations for why, in some cases, Tibetan nomads manage their land and livestock well, whereas in other cases, they are driven to degradation and ill health. The critical research questions for the Tibetan Plateau are as follows: (a) What are the land-use, livelihood, and human transitions? (b) Do land-use and livestock transitions lead to overgrazing and rangeland degradation? (c) Do land-use and livelihood transitions contribute to improved human health or a nexus between land use and human health? Drawing on transdisciplinary, preliminary field work in Gangga Township of Dingri County in the foothills of Mt. Everest, this article presents results of a largely descriptive study designed to gain greater understanding of land use, livelihoods, and health transition among Tibetan nomads.

STUDY AREA

Dingri County

Dingri County (86.2°–87.7°E, 27.8°–29.1°N) is located in Shigatse Prefecture of the Tibetan Autonomous Region (TAR) of China, in the foothills of the northern Himalayas at an average altitude of 4300 masl and bordering Nepal in the south. Dingri is located at the junction of the Palaearctic and IndoMalayan biogeographic realms, dominated by the Tibetan Plateau and Himalayan Highland ecoregions. The vegetation is xeric shrubland and alpine steppe, varying in species' composition and structure based on factors such as elevation, aspect, drainage, and precipitation, and is particularly rich in species along the Pengqu River which cuts through the Himalayas in the south into Nepal.

Dingri is composed of 13 townships with a population of 47,466 in 2003 (Tashi, 2007); of them, 99.8% are Tibetan. It has a total area of 14,000 km² intersected by the Sino-Nepal Highway. The population density is 3.33/km². Livestock holdings consist of yak, sheep, goats, and horses; the proportions of each species kept vary regionally: the total is 68,300 large animals and 300,500 sheep and goats. The whole county is situated inside the Mt. Everest (or Qomolangma) Nature Preserve (QNP) which was established in 1989. The QNP has four peaks above 8000 masl, including the world's highest peak. In early summer, many mountain climbers come to base camps in Dingri and wait to climb Mt. Everest's north face. With a railway connection to Lhasa and Tibet's opening up for tourists, Dingri is quite busy in the summer season. Climatic conditions differ greatly from south to north due to the combined effect of exposure to the monsoon and a mountain-induced rain shadow. The southerly slopes are moist and warm, while northerly slopes are cold and arid. It has a wide variation in temperature between day and night, low precipitation, high evaporation, and long periods of sunshine. The mean annual air temperature is 0.7°C; precipitation varies between 474.3 mm and 104.9 mm, with an average of 319 mm annually of which 95% is distributed in June and September; and the annual evaporation reaches 2527.3 mm. There is little snow in winter, and winds are fierce and intermittent throughout the year. The single growing season begins in late April or early May and ceases in Sep-

tember. There is inadequate grass to collect as fodder to supplement the long winter period.

Gangga Township

The study area, Gangga Township (or Xiang), is located in the western part of Dingri County on a relatively flat plateau surrounded by a large wetland and productive agricultural land (1500 ha). It lies at an altitude of 4340 masl (see Fig. 1). Gangga is an important sub-watershed of the Pengqu River, the upper stretch of the Arun River. It has 34 villages predominantly settled by Tibetans. Most Tibetans are engaged in agropastoralist occupations which range from seasonal migration of the entire family as features of a nomadic lifestyle, as well as the division of animal husbandry tasks among family members, to sedentary agriculture. The total income for Gangga is about 2.4 million USD, with an average income of about 200 USD per capita per year in 2006. Agricultural production (mainly barley and wheat) amounts to 4912 tons from 1338 ha of cultivated lands. Livestock holdings numbered 7335 yak and 44,465 sheep in 2006. Yak dung, crop straw, shrub, and even turf are collected for cooking and heating. Two villages, Xibei and Chazi, have been selected for an in-depth survey.

