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Traditional Ecological Knowledge (TEK) and Modern Natural Resource Policy in China: Pathways for Integration

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by

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Table of Contents

Abstract

By the late 1990s, decades of environmental mismanagement, guided by the exclusive goal of economic growth, culminated in widespread environmental problems in China. China has implemented sweeping projects aimed at reforming land use in rural areas, where the government says local and indigenous peoples are causing environmental degradation. However, many claim the Chinese government, acting on urgent modernization goals and internal prejudices against indigenous groups, has implemented excessive and inappropriate restrictions that damage livelihoods and the environment. Indeed, researchers have advocated the benefits of traditional ecological knowledge (TEK) and indigenous cultivation systems for their holistic view of the environment and suitability to local conditions.

This paper will first describe characteristics of TEK and place it in the context of “new ecology” and nonequilibrium theories. This paper will then illustrate China’s history of environmental policy since Mao Zedong and analyze current environmental programs. Next, this paper will look at case studies of traditional cultivation and indigenous knowledge systems in various rural communities in China. Finally, this paper will suggest solutions for integrating TEK and modern resource management in order to provide a more appropriate and effective environmental policy in China.

Introduction

China is a vast territory with incredible variation in landscapes, extending from the lush tropical rainforests of the southeast to the grasslands of the northwest to the vast, arid Tibetan and Loess Plateaus of the central and western provinces. The difficulty of environmental management in China has been a concern since the imperial era, however, and since the 1990s, environmental degradation has raised considerable alarm among government officials and the general populace. These ecological problems include air and water pollution, the loss and degradation of forests, and soil erosion and desertification. The balance between environmental sustainability and economic growth has been difficult to manage. Cao noted, "Of the 142 countries for which environmental sustainability has been evaluated, China ranked 129th, higher only than Nigeria among countries in a comparable stage of development" (Cao 2010, 1455). The use of China's limited and rapidly disappearing natural resources has been a focus of the central government since Mao's accent to power in 1949 in order to maintain social stability, increase economic prosperity, and improve its image on the world stage.

Since the Deng era, the focus on the "four modernizations" of industry, agriculture, national defense, and science and technology has guided top-down economic and social policies in China. Policymakers created a dialogue of urgent modernization aimed at drastically increasing quantitative indicators of economic growth through top-down governmental approaches, while remaining short sighted in the face of growing ecological problems. When the extent of China's of environmental degradation became too severe to ignore in the late 1990s, national leaders implemented a series of programs, among them the Sloping Land Conversion Program (SLCP) and the National Forest Conservation Program (NFCP). These programs target major watersheds like the Yangtze and Yellow Rivers, which contain thirty-nine percent and

nineteen percent, respectively, of China's cultivated area affected by "intensive" erosion (Bennett 2008, 700). However, like much of China's environmental policy, SLCP and NFCP have been criticized for their intense focus on short-term, quantitative goals and lack of consideration for local environments and communities. Many have questioned whether SLCP and NFCP are creating long-term, qualitative improvements in China's environments and whether they are having unintended consequences regarding social and economic development in rural areas. Scholars have called upon Chinese politicians to look at a different approach to environmental policy, one that is created in cooperation with rural communities and allows for incorporation of indigenous knowledge and practices, termed Traditional Ecological Knowledge (TEK). "New ecology" and nonequilibrium theories offer unique viewpoints on TEK and its function within alternative resource management systems that question conventional resource-use wisdom and seek integrative environmental policy that is more appropriate to local communities and their environments.

Chapter One

Traditional ecological knowledge

Traditional ecological knowledge defined

Traditional ecological knowledge (TEK), local ecological knowledge (LEK), and indigenous knowledge (IK) are all terms used to describe the worldviews and understandings of a community derived from a broader, more holistic knowledge of one's social and natural environments. TEK and LEK result from "a very intimate relation among people, the environment, and natural resources" and reflect livelihood dependencies "embedded within specific localities" as well as "a very particular and detailed knowledge of local environmental conditions and ecological relations" (Davis & Wagner 2003, 464). Berkes et al. describe traditional knowledge as a "knowledge-practice-belief complex" that consists of three components: local observation of environmental phenomena, practice of how people carry out resource use activities, and belief of how people fit into their ecosystem (Berkes et al. 2000, 1252).

TEK and LEK have been cited as valuable contributions to environmental policymaking because they often imbue various characteristics that are environmentally and socially beneficial. TEK and LEK are unique in that they are derived through place-based, experiential learning that fosters a connection to the environment and motivation to participate in and protect the natural surroundings (Liu 2010, 278). This is often reinforced by a reverence for nature, the core of the worldview for many indigenous communities' that also imparts sacred or religious association on native flora and fauna and other natural phenomena like lakes, forests, and springs (Luo et al. 2009, 1995). This "sacred ecology" upholds the idea that humans and nature are interconnected

and is thought to contribute to the conservation of landscapes (Xu et al. 2005, 160). Perhaps the most distinguishing characteristic of TEK and LEK is its dependency on social mechanisms, which help internalize a community's knowledge and belief systems. According to Berkes et al., social mechanisms can largely be categorized by folklore, taboos, and rituals, which work together to maintain and preserve ecologically sound management practices. Social mechanisms also build resilience in ecosystems by coping with unexpected events through short-term responses to "environmental surprises" and institutional flexibility under changing circumstances (Berkes et al. 2000, 1257-1258). The result of TEK and LEK's unique characteristics is a holistic worldview that promotes environmental ethics and a cosmology that views the world as a "community of beings" (Berkes et al. 2000, 1259).

Arguments for TEK in natural resource management

TEK is part of a relatively new paradigm within the scientific community known as "new ecology," a biogeographical theory that emphasizes natural and human-made disequilibria, instability, and fluctuations within the environment (Zimmerer 1994, 108). Disequilibrium and disturbances, like fires, pest outbreaks, and other natural disasters, are inherent to ecological function and often trigger necessary renewal processes. Holling (1986, 1992) describes the cycle of ecosystem succession and resilience as a sequence of phases. The exploitative phase is characterized by high resilience and rapid colonization in recently disturbed areas. This is followed by a conservation phase, whereby material and energy are accumulated and stored and species experience slower growth rates. This phase is also characterized by decreasing ecological resilience, whereby the system approaches its limits to growth and stability becomes very narrow. The conservation phase ends when a disturbance, like forest fires or intense

grazing, initiates structural changes to begin the phase known as creative destruction. The system then enters the fourth phase of reorganization and begins the process again (Holling 1986, 1992 in Gunderson 2000, 430).

Some traditional and indigenous subsistence practices create and foster disturbances to improve ecosystem function and resilience, which is defined as "the ability of a social-ecological system to withstand disturbance…and to remain flexible in response to changing environmental and social contexts" (Bohensky 2010). This is true of traditional agroforestry practices like *milpa* and *jhum*, which intercrop by creating gaps in the forest in order to harvest crops without disrupting these natural disturbance cycles (Berkes et al. 2000, 1256). TEK also enhances ecosystem resilience because it is formed through generations of accumulated observations and experiences, which allow it to be flexible and complex (Bohensky 2010). Although some perceive TEK to be an uncivilized or crude method for deriving information from the environment, its practices of observation and experiential learning offer invaluable insight into the surroundings that help in response to environmental feedbacks. Because individuals live and work in such close proximity to the resource, they are able to observe daily changes and accumulate very detailed information about their local ecosystem often in areas where little formal knowledge exists (Bohensky 2010). Traditional societies also often utilize a diversity of resources for livelihood security that maintain resilience and minimize risk, such as the practice of rotating resources through integrated farming and shifting cultivation in order to prevent overuse and maintain ecosystem integrity (Berkes et al. 2000, 1260).

The call for a new approach to environmental management is often centered on the desire to expunge old management systems that attempt to predict the future and adopt a new paradigm that is able to react to environmental feedback and accommodate local and traditional

knowledge. New ecology and nonequilibrium theory are often seen as contradictory to conventional ways of thinking about the environment, which believe nature is constantly seeking stability and balance (Zimmerer 1994, 108). Conventional resource management has been criticized for too much emphasis on ecosystem stability, predictable yields, and the use of primarily quantitative techniques (Berkes et al. 2000, 1259). Modern resource management often fails to consider the complex relationships among many variables, including non-environmental ones, which lead to disturbances and unpredictability within the environment, breaking down analysis into piecemeal sets of solutions (Gunderson 2000, 431). These practices appear to cause loss of ecological resilience that is often masked through modern technological inputs, like fertilizers, or socioeconomic structures that distribute financial incentives for maintaining practices despite signs of ecological disturbances (Berkes et al. 2000, 1259).

TEK, viewing resource management from a resilience and adaptive point of view, addresses the shortcomings of modern management techniques and invalidates much of the conventional wisdom about indigenous knowledge. Although some may falsely view indigenous groups as being "noble managers" of their environment, imbued with a higher environmental morality, in reality, the insightfulness of TEK is derived from historical experience with disturbance and ecological surprises, the social mechanisms engendered from these experiences, and the lack of modern technology to otherwise cope with disturbance (Berkes et al. 2000, 1260). In some cases, TEK is more accurate and complete than formal scientific analyses because it incorporates a practical concern and awareness of which ecosystem functions are most valuable and how best to maintain those functions (Chandler 1994, 416). Zimmerer argues that "new ecology" is more in touch with actual environmental conditions and therefore more realistic than equilibrium-based models that seek absolute certainty in environmental fluctuations, saying "The

hubris of unwarranted certainty, it turns out, has been responsible for numerous cases of environmental mismanagement" (Zimmerer 1994, 115).

"New ecology" and the theory of nonequilibrium ecology have made their way into the dialogues of new scholarly understandings of biodiversity in rainforests and rangeland ecology. The theory of nonequilibrium has shed new light on desertification and soil degradation as a natural phenomenon, whereby soil fertility may be renewed once a plot of land has been cultivated, abandoned, and had sufficient time to recover (Ho 2000, 356). "New ecology" has also challenged the traditional theory of carrying capacity by questioning its underlying assumption of "spatial homogeneity of environments" that is often used to create generalized, sometimes artificial, quotas for livestock on grasslands (Zimmerer 1994, 112-113). Moreover, international organizations have begun to recognize the significance of adaptation on rangelands and how many pastoral groups have cultivated such knowledge. The International Convention to Combat Desertification requires parties to "…protect, integrate, enhance and validate traditional and local knowledge" and "…protect, promote and use in particular relevant traditional and local technology…" in policies related to desertification and soil erosion (Mauro & Hardison 2000, 1266).

On the issue of biodiversity, it has been shown that nonequilibrium theory not only exists in diverse landscapes, it is also integral to the enhancement of biodiversity. Vandermeer et al. illustrate how rain forest structure consists of many potential points of equilibrium and multiple "basins of attraction," with "continual shuffling among various basins as disturbance events repeatedly affect the forest and deter any particular basin from capturing the trajectory permanently" (Vandermeer et al. 2004, 576). The idea that disturbances and fluctuations are inherent to rain forest function prompted "new ecology" scholars to question the idea that

competitive exclusion and niche specialization are solely responsible for biodiversity, as well as the "stable" conditions that were believed to allow ecological specialization. Instead, "new ecology" has highlighted a variety of aspects that contribute to biodiversity and environmental complexity and called for biodiversity management practices and biosphere reserves to acknowledge these factors (Zimmerer 1994, 114).

Incorporation of TEK into resource management not only benefits environmental integrity but also serves to empower local and indigenous communities. By recognizing the value of what local and indigenous people have to contribute to environmental policy, regional and national leaders empower these communities by developing respect and allowing them greater flexibility in self-directing management within their own surroundings (Davis & Wagner 2003, 465). In recent years, conservation biologists, ecological anthropologists, and pharmaceutical researchers have all expressed interest in TEK for scientific or economic reasons (Berkes et al. 2000, 1251). The United Nations has also made TEK a primary focus within its development agencies among those concerned with sustainable development and indigenous rights. In their *Agenda 21* put forth at the 1992 Earth Summit, the United Nations declared:

> …in view of the interrelationship between the natural environment and its sustainable development and the cultural, social, economic, and physical well-being of indigenous people, national and international efforts to implement environmentally sound and sustainable development should recognize, accommodate, promote and strengthen the role of indigenous people in their communities (Jun 2010, 59).

Government policymakers have been accused of being detached from the surroundings that they manage, as they are not direct resources users (Berkes et al. 2000, 1259). TEK, unlike

ponderous federal bureaucracies, acknowledges that the environment is always evolving and that uncertainty and adaption are inherent characteristics of all ecosystems (Berkes et al. 2000, 1260). Like the dynamism and intricacy of environments, the complexity of indigenous livelihoods is often misunderstood, as is evident in China's current bureaucratic policies that simplify these dynamic systems and force people out of nature reserves and into sedentary or "modern" lifestyles (Xu et al. 2005, 155). As a result, indigenous practices and discursive knowledge have been largely excluded from the dialogue on environmental management and conservation, however, were traditional and indigenous practices to be incorporated into resource management, environmental policy would greatly benefit from their astute observations and unique approach to management and conservation. This includes practices such as polyculture, integrated farming, and agroecology that have been discredited for being environmentally degrading or economically inefficient but are now being rediscovered (Berkes et al. 2000, 1254). Long & Zhou point out that "it is the indigenous people who have defended forests and biodiversity in their traditional agroecosystems for many generations" (Long & Zhou 2001, 753). The acceptance and integration of TEK into environmental and social polices therefore cannot simply be a superficial symbol of goodwill or underhanded attempt at social coercion, but must imply a radical shift in thinking about environmental management and social welfare.