Xibei village has a population of 171 living in 22 households; Chazi village has 417 people in 69 households. Some Tibetan families still practice polyandry in which two

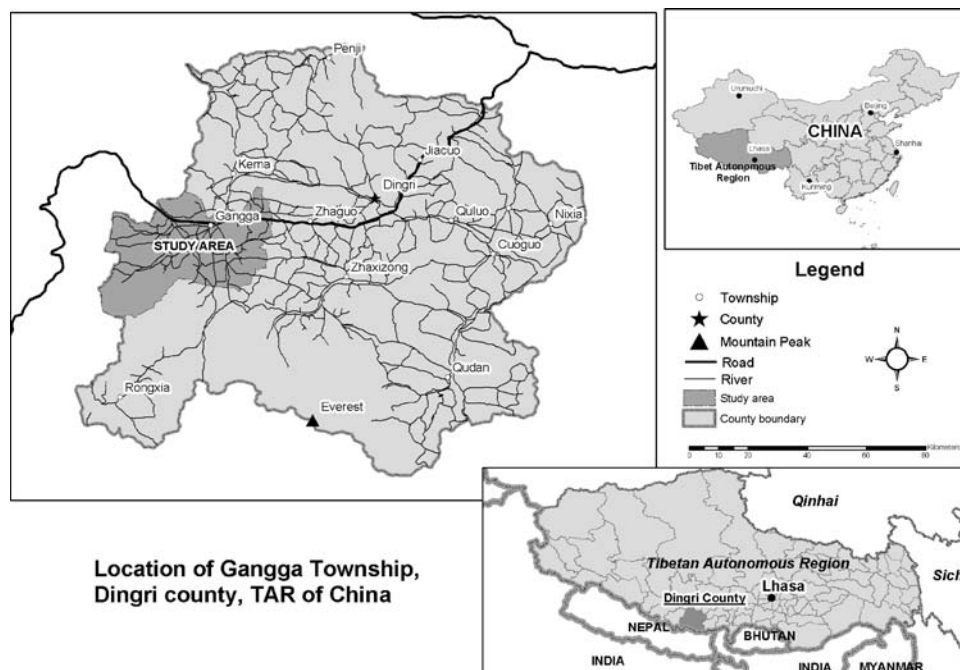


Figure 1. Location of Gangga Township, Dingri County, TAR, China.

or more brothers share the same wife. This concentrates labor in the household and avoids division of the land the family received during the de-collectivization period. Benefits for local Tibetans from the tourism boom are still limited, apart from earnings from selling local products such as vegetables. Many Tibetans are involved in road construction as off-farm labor.

METHODS

The project integrated the development of a spatial understanding of land use, including agricultural and pastoral production and herd management, with information collected through interviews with Tibetans and other key informants, and an analysis of relevant socioeconomic data and government policies. This spatial data served as a framework for analyzing changes in land-cover and pasture patterns through time, as well as a tool for analyzing information and insights collected in interviews and through policy analysis.

The spatial land-use database was developed using a 2000 (March) Landsat Thematic Mapper image. The Landsat image was divided into four classes: wetland, grassland, cropland, and land without vegetation. The land without vegetation was further subdivided into three classes—snow or glaciers, tundra, and bare land or desert. Ground truthing was carried out in August 2006 and August 2007.

Secondary data on variables such as populations of humans and livestock, cultivated agricultural land and food production, as well as other socioeconomic factors were collected from different government agencies at township and county levels; however, such data is often unreliable, particularly in land use and food production. Government officials and township health workers were interviewed in order to understand policies and related social services supporting local health care and rural development.

The project team—consisting of an ecologist, ethnobotanist, agronomist, public health workers, traditional Tibetan medical doctors, and geographers, from the agricultural academy, university, and Tibetan hospital, together with government extension workers—had been trained in transdisciplinary assessment by trainers from the International Centre for Integrated Mountain Development through a workshop funded by the Ecosystem Approaches to Human Health Program Initiative of the International Development Research Centre in April 2006, Kunming,

China. The transdisciplinary team carried out five field assessments between 2006 and 2007. The team was divided into three groups in the field. Each group visited a particular household and asked questions relating to the environment, livelihood, land-use transition, and its impacts on health; this was followed by group discussion and triangulation. Key informants—such as local township officials, health workers, extension technicians, village leaders, and older people—were interviewed to integrate the individual, common, and specialized knowledge about linkage between environment and health, and perceptions of the sustainability of ecosystems and of human behavior. Extensive household interviews were held with individual Tibetans to collect data about how families arrange their pasture and agriculture across the landscape, and how they collaborate with neighboring villagers and communities to manage livestock and natural hazards. Participatory observation and mapping as well as a transect walk (Salas et al., 2003) were used to arrive at an understanding of spatial and temporal patterns of land use, migration of humans and animals, access to water resources and grassland, and common property categories. Focus group discussions were organized to learn about the socioeconomic factors contributing to decisions to change land uses and livelihood practices in the area. An output of the project was to build team members' capacity in “transdisciplinary approaches” to integrating knowledge across disciplines, users, and perspectives (Parkes et al., 2005).

PRELIMINARY RESULTS

Government Perception of Tibetan Nomads and Its Policies Affecting Land Use

Since 1950, China has implemented numerous, and sometimes conflicting, policies affecting the ownership of land, including rangeland, cropland, and forests. In China, all residents, whether nomads or farmers, Han or ethnic minorities, are citizens (Harrell, 1995). The state method of identifying citizens and levels of development involves how the state defines minorities in relation to culture, level of poverty, geography, land use, and, further, in relation to its own development goals. The government's perception of the nomadic system is similar to the mainstream view held by the public, not only in China but also in other parts of the world (Goldstein et al., 1990). That view is that nomads have “backward” and “inefficient” methods of land and

livestock management, and this means, therefore, that they are inevitably associated with “poverty” and “environmental degradation” (Williams, 2002). The government has tried to sedentarize Tibetan nomads and restrict the movement of livestock and people over past decades. Among other things, placing Tibetans in sedentary villages is of symbolic value, as the state authorities see it as a measure of their integration into Chinese society and of modern development. Whereas state policies emphasize political stability, local people are faced with legal ambiguities in terms of land tenure and of flexibility in land-use practices based on customary institutions (Yeh, 2004).

According to (interviews with) local herders, a pastoral commune was established in 1966 to increase both agricultural and pastoral production, hence, livestock became the property of the collectives and remained this way until the early 1980s. Interviews with governmental officials identified overstocking and overgrazing as the cause for rangeland degradation, rather than failure of collectivism. The affairs of pastoral nomads were not easily administered, due to their living on the geographical periphery and in inaccessible or remote areas. To address the perceived issues of rangeland degradation, the Chinese government, encouraged by the success of rural reforms as a result of the “Household Responsibility System” in rural China, redistributed livestock to individual households but left rangelands to communal use in 1981, and then formulated the Grassland Law in the mid-1980s.

Local herders reported that after livestock management was returned to individual households, animal husbandry tasks were divided again among family members. Division of labor is clearly gender specific: The duties of women are milking, milk processing, and all other tasks in and around the tent; men carry out the work away from the tent, such as grazing livestock and trading. Rangeland was still managed collectively, however, although customary boundaries were delimited among different communities. The idea of privatization emerged in the 1980s and was finally implemented locally in 2005. In fact, enclosed privatization, despite the state’s modernization drive, is not the preferred option for most herders residing in more densely populated semi-pastoral areas. Shared labor is common practice among herders. The entire livestock herd of 2710 from 67 households in Chazi village is organized into only 8 or 9 herds, summer pastures at high altitude are usually maintained for about 4 months, and herders generally move several times within the area during that period depending upon the condition of the vegetation in each place. In

December, most livestock return to low altitudes nearby where they reside during winter, spring, and summer.

Land Use and Land Cover

Remote sensing shows that the predominant land use (66.1% of the total) in Gangga is grassland for pasture, followed by nonvegetation gravel soils (15.2%), wetlands and glaciers (8.5%), respectively (see Table 1). Cropland accounts for only 1.7% out of a total area of 11,640 ha according to spatial analysis using a 2000 Landsat image.

Wetlands account for 8.5% of the land cover and vary from peat land to swamps and from alpine meadows to riparian sites along the Pengqu River. The wetlands are extremely important because of their productivity and diversity. They provide important grazing areas at low altitudes, particularly during winter and early spring. Floods coming from upstream as a result of glaciers melting have occurred several times and have destroyed agricultural land and changed waterways. Loss of wetland habitat is due to overgrazing, conversion into agriculture, and destruction when turf is collected for housing, heating, and cooking. Climate change is another factor particularly mentioned by local officials for the disappearance of wetlands. Initial remote sensing by satellite imagery also shows changes from wetland to marsh, from marsh to meadows, and from grasslands to desert.