Chapter Two

A history of environmental policy and environmentalism in China since Mao Zedong

The Mao era

In the years leading up the Communist takeover of China under Mao Zedong, the country witnessed devastation as a result of the invasion of Japan and civil wars between the Nationalist and Communist parties, events that were worsened by economic blows like the loss of resource-rich Manchuria to Japan in 1932 and rising prices due to the outflow of silver in 1933 (Ho 2000, 3735). These events had notable effects on the nation's rural poor, who constituted a large majority of the population. When Mao Zedong and the Communist Party came to power in 1949, they sought to establish legitimacy by focusing on social justice and rural economic development, beginning with the overthrow of the "feudal" system of private land ownership and the establishment of collectively owned People's Communes (Muldavin 1997, 582). People's Communes owned the agriculture and forest lands, however land-use decisions were made at the national level in accordance with quotas set forth under the centrally planned economy with little regard to local environmental or human needs (Xu et al. 2005, 157). These agricultural practices were part of a national "eco-philosophy" influenced by Western Enlightenment notions of the environment that "regards nature as an instrument to serve human ends, that focuses on human mastery over nature, and that forsakes the core of traditional culture that sanctifies nature" (Shi 2002, 360). It is therefore not surprising that when development of China's modern legal system began in the 1950s, scarce attention was given to environmental legislations (Palmer 1998, 780.) Indeed, legislation rarely addressed the rural environment for the majority of Mao's rule, although the People's Communes were often used to mobilize peasantry to construct environmental infrastructure like dams and irrigation systems and often indirectly facilitated

degradation of the nation's grasslands, forests, waterways, and agricultural lands (Sanders 1999, 1204). Two distinct periods of environmental and social devastation emerged in the decades of Mao's rule: the Great Leap Forward (1958-1961) and the Cultural Revolution (1966-1976).

Great Leap Forward

Mao's utopian strategy of mastering and manipulating nature in the pursuit of economic growth became national policy during the Great Leap Forward. The peasantry was encouraged by Mao's impassioned directives to "[o]rder rivers to change their channels; make mountains give way." Mao's policies covered every aspect of the environment, but were primarily concerned with the expansion of agricultural land through the filling in of wetlands, rivers, and lakes, and the felling of forests in order to fuel the massive steel smelting campaigns (Hou 1990, 155). Mao's agricultural policy was driven by the policy known as "take grain as the key link" (yǐ liáng wèi gāng 以粮为纲), which sought to increase grain production through the creation of monoculture plantations, aided by the use of chemical fertilizers and pesticides. This quantitative decision by the central government created widespread environmental devastation, due to the leeching of chemicals into waterways, which caused water eutrophication and toxicity and the degradation of soil fertility (Sanders 1999, 1203).

Forests witnessed similar exploitation and destruction of resources during the Great Leap Forward, primarily because policy was driven by the classical economic "labor theory of value," which values commodities based on how many units of labor was involved in its production. Because human labor is not involved in the production of forestry products, like timber and animals, these resources were perceived to have only positive economic input and were therefore treated as "free goods" to be exploited without regard to replacement (Harkness 1998, 913).

Natural forests in particular were viewed as lacking any value in their natural form because no human labor had been involved in their growth, and many were cut down and replaced with economically productive commodities like fruit trees (Sturgeon 2009, 489). Government ministries acted more like suppliers of raw materials like timber and coal rather than managers of limited, renewable resources (Harkness 1998, 913). Although Mao showed interest in maintaining environmental integrity through the promotion of "green agriculture" and afforestation programs, these concerns were overshadowed by economic priorities and rarely achieved lasting results (Palmer 1998, 790). These afforestation campaigns had ambitious tree-planting goals, however they have very low survival rates, often only a few percent (Uchida et al. 2003, 3).

Cultural Revolution

During the decade of the Cultural Revolution, the threat to the environment was more indirect, resulting in the intentional eradication of indigenous knowledge and practices. Mao viewed local cultural beliefs as an impediment to China's modernization and industrialization and, true to modernist belief, propagandized indigenous practices as "superstitious and backward." All religious practices were forbidden, local temples and monasteries closed or destroyed, ancient literature burned in public, and religious practitioners chastised as belonging "to one of the 'nine categories of bad people' and classified as 'monsters and demons' and 'forces of evil'" (Xu et al. 2005, 158). Much traditional ecological knowledge was lost during this period, creating a generational knowledge gap of cultural identity and resource management. The breakdown of local and customary institutions facilitated widespread environmental destruction, particularly deforestation, in once sustainably managed ecosystems (Xu et al. 2005, 158). Personal lands,

which were denounced as the "tail of capitalism", were collectivized and all forests and agricultural land was placed under the authority of communes (Long & Zhou 2001, 756). In addition to policies during Mao's tenure that directly undermined environmental function and integrity, his belief in "humankind dominating nature" led to an unprecedented seventy-one percent growth in the population within a quarter of a century (Sanders 1999, 1203). The resulting strain on the environment led unavoidably to the pollution of already scarce water resources, deforestation and loss of biodiversity, and the increase of floods and droughts due to the disruption of upland watersheds (Sanders 1999, 1203).

It was not until 1972 that three important red flags finally alerted Mao's regime to the severity of China's environmental destruction. The first two were domestic environmental disasters located close to the government's seat of power in Beijing. First, a massive red tide in Dalian Bay, located east of Beijing, caused significant losses in shellfish and a crisis for the local seafood industry. Second, the distribution of toxic fish from the Guanting reservoir, polluted by industrial chemicals, to the Beijing fish market led to the first state acknowledgement of widespread pollution problems. The third critical event was the United Nations' Conference on Health and Environment in 1972, which was attended by a Chinese delegation, whose recommendations promoted China's State Council to issue a series of new environmental decrees and policies (Muldavin 2000, 252). The UN conference reflected a growing global movement towards environmentalism, spear-headed by the 1972 *Stockholm Declaration*, which proclaimed "man has the fundamental right to freedom, equality, and adequate conditions of life, in an environment of quality that permits a life of dignity and well-being, and that he bears a solemn responsibility to protect and improve the environment for present and future generations" (Jun 2010, 59). The international environmental movement aided in the strengthening of

environmental awareness and regulatory work in China, and, in 1973, the State Council held its first national conference on environmental protection in Beijing (Muldavin 2000, 253). The conference produced a draft for the 1973 Rules on Protecting and Improving the Environment, which provided a basic framework for environmental protection (Palmer 1998, 790).

The Deng era

In the wake of Mao's radical social and economic policies that left the populace and the environment yearning for reprieve, Deng Xiaoping emerged as a reformist leader who sought to restrain unabated environmental destruction and restore personal rights. Deng embraced the concept of environmental protection, as evidenced by the incorporation of environmental welfare into the Chinese Constitution, enactment of environmental laws and policies, and commitment to international environmental treaties. However, in keeping with Chinese communist ideology, this was entirely enacted at the federal level through quantitative means and gave the central government sweeping authority in the realm of environmental policy. In 1978, the constitution was amended to include Article 11, which declared, "the state protects the environment and natural resources, and prevents and eliminates pollution and other hazards to the public." In 1982, the central government's authority over the environment was again expanded to include Article 26, which stated, "the state protects and improves the environment in which people live and the ecological environment," "prevents and controls pollution and other public hazards," and "organizes and encourages afforestation and the protection of forests." Article 9 was also added to ensure "the rational use of natural resources and protects rare animals and plants" and prohibit the "[a]ppropriation or damaging of natural resources by any organization or individual" (Palmer 1998, 790). The Chinese central government vastly increased the quantitative indicators of

progress in the environmental arena. In 1979, the Environmental Protection Law and Forest Law were ratified, which were landmark in their facilitation of the establishment of nature protection reserves; in 1982 alone 100 reserves were established with the aid of 2,500 specialists (Harkness 1998, 915). By 1990, three principles had emerged as the pillars of China's environmental protection paradigm: "'putting protection first and combining prevention with control', 'making the causer of pollution responsible for treating it' and 'intensifying environmental management'." As a result, environmental impact statements were encouraged, responsibility systems developed, and environmental monitoring strengthened (Sanders 199, 1206). International treaties and conventions, including those pertaining to the environment, increased dramatically, and this period accounted for eighty-eight percent of all treaties that had been signed or ratified since 1949 (Chan 2008, 293).

Despite legal advances and political initiatives made in the name of restoring environmental integrity and social rights, many of Deng's policies continued the policy of economic prioritization. In 1978, the third plenum of the party's Eleventh Central Committee introduced a new idea on Chinese modernity, characterized by the "four modernizations" in industry, agriculture, national defense, and science and technology, of which population became the key barrier to achieving these urgent goals (Greenhalgh 2003, 165). China's population was experiencing an explosion following governmental mismanagement of the environment and a series of natural disasters from 1959-1961 that reduced the rate of natural increase to -0.46% (Shen 1998, 32). However, by 1970, the fertility rate in China had increased to 5.75, and political leaders adopted the idea that population was the singular obstacle, and indeed a social and economic crisis, to the achievement the "four modernizations" and rapid development (Shen 1998, 36, Greenhalgh 2003, 172). The desire to increase economic output while curbing

environmental destruction prompted the Committee to initiate stringent family planning programs, the most controversial of which is the 'one-child' policy. This policy emerged from Western scholarly ideas about "limits to growth" and Malthusian population dynamics, which raised alarm over population explosion and proposed control theory to mitigate growth (Greenhalgh 2003, 170).

However, the one-child policy exemplifies many flaws resulting from China's urgent preoccupation with modernization through top-down "scientific" research. Although many critiques had emerged over "limits to growth" theory, Chinese policymakers focused solely on bureaucratic, "engineering-type" control solutions for their perceived population crisis (Greenhalgh 2003, 170). The idea that science and technology was "the prime source of truth" and "an all-powerful solution to China's problems" dominated the Deng regime's economic and social policy. It was believed that the key to achieving national wealth, power, and glory lay in Western scientific ideas on population that treated people "like numbers to be manipulated from a center of control" (Greenhalgh 2003, 170). This idea extended to the growing concern of environmental degradation, which was believed to be a symptom of excessive population pressure that was decreasing forest area, arable land, and food supplies (Greenhalgh 2003, 175). Greenhalgh describes the mindset of policy-makers and population scientists during this period:

> In the Chinese political context, where the "correct" policy could only be determined by political leaders, science certainly could not mean the systematic testing of hypotheses and rejection of ones that lacked empirical support. Both published discussions from the [Second National Symposium on Population in Chengdu] and interviews I conducted a few years later make clear that science meant quantification and mathematical manipulation of numbers, especially using

> what were seen as advanced analytic techniques from abroad. The systems engineer Wang Huanchen put the point forcefully, arguing that Chinese social science, "because it lacks quantitative things", was not up to the task required of the population field, but the quantitative research, especially along the lines of population systems engineering, could provide the answers to China's critical problems of population policy (Greenhalgh 2003, 169).

Moreover, the true nature of population growth and its role as the sole contributor to environmental degradation and economic hinderance in China during this period was largely exaggerated in order to validate strict and unpopular family planning policies like "one-child" policy. Policymakers often compared China to the United States and Japan, whose per capita incomes had greatly increased during this time, while China's had only grown modestly. It was asserted that China's population, rather than other sources of economic problems, was the only striking difference between these countries' trajectories, and its control would surely bring about a "quick fix" to the myriad problems facing the Chinese economy and society (Greenhalgh 2003, 175).

In addition to the "one-child" policy, Deng's regime initiated another plan aimed at removing the obstacles to economic growth. The Household Responsibility System (HRS), instituted in 1981, dismantled the commune system set up under Mao and redistributed agricultural and forest land to peasants in order to stimulate agricultural production in rural areas (Sturgeon 2007, 140). Although the system increased peasants' immediate direct control over agricultural production, the program largely reduced peasants' decision-making regarding resource management and promoted environmental destruction of agricultural and forest lands. This is partly attributable to the elimination of the communes, which previously provided the

collective action needed for resource conservation and ecological projects, such as those pertaining to pest management, soil and water conservation, and biogas production (Shi 2002, 364). In some areas, the implementation of the HRS was a direct cause of environmental destruction; in the early 1980s many farmers were fearful of another sudden change in land use policy and responded by cutting down all the trees on their land (Harkness 1998, 914). In her work in Mengsong village of Yunnan Province, Sturgeon illustrates how HRS undermined the local indigenous community:

> The best quality forests went to the state; households received plots for fuel-wood forest; and hamlets got areas of collective forest for house construction. The areas of customary protection—woods right around the hamlet, watershed forests, and cemetery forests— were designated as protected forests, but now monitored by the [local] forestry station rather than by village elders (Sturgeon 2007, 140).