Land-Use Transition

Traditional Tibetan land use is a function of altitudinal gradients, latitudinal variation, and the local political economy. High elevations have limitations in terms of crop production, but have ample alpine meadows and steppe rangelands, whereas villages at lower elevations depend

Table 1. Land-Use/Land-Cover Types in Gangga Township, Dingri County^a

Land-use/land-cover types	Areas (km ²)	%
Wetland	115.7	8.5
Grassland	902.4	66.1
Gravel	206.8	15.2
Cropland	23.4	1.7
Glaciers and tundra	116.4	8.5
Total	1364.7	100

^aInterpreted from Landsat TM (2000) image.

heavily upon agriculture. Mobility was a central characteristic of Tibetan nomads and is still a vital element for agropastoralists in Gangga, although livestock movement patterns are being curtailed, due to escalating sedentarization and establishment of protected areas. The pastoral system is designed around the movement of livestock to different pastures at different seasons of the year, and the favorable forage conditions tracked down by herders living among several tents from the summer to the fall. Local herders reported that most herders graze their herds on a seasonal basis; some maintain permanent camps at high elevations. Groups of herders from each village have delimited grazing areas; all group members have the right to graze their livestock individually and jointly.

More wetlands, including rangelands near local residential areas, have been converted into agriculture, mainly for barley cultivation. Food production reached 1086 kg/capita in Chazi village and 835 kg/capita in Xibei village in 2005, and these amounts are above the national average of 400 kg/capita for China. More and more Tibetans are growing vegetables such as potatoes, peas, and cabbage and other leafy vegetables, not only for self-consumption but also for sale to tourists in Gangga. Landholdings vary from 0.1 to 3 ha per household. Pastoralists and their production systems are always being confronted with changes—droughts that wither the grass, winter storms, and livestock epidemics that wipe out the herds—but the changes pastoralists are facing today are likely to have more significant, long-term effects on their way of life and the ecosystems in which they live.

Population and Livelihood Transitions

Although the “one child” policy does not apply to national minorities, population trends in Tibetan communities have not followed the regional trends of exponential increases. Indications are that population sizes are affected by poor health care, cultural practices of population control and family structure, and emigration. Compared to the previous generation, young people manage more agriculture and less livestock because of rangeland degradation and increased government restrictions on overgrazing. There are increasing opportunities for trade, and off-farm labor such as road construction and tourism development. Local Tibetans have experienced profound livelihood transitions. Diversification of livelihood strategies at household, village, and regional levels is an apparent phenomenon in the TAR. The recent combination of conservation and development

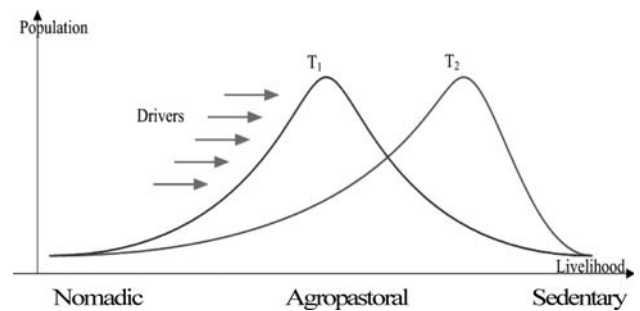


Figure 2. The combination of conservation and development policies, market economy, and rural reforms have driven more of the Tibetan population from a lifestyle of nomadic to sedentary agriculture in TAR, China.

policies, market integration trends, and rural reform has transformed Tibetan society from a lifestyle of nomadic pastoralism into sedentarization in Tibet, as observed by research participants and our project team (see Fig. 2).

The Tibetans have long had a flexible, open-range grazing system suited to optimizing on favorable climatic and spatial changes. Tibetan nomads often own herds of mixed species with production outcomes directed towards human survival, milk and wool production, asset accumulation, and risk aversion, and, in general, maximization of production gains per land unit and labor unit. The failure of state project planners to understand the nature of such systems has led to inappropriate government policies based mainly on fixing the problem (as they see it) of environmental degradation. The frequent shift in land tenure and management practices in past decades has eroded not only traditional practices but also the capability to adapt to a changing environment. Tibetan livelihood transition needs embedded traditional, ecological knowledge (TEK) which is the cornerstone of community-based natural resource management and landscape mobility. Additionally, TEK about population regulation in Tibet includes matrilineal descent and polyandry, and, although polyandry is not always practiced, in the past such systems have managed human populations successfully.