Another aspect of HRS that had unforeseen consequences for the environment was the introduction of market economics, which today still has significant influence on environmental protection. Muldavin notes that the market has replaced the collective commune as the decision-maker, and the new highly competitive environment has forced peasants to shift to less sustainable production practices despite knowledge of their long-term unsustainability (Muldavin 2000, 254). Chemical fertilizers have largely replaced organic fertilizers and other traditional practices, which are typically time-consuming and labor-intensive (Shi 2002, 364). The lack of appropriate technology and skills has led to wasteful extraction of coal and minerals and contributed to air and water pollution (Muldavin 2000, 255).

Market economics have not just been passively allowed to transform rural environments, but economic growth and development are consistently prioritized over environmental protection

at both the national and local levels. The view was encouraged that China must “avoid ‘negative protection of the environment’ at the expense of developmental needs,” and, as a result, the government has underfunded many forest and agricultural programs (Palmer 1998, 791). Local town and village enterprises that employed environmentally destructive practices were rarely prosecuted for ecologically destructive practices, but in fact received preferential treatment in the form of relaxed environmental regulations in order to encourage economic development. A 1986 study by the International Centre for Integrated Mountain Development in Nepal and the Beijing-based Commission for the Integrated Survey of Natural Resources found timber harvest rates in Sichuan Province (see Figure 1) to be three times the rate of regrowth, leaving areas of land as large as 42,000 square miles in western Sichuan denuded and at risk to soil erosion (Litzinger 2004, 495). In most cases, environmental neglect also resulted from inadequate fiscal support from the central government, which expects local communities to foot the financial burden of implementing state-planned environmental projects and enforcing regulations (Muldavin 2000, 255). Policies like these ensure that even the most protected areas fall victim to exploitation. Lack of funding for the nation’s nature reserve system has led central authorities to encourage reserve directors “to diversify their funding sources and also to ‘fully exploit the resource advantages of nature reserves and on the basis of strengthening conservation, rationally open up utilization, develop your own industries, and increase reserves' abilities for self-accumulation and self-development’” (Harkness 1998, 917). The result has been that China has remained well below the worldwide average forest cover of thirty-one percent, plagued by “‘massive illegal logging’, ‘enormous fraud and waste’, ‘inadequate prevention of forest fires and poor fire-fighting facilities; and ‘false reporting, ineptitude…bad management, theft and blatant looting’” (Sanders 1999, 1207).

The agricultural sector witnessed similar widespread financial neglect in the late 1980s in the name of economic liberalization. By the 1990s, state expenditure in agriculture had dropped from thirteen percent to five percent since 1978, and in 1988 one-third of state investment in this area was financed by foreign sources like the World Bank. Even the most basic of agricultural infrastructures, like dikes, irrigation canals, and erosion control structures, received little investment for maintenance or improvement (Muldavin 1997, 600). The decline was so catastrophic to the agricultural sector that the period between 1985 and 1989 witnessed nationwide agricultural stagnation (Muldavin 1997, 598). Degradation of agricultural land continued into the following decades. Industrial expansion claimed vast areas of agricultural land, which shrank by a net total of 4.42 million hectares (roughly the size of Vermont and New Hampshire combined) between 1978 and 1996 (Lin & Ho 2005, 411). It is estimated that, by 2006, more than sixty million farmers in China had lost their lands to commercialization and development, and that these land sales were often used to provide "extrabudgetary revenues" and kickbacks to local Party officials (Bardhan 2010, 139).

The social effects of China's economic policies and environmental neglect resulted in an acceleration of local-level disasters and social unrest in the 1990s. The dire state of agricultural infrastructure meant that rural agricultural fields eroded and salinized. Continued environmental degradation and pressure for economic growth, combined with the government's refusal to provide assistance to local communities, bred anger among China's rural population. Muldavin notes the abundance of complaints by villagers who feel trapped by "the contradiction between their attempts to meet subsistence needs and the demands of local state authorities for higher taxes" (Muldavin 1997, 600). Social unrest in rural, agricultural areas emerged in the 1990s with instances of small-scale acts of resistance and ethnic and class-based conflicts, including

cheating on grain quotas and evading taxes (Muldavin 1997, 604). Moreover, the single-minded objectives of state-sponsored environmental projects—increasing forest cover or agricultural output—have diminished local peoples' right to influence decisions made in their own communities and excluded any consideration for their insightful knowledge of indigenous species and traditional management practices.

Chapter Three

The post-Deng era and "ecological crisis mode"

Capitalism and sustainable development

Although the tenures of both Mao and Deng oversaw environmental damage caused by decisions enacted at the federal level with little input at the local level, one should not suppose that none of China's political leaders advocated for the protection and preservation of the environment. Since the 1980s, Chinese Premier Wen Jiabao had warned against the "growth first, clean up later" path that had been taken by other developing countries because it would cause environmental pollution and health problems. Many held the view that economic growth alone would not bring about sustainable and lasting development, especially if this growth undermined environmental quality and social justice (Liu 2012, 86). The idea of sustainable development, a broad concept that encompasses the political, economic, social and ecological spheres, had been circulating around international circles for many years. It was the subject of a 1987 United Nations publication called *Our Common Future*, which provided the standard definition of sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Langhelle 1999, 133). It was through international debate that the idea of sustainable development first entered the Chinese national dialogue following the 1992 Rio Earth Summit, when Chinese officials first adopted the principle of xié tiáo fā zhǎn 协调发展 or "co-ordinated development" in order to give equal standing to environmental protection (Palmer 1998, 791). The emergence of sustainable development in China corresponded with dire reports on the condition of China's environment. In 1992, the National Environmental Protection Agency (NEPA) identified a litany of problems plaguing the environment, among them "the continuing overburdening of land

resources, grassland degradation, the fragility of forest resources, water shortages, marine pollution and degradation, the loss of species diversity, air pollution caused by coal-burning, industrial pollution and urban environmental strain" (Sanders 1997, 1208).

The acceleration of China's environmental degradation and growing desire for sustainable development in recent years can be linked to the explosion of the country's economy and changing socioeconomic conditions that have introduced a material culture to Chinese society. In 1990, Deng Xiaoping initiated the "open door" policy that allowed foreign direct investment (FDI) to enter China, and, in coordination the Household Responsibility System, the economy grew dramatically (Feng et al. 2009, 150). By nature, capitalism is a growth-oriented system based on the accumulation of capital through the marketing and sale of goods to consumers. Capitalism is inextricably linked to the creation of a "mode of social regulation," whereby political and social institutions ensure demand for products produced by capitalists and investors. This is achieved through the development of habits, social norms, and laws that create a "regulatory system" to integrate individual behaviors into the overall capitalist production system (Tickell & Peck 1992, 192). Such norms stipulate that affluence in a capitalist society is determined by one's consumption of material goods, and, over the past couple decades, the establishment of capitalism in China has made significant economic and lifestyle changes that have created an enormous material culture. From 1996 to 2002, total living expenditures in China doubled (Fent et al. 2009, 150). Many residents in both urban and rural communities aspired to a higher quality of life validated by the purchasing of fashionable goods and amenities that reflect lifestyles in rich countries. This desire is supported by an increase in disposable income that has allowed people to buy more products, particularly household appliances and recreational goods (Feng et al. 2009, 153).