Health Transition

Although the nomadic pastoral lifestyle is often regarded as a harsh, strenuous way of life, our interviews suggest that nomads consider it to be healthy. In contrast, one of the objectives for sedentarization is to create better access to health-care services. However, delivery of health services to the majority of rural Tibetans is hampered by the fact that

health workers in the townships are not very well trained and are not adequate in terms of numbers. With increasing barley production, there has been a significant increase in consumption of barley wine or local alcoholic drinks, as indicated by an increase in liver problems and stomach aches according to records from the health centers. Poor sanitation and inaccessibility to drinking water, particularly in Xibei village, were also reported by villagers. Cooking with biomass fuel causes indoor air pollution which leads to respiratory problems and increases the risk of tuberculosis (Mishra et al., 1999). The poor burning quality of turf makes the situation even worse. Unhygienic living conditions, degraded quality of fodder, and consumption of dirty water increases the probability of transmission of infectious diseases, such as tuberculosis, and waterborne diseases, such as diarrhea, in the village. Salty butter tea, a common drink among Tibetan nomads is not as suitable for a sedentary lifestyle. Degradation caused by climate change and human activities results in an increase in dust storms in winter and spring (Qian and Zhu, 2001). All these changes contribute to more noncommunicable diseases such as diabetes, heart disease, and chronic bronchitis and other respiratory problems. Increasing tourism and migration bring other health risks such as HIV/AIDS. Improved road transportation is always associated with increasing numbers of traffic accidents, infectious diseases, and also social issues. The transitional impacts of land use and socioeconomics on different social groups can vary across temporal and spatial scales. Women are seen to be more vulnerable than men. The Gangga Health-care Centre often has more female patients than male (see Fig. 3), although many other factors apart from gender contribute to health-care behavior.

Health issues related to environmental conditions are quite common, and upper respiratory tract infection,

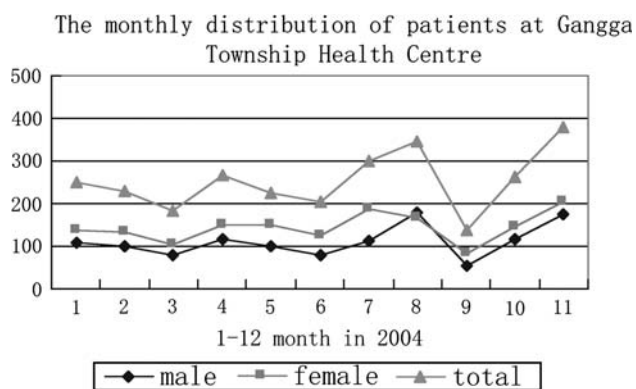


Figure 3. Gender differences in seasonal distribution of patients at Gangga Township Healthcare Centre.

diarrhea, and arthritis are the three predominant health problems in Gangga (see Table 2). Certain diseases, for example tuberculosis, might be underestimated to a significant extent due to poor access and lack of proper diagnoses. Human health transition is closely associated with population, land-use, and livelihood transitions. Emerging climate change may also have significant impacts on human health.

DISCUSSION: MOVING BEYOND MYTHS

Nexus of Land Use and Environmental Degradation

Since the early 1980s, official definitions of “poverty” have gone through several iterations. Definitions in the mid-1980s associated poverty with certain landscapes and land uses, including nomadic pastoralism (Williams, 2002). In the 1990s, official identification of “environmental degradation” in the TAR again associated it with nomadic pastoralism, which is considered to be a “backward” land-use practice, therefore “scientific livestock production practices” needed to be introduced (Miller, 2000). Government projects have sought to settle or sedentarize Tibetan nomads for decades. At the center of the sedentarization project was the conversion of the Tibetan herder into not only a sedentary farmer, but also into one with a modern worldview who is a participant in the market economy. Sedentarization, as an attempt to settle migratory peoples permanently in terms of land use, property, and settlement, is perhaps the oldest and most continuous project of states (Sahlins and Scott, 2001). But modern state-making projects have produced a unique mode of sedentarization: a project of spatial and political identification; houses constructed in evenly spaced straight rows along the road with centrally located schools and health centers; and rangelands fenced into blocks and managed by individual households, which can be easily quantified in terms of carrying capacity of livestock. Such attempts to locate, fix, identify, order, and monitor population, production, property, and exchange are often the project of national states (Sahlins and Scott, 2001). As a result of sedentarization, many nomads have converted into a sedentary lifestyle.

There is a widespread belief that rangelands have relatively constant carrying capacities, which are derived from their native agro-ecological potential, and that stocking strategies exceeding these capacities cause degradation, especially in alpine and arid zones. The intrinsic variability of rangeland ecology, however, makes it difficult to dis-

Table 2. Disease Patterns in Gangga Township of Dingri County in 2004

Type of diseases/symptoms	Female		Male		Total	
	No.	Ranking	No.	Ranking	No.	Ranking
Upper respiratory infections	376	1	337	1	713	1
Diarrhea	200	2	153	2	353	2
Arthritis/joint pains	134	3	85	3	219	3
Stomach ills (gastric ulcer, acid stomach, etc.)	117	4	80	5	197	4
Pain (headache and other pains)	101	5	81	4	182	5
Cholecystitis/gallbladder pain	95	6	35	9	130	6
Heart problems (pain, inflammatory)	66	7	19	13	85	9
Infections	60	8	48	7	108	7
Injuries	46	9	60	6	106	8
Skin problems	31	10	23	12	54	11
Hypertension	29	11	15	15	44	13
Eye infections	25	12	27	11	52	12
Dropsy	24	13	18	14	42	14
Pneumonia	22	14	39	8	61	10
Toothache and infections	21	15	18	14	39	15
Urinary infections	10	16	28	10	38	16
Others	210	—	154	—	364	—
Total	1567	—	1220	—	2788	—

tinguish directional change (e.g., loss of biodiversity and soil degradation) from readily reversible fluctuations; hence, interpretations of “degradation” and “desertification” should be viewed with caution (Lambin et al., 2001). Rangelands in alpine or arid zones are increasingly seen as nonequilibrium ecosystems. Modification in the biological productivity of these rangelands on the annual to decadal time scales is mainly governed by biophysical drivers, such as climate change, and human factors such as mismanagement. State policies are framed under the assumption that Tibetan pastoralists overstock rangelands and that this leads to their degradation. The resulting policy interventions and management strategies aim to privatize grazing lands to the care of individual households, exclude livestock through fencing of pastures, and plant forage species to harvest hay for winter consumption. These development activities are being undertaken on a large scale with substantial government investment. Weakened indigenous pastoral systems undermine resilience of local people to natural hazards, such as drought and snowstorms, because mobility was central to its productive efficiency and ecological sustainability. With a sedentary lifestyle, land use will be concentrated in settlements established close to one

another, and, thus, local overstocking and degradation are inevitable.

Exclusion and reduced grazing also lead to poor livestock composition, with implications for animal production, biodiversity, and livelihoods. A reduced number of yaks means less dung for fuel; when nomadic populations are settled, there will be an increasing demand for fuel for heating and cooking. Barley is the predominant staple and is eaten in the form of roasted barley flour. The preparation of barley flour needs huge amounts of fuel. Most of the cooking fuel used is in the form of dried turf and animal dung cakes. Extraction of turf has increased substantially, contributing to degradation of the pastures, particularly at low elevations. When the turf is removed, an area soon becomes desertified due to high rates of evaporation. Increasing demands for turf for cooking, heating, and roofing is one of the challenges of a sedentary lifestyle. The local government has controlled turf extraction by limiting it to 50 pieces per family annually. Rangeland degradation caused by overgrazing and turf collection provides a suitable environment for unpalatable plant species, and palatable grasses decrease under heavy grazing. Insufficient fodder of good quality has direct impacts on animal health

in terms of nutrient availability; hence, also on human health.

The contribution of climatic factors to local degradation is also mentioned by both Tibetan herders and local officials. One study (Jin et al., 2004) cites an observed temperature increase of up to 3°C from 1960 to 2000; this has impacts on glaciers and permafrost at high altitudes causing glacier loss of 10%, a reduction of 9% in glacial coverage, and decrease in mass balance of 8.4%. This warming trend is much greater than that of China as a whole, and than the global average. Local climate warming promotes vegetation growth, and accelerates land degradation by affecting water conditions (increase in evapotranspiration) (Du et al., 2004). Although rainfall increases, it does not offset the water lost from the increase in evapotranspiration. Local people report both loss of wetlands and desertification of rangelands.

Nexus of Land Use and Human Health

Poor health services in rural Tibet have resulted in high infant morbidity and mortality, and frequent occurrence of hepatitis, tuberculosis, and other diseases in adults, hence, suggesting a significant link between environmental sanitation and disease (Foggin et al., 2006). Despite changes in perceptions of poverty–human links, many policies and economic incentives for rangeland management systems and development strategies are still based on separating people from their environments, their traditional livelihoods, and from their cultural practices. Human health is seen solely as a technical and infrastructural issue. Such policies have limited success in addressing linkages between ecosystem functioning, rural development, and human health. The resulting health interventions, therefore, aim to improve health facilities, subsidize treatment, tap drinking water, and vaccinate children in the same way that interventions are taking place all over rural China. Another intervention settles nomads by constructing homes along the roads or already congested winter pasture sites at low elevations. Common features include inadequately addressing endemic health issues, weakening traditional ecological knowledge systems for access to local, natural resources such as water, fuel, and nutrition, and new health risks in the changing environment, such as indoor pollution and sanitation.