The dramatic increase in affluence has also necessitated more energy consumption and better quality energy sources for lighting, cooking, and other daily uses, as electricity has come to account for fifty-nine percent of total household energy consumption in most Chinese cities (Hubacek et al. 2012, 27). From 1985 to 2002, coverage of electrification increased to thirty-two percent for washing machines, fourteen percent for refrigerators, and sixty percent for color televisions (Feng et al. 2009, 153). China's total energy consumption grew 5.8% annually between 1990 and 2010, and carbon dioxide (CO_2) emissions expanded by two and a half times, making China the largest emitter of CO_2 in the world (Hubacek et al. 2010, 23). Feng et al. contend that affluence has been the highest contributor to CO_2 emissions, accounting for a 180% increase in total change that has outpaced a 114% decrease due to technological improvements in emission intensity (Feng et al. 2009, 149). Moreover, the continued logging of forests and use of fuelwood in rural areas contributed to the degradation of cultivated land and destruction of forests in the mid-1990s (Hubecek et al. 2012, 27). The rapidly growing economy at the expense of the nation's natural resources, combined with a new outlook on sustainable development, ultimately brought cries of concern from many scientific communities.

1998 floods

However, international forewarnings and domestic signs of environmental abuse went fundamentally unheeded at the federal level, and the Chinese government could claim few environmental accomplishments until the death of Deng Xiaoping in 1997 (Goodman 2002, 2004). Deng's death allowed a new class of leaders to enter Beijing and ushered in a new era of thinking, particularly concerning social justice issues like growing income inequalities and poverty alleviation in western and autonomous provinces (Sturgeon 2009, 494). Coincidentally,

Deng's death also corresponded with catastrophic flooding on the Yangtze River, China's longest waterway, in 1998. The floods killed 3,000 people, displaced 230 million residents, and devastated large portions of China's most fertile agricultural lands. The cause of the flooding was attributed to intensive industrial logging of forests located in the Upper Yangtze Valley under the direction of the central government since the 1950s. Studies have shown that this period witnessed extensive conversion of forests to agricultural land and overharvesting, which constituted the main causes for the loss of eighty-five percent of old-growth forests along the Upper Yangtze (Litzinger 2004, 495). However, government officials argued that years of extensive deforestation by local and indigenous farmers had contributed to the disastrous 1998 floods and responded by instituting new environmental policies aimed at excluding local communities from resource use and reclaiming vast areas of forest land in western China, an area containing a large portion of Chinese ethnic population (see Figure 2), to be managed by federally-appointed officials. Sturgeon said this change "undermin[ed] the security of farmers' property rights in forestland," and, in Mengsong village, Yunnan Province (see Figure 1), "entailed the loss of forests, pastures, and shifting-cultivation lands" (Sturgeon 2007, 132).

In addition to redirecting environmental management under the central government, the 1998 floods prompted a surge of quantitative accomplishments in environmental protection. By 2005, China's environmental bureaucracy has grown to an enormous size: 800 national environmental protection standards, 75,000 cases of environmental law violations, 3,226 environmental protection administration departments at various levels, 167,000 people engaged in environmental work, and 3,854 environmental law enforcement agencies with more than 50,000 staff members (Chan 2008, 296). Environmental goals were also written into the country's economic Five-Year Plans, which allocated 1.3% of the nation's GDP toward

environmental spending during the 10th Five-Year Plan (2001-2005), a significant increase from the previous decade (297). The 11th Five-Year Plan (2006-10) had equally ambitious goals, which aimed to cut energy consumption by twenty percent, emissions of major pollutants by ten percent and increase forest coverage from 18.2% to 20% (Chan 2008, 299). China also reached out to the international community by setting up meetings with environmental ministers from Japan, South Korea, and ASEAN (Association of Southeast Asian Nations), entered into environmental discussions with the European Union, and joined the Asian Pacific Partnership to develop technology and control environmental pollution (Chan 2008, 294). Social consciousness of environmental degradation and its effect on the community also expanded. For example, in 2002, the Center for Legal Assistance to Pollution Victims in Beijing won a landmark case in which the local court ruled against a paper factory for dumping toxic chemicals into the Shiliang River in eastern Jiangsu Province (see Figure 1) and ordered the company to pay 5.6 million yuan to 100 peasant families. Chan summarized an observation by Liang Congjie, an influential Chinese green activist, saying "almost nobody in China had ever used environmental law to protect his or her rights before 1992" (Chan 2008, 301). On the surface, it appeared that China had successfully identified the sources of its environmental problems and taken significant steps to address the various social and political aspects of its ecological degradation.

Current environmental policy

Although rhetoric that stresses issues of environmental justice or that punishes environmental degradation are beneficial steps toward recognizing and addressing ecological problems in China, the country's environmental policy has not made true progress in these areas and instead focuses on quantitative goals that provide instant, cursory results. China's national

environmental programs have been unable to empower millions of rural poor because they are essentially broad, highly centralized policies that unfortunately characterize the Chinese bureaucracy. The Chinese government appears increasingly desperate to improve its environmental image and has turned to a mindset of "ecological crisis mode" and the adoption of extraordinary environmental goals. Moreover, these policies have had serious environmental and social consequences as they are often too focused on short-term results, not considerate of variations in local environments, and disregard indigenous knowledge that could serve as valuable tools in environmental restoration. The perception by the central government that local and indigenous communities are ignorant of environmental issues and are incapable of understanding such problems due to their "low quality" prevails among government officials (Sturgeon 2009, 495). This perception has extended to decisions whereby many "uncivilized" indigenous people have been resettled because their villages "were categorized [by bureaucrats] as 'remote and dispersed' or 'unserviceable' and their environment classified as 'inhospitable and uninhabitable'" (Xu et al. 2005, 158). China's environmental programs have also focused on economic issues such as poverty alleviation and technological improvement as a pathway to mitigate environmental degradation. The central government and NGOs often promote well-intentioned, yet very narrowly focused, "solutions" to combat environmental issues. For example, since 2002, NGOs and government-managed nature reserves have developed a program to substitute fuelwood with electricity along the Baishuijiang River to reduce villagers' pressure on the reserve's biodiversity of the nearby and improve the conditions of the local community. One villager from the Baima Tibetan village of Die Bao Zhai in Gansu Province (see Figure 1) comments:

> We don't benefit much from developing large reservoirs and hydropower stations. The large reservoirs flood our lands. You must know that lands along the riverbanks are the best farmlands for us, for the fertile soil there guarantees high productivity. The dam drove away the fish in the river too. We can no longer feast our guests on the fish that we could take from the river as before, even the giant salamander that we had never served for dinner before has disappeared. Now we have to pay the hydroelectricity bill, which also increase our expenditures. We don't think it is better than the small hydropower stations. Although the small stations might not be able to supply our demands sometimes, they had never posed any threat to the lands and fish. Small stations also saved our expenditures, and have been good for both the environment and our daily life (Luo et al. 2009, 1999).