There is a range of possibilities for interaction between humans and the ecosystem. Measures towards economic development should take into account the historical,

political, economic, and cultural contexts of these interactions. It is only too common to place the responsibility for environmental problems on local communities while disregarding the linkages between state policies and economic pressures. Overcoming the dichotomy in the perspective of local communities as either “noble” or “bad” savages is equally important in promoting an ecosystem approach to human health and rural development. Recognizing new types of knowledge (scientific, local, and indigenous) and their role in managing land use, livelihood, and health transitions will help to avoid the extremes of either dismissing local perceptions, practices, and knowledge as “unscientific” and harmful, or idealizing them. Human health is dependent not only on access to basic health services but also on ecosystem services through different land-use practices.

Both government programs and economic development have profound socioecological consequences on traditional pastoral systems. It is important to develop an ecosystem approach of from water to land, from food to energy, and from housing design to basic sanitation in the construction of new, rural Tibetan communities. Old infectious diseases, such as tuberculosis, seem more severe than ever before due to more interaction between livestock and humans (Xiao, 1998; Cosivi et al., 1998), increasing use of biomass fuel (Mishra et al., 1999), and congested settlement; new diseases, such as HIV/AIDS, emerge as a result of migration and increasing numbers of tourists. Non-communicable chronic diseases, such as heart disease and cancer, appear to be due to changes in lifestyle.

The state modernization project also creates new nomads, the urbanized Tibetan population. The surplus of rural labor and limited employment opportunities are common social issues in rural Tibet. Rural–urban movement in the TAR, linked to complex socioeconomic changes, threatens the whole notion of “the urban,” “the civilized,” and the “city” itself. Sedentarization has been accompanied by an increase in other social and health issues that accompany a settled living environment.

CONCLUSION

Healthy ecosystems and good health are vital to the continued “virtuous cycle” and its sustainability in coupled human–environmental systems (Manuel-Navarrete et al., 2007). Where ecosystem degradation often leads to poor health and poverty, the consequences are “vicious cycles”

of poor health and poverty. Socioeconomic development driven by outsiders might have positive, but sometimes has negative, impacts on human health (Woodward et al., 2000). Tibetan nomads have been experiencing profound environmental changes and socioeconomic transformation, and these have significant long-term implications on their nomadic way of life, the ecosystem they strive to maintain, use, and nurture, and their health in both positive and negative aspects. The agropastoral system is still in a state of transition. The case study on Tibetan nomads we have presented above shows how rich the array of local-level human–ecosystem interactions can be. We argue that many development programs for mountain people, such as Tibetan nomads, are based on a limited understanding of their land-use system and its implications for human health, and vice versa. In other words, environmental change—including climatic warming—and other socioeconomic transformations have accentuated the critical linkage between land use and human health in the case of the Tibetan agropastoral system.

There is still a great deal of uncertainty about the Tibetan pastoral system and human health. The sedentary way of life needs to be established with proper management systems, as pastoralists are not familiar with the rate and magnitude of socioecological changes or the potential implications for their health. During the same period that some government policies have claimed to focus on new health programs and interventions, new health problems have become visible among increasingly sedentary Tibetan nomad populations. This reminds us that human health should not only be seen in relation to health services, but as being intimately connected to the state of: 1) the ecosystem—including land use and land cover; 2) social institutions for settlement and social services; 3) diet and nutrition; 4) rural energy and sanitation; 5) mobility and flexibility of social networks; 6) access to primary health care; and 7) evolving ecological knowledge along the land-use and human health nexus. Health interventions that ignore these factors will seldom be as successful as desired. Rural development programs should not only pay attention to the production of food and fuel and but also to an integrated approach to management of rangelands, wetlands, and other habitats. Ecosystem approaches that link land-use transitions and human health can help to define important complex pathways of feedback from coupled human–environment activities. Improved understanding of how human actions affect land use and land cover, and the consequences of these changes on the human health of

indigenous people, should be the focus of ongoing research, evaluation, policy, and action.

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