The example of the introduction of oxen from foreign regions to communities that were perceived to be economically lucrative exemplifies another shortsighted attempt at poverty alleviation by government agencies through environmental and economic policies. Although the introduction areas had high-quality pastures, low-cost fodder, and economic demand for oxen, half of those introduced died six months after the program had been implemented due to their incompatibility to local conditions (Luo et al. 2009, 1999). These examples illustrate the socially harmful and environmentally inappropriate nature of many of the central government's policies, however there are two environmental programs in China that are notable in their extreme focus on quantitative goals and ineffectiveness for social and environmental progresses.

NFCP and SLCP: overview and criticisms

The Sloping Land Conversion Program (SLCP) and National Forest Conservation Program (NFCP), two hallmark environmental initiatives of the Chinese central government, aim to mobilize millions of farmers to “repair perceived environmental damage” and “re-green the landscape” by broadly categorizing existing farm and forest lands as unsuitable for human disturbance and instituting generalized policies for how they should be “regenerated” and protected (Sturgeon 2009, 495). The National Forest Conservation Program (1999) seeks to rehabilitate forests by instituting a sweeping ban on logging of forests in the upper and middle sections of the watersheds of major rivers like the Yangtze and Yellow Rivers. The NFCP has been described as “one of the world’s most ambitious conservation set-aside programs” (Cao 2010, 1455). According to Cao, its specific objectives include: (1) to reduce annual timber harvest from natural forest from 32 million m^3 in 1997 to 12 million m^3 by 2003, (2) to conserve nearly 90 million hectares of natural forests, and (3) to afforest 31 million hectares by 2010 by means of aerial seeding, artificial planting, and eliminating forest harvesting in mountainous areas (Cao 2010, 1455). In conjunction with the approval of NFCP, the State Forest Administration affirmed a plan to spend RMB 96.2 billion (US $11.6 billion) over the next ten years on forest protection, regeneration, and management (Cao 2010, 1455). The NFCP’s inception actually dates back to the 1970s and 1980s when the Chinese government instituted similar afforestation programs along major watersheds, which had few significant results. Although these plans increased overall forest cover to fourteen percent, these gains were lacking qualitatively and were mostly comprised of young trees planted in single-species plantations, and overall timber volume and biodiversity did not increase (Weyerhaeuser et al. 2005, 239).

The Sloping Land Conversion Program (1999), also known as "Grain for Green," is a large-scale on-farm afforestation program that provides grain and cash subsidies to encourage farmers to plant trees on their cropland in order to convert vast areas of steeply sloped agricultural land to forest or grassland, specifically targeting areas with slopes greater than 25º. This project is a direct response to the hydrologic instability of the Yangtze and Yellow Rivers that caused the 1998 floods (Hu et al. 2009, 2010). For this reason, the Yangtze and Yellow River watersheds are the main focus of SLCP, which reports that two billion tons of fertile silts are released in to the Yangtze and Yellow Rivers annually, with two-thirds of this coming from sloping cropland. SLCP is the largest land retirement program in the developing world, with a target of converting around 14 million hectares of cropland to forests, 4.4 million of which is on land with slopes greater than 25º, and a total budget of RMB 337 billion (US $40 billion). It is estimated that SLCP could beget a ten to twenty percent increase in China's natural forest areas and a corresponding ten percent decrease in cultivated land. SLCP is different from China's other environmental programs in that it is the first "payment for environmental services" project and uses public payment to directly engage tens of millions of rural households. This engagement also reflects the program's secondary goal of poverty alleviation, whereby rural households will be encouraged to shift to more sustainable production practices so that the government may restore perceived "barren and degraded wasteland and mountainous areas" (Bennett 2008, 700).

NFCP and SLCP, like many of China's environmental restoration programs, have come under criticism for their ineffectiveness due to purely quantitative assessments and their negative impacts on local communities. Overall, logging bans and reforestation programs on barren land have proven to be an inadequate method for forest conservation in the region for a number of

reasons. First, as Bennett argues, the linkages between cultivation of sloping cropland and the frequency and severity of floods “are not as clear-cut as commonly presumed” (Bennett 2008, 701). The program also lacks a means to measure the environmental benefits of each site, which could compromise environmentally sensitive plots that are identified by SLCP as in need of afforestation. Second, local governments have reported that they are overwhelmed by the scale of the programs due to the lack the financial resources and skilled personnel to implement projects like SLCP. The current forestry staff is also insufficient; nearly fifty percent are former soldiers without any education in forestry or agriculture that are simply assigned to the office by the central government (Weyerhaeuser et al, 245). Due to lack of financial support, some regions give priority to sites close to a road system to facilitate easy inspections and monitoring (Uchida et al. 2003, 8).

Perhaps the most pressing criticism, and certainly the most important for this paper, is that environmental programs like SLCP and NFCP lack effectiveness because their policies have not been cooperatively developed with local communities. The environmental impacts of such policies have proven ineffective and undermined true conservation and protection initiatives. For example, the government often reforests areas of land using only a few of the region’s native tree and plant species. Unsurprisingly, many of these planting are unsuccessful, and these areas often suffer from depleted biodiversity and attacks from pests—a common problem in forestry monocropping (Xu et al. 2005, 168). The absence of community engagement and cooperation is likely to have a large impact on indigenous people, as SLCP affects 40-60 million rural households and more than 10 million mountain inhabitants (Hu et al. 2009, 2010). A survey conducted by Zhang et al. found that SLCP is the third most common project being implemented at the village level, behind road and bridge and irrigation investments (Bennett 2008, 703). The

broad reclamation of forests by the state has resulted in many upland farmers, who are largely ethnic minorities, being excluded from their traditional agricultural and forest lands. In rural areas of Yunnan Province, this process has led to several changes in land use, including the loss of shifting cultivation and the loss of pastures, in order to discourage subsistence strategies that are perceived to cause environmental degradation. Despite official policy that promotes SLCP and other programs as economic tools for poverty alleviation, some communities have seen a twenty-five percent decrease in household income since 1997 (Sturgeon 2009, 504).

Farmers who have entered into SLCP and NFCP have also suffered from the program's lack of funding. These programs have largely been welcomed by farmers because of the initial perception of extremely high compensation rates and incentives they provide, which amount to more than fifteen times the average rental payment in purchasing power parity (PPP) under similar programs in the United States, specifically the Conservation Reserve Program (CRP). Authorized under the Farm Bill of 1985, the CRP provides farmers with an average annual rental payment of $113.23 per hectare for retiring highly erodible or environmentally sensitive cropland for ten to fifteen years (Uchida et al. 2003, 5). The Chinese government provides approximately 1500 to 2250 kilograms of grain per hectare, free seedlings valued at RMB 750 (US $118) per hectare and RMB 300 (US $47.4) in flat compensation per hectare to farmers in their conservation set-aside programs, totaling RMB 4200 (US $663) per hectare in the upper and middle reaches of the Yangtze River and RMB 3150 (US $497.7) per hectare in the upper reaches of the Yellow River (Uchida et al. 2003, 7). However, Cao reports that farmers and livestock grazers are not compensated for the weeks of their own time that they must invest into restoration activities, and they are required to plant trees without compensation for an average of 21.7 days per year because they must ensure the trees grow well in order to receive the annual

subsides (Cao 2010, 1460). Cao also details a study that claims local Chinese residents as a whole stand to lose about US $287.5 million in income as a result of these programs, due to the ban on logging and grazing, which has led to a severe shrinkage the local economy, and the neglect of job creation and training programs by the government, the combination of which will most likely adversely affect the poorest rural residents (Cao 2010, 1460). The lack of job creation and economic development plans for rural communities have led many residents to conclude that they will simply return their land to cultivation when the subsidy period ends (Weyerhaeuser et al. 2005, 244). Recent surveys reveal that these drop-out rates are high: thirty-seven percent in Shaanxi Province, thirty-four percent in Guizhou Province, and twenty-nine percent in Ningxia Province (see Figure 1) plan to return to their old farming, livestock, or forestry practices after compensation from NFCP and SLCP ends (Cao 2010, 1461).

Criticisms of China's overall environmental policy

Beyond actual implementation, criticisms of China's environmental programs reflect broader social, political, and cultural issues regarding the inequality between the majority Han Chinese and the country's various minority groups. There has emerged in China a narrative about the "quality" of the various ethnic groups regarding who is merited to manage resources and run local affairs. The national dialogue often portrays urban Han Chinese to be of "high quality" and more advanced in terms of economic and social development, while stereotyping rural communities as "low quality," backward, and irrational and ethnic minorities as even further behind and "not knowing how to develop" (Sturgeon 2007, 135). Han Chinese dominate China's bureaucracy, and they often perceive their role to be one of "civilizing" rural peoples and ethnic minorities who live outside the economic center. As Xu et al. put it, "The center

presumes that its own civilization, based on Han cultural values, is superior and may take upon itself a so-called noble commitment to uplift peripheral people" (Xu et al. 2005, 153). This philosophy has pervaded national policies, particularly economic development and environmental conservation projects, as ethnic minorities of "low quality" are perceived as sources of social chaos and ecological destruction. These policies often discredit the knowledge and insights of rural peoples and view them as in need of "fixing" through instilling behaviors that are in line with Han Chinese ways of thinking—as conceptualized by the central government (Yeh 2005, 13). Sturgeon describes her experiences with the Akha minority group of Yunnan:

> The designation of Mengsong as a 'poor village' relegated the whole of Mengsong as a site of 'people of low quality' – the spatial manifestation of a lack of *suzhi*. This official pronouncement reinforced the essentialised designation of Akha as one of the backward hill peoples, those who 'eat the mountain'. In spite of the election of officials of slightly higher 'quality', the whole population of Akha in Mengsong had been cast into the realm of those who did not know how to manage forests, did not know how to develop and who had even gone backward over the past few years. Five years earlier there had been variable narratives about Akha, some of which granted Akha some characteristics of 'people of high quality', including some knowledge of forest management. Now the narrative had become unified as people lacking in quality, blamed for deforestation and identified as 'poor' as well as backward. As produced by the *suzhi* discourse, in which individuals were responsible for their own improvement, Akha farmers deserved to be poor and lose their lands as a result of their own low quality (Sturgeon 2009, 504).

The issue of ethnic minority discrimination is complicated by official proclamations that claim issues of indigenous rights do no apply in China. According to a 1995 official Beijing statement, the "indigenous question" is only applicable for countries where European colonialism marginalized indigenous groups, and this issue is simply "the product of European countries' recent pursuit of colonial practices in other parts of the world." As a result, the central government has banned the use of the word "indigenous," preferring the term "minority nationalities" to refer to ethnic groups (Sturgeon 2007, 130).

The "top-down" structure of the Chinese bureaucracy is another obstacle to the consideration of local and indigenous knowledge into policy-making. Despite official statements that claim to prioritize environmental protection, the goal of national economic growth and development remains China's primary concern at all levels of government. The State Environmental Protection Administration (SEPA), despite being elevated to ministerial level, is often put under immense pressure by the economic and industrial sectors to lessen environmental regulations and overlook cases of mismanagement (Chan 2008, 298). Governments at the provincial and local levels also struggle with competing interests between combating environmental degradation and maintaining economic growth. Because local officials are often assessed based on their record of economic growth, many have adopted the belief that "rapid economic growth must be achieved at any costs, even if the cost of future cleanup is higher than current economic gains" (Liu 2012, 87). This top-down approach is also characteristic of NFCP and SLCP, whose land retirement quotas are distributed from the central government to the provinces and then down through counties, townships, and participating villages (Bennett 2008, 701). In a 2003 survey among villagers in Shaanxi, Gansu, and Ningxia Provinces, Bennett found that, although forty-three percent of participants indicated that villagers had been

"consulted by higher level authorities regarding program design and implementation before their village started SLCP," the nature of this "consultation" appeared to be an authoritative command than a voluntary request to participate in SLCP. Only fifty-three percent of households surveyed indicated they had the choice to participate in the program, with this number being as low as thirty-one percent in Gansu Province (Bennett 2008, 706). Some of Bennett's findings are illustrated in the table below:

		% that indicated "yes"			
		All	Shaanxi	Gansu	Sichuan
Autonomy under SLCP in choosing…	Type of trees to plant	36.0%	47.6%	34.1%	22.4%
	Which areas to retire	34.5%	53.4%	15.3%	30.3%
	Which plots to retire	29.9%	40.8%	12.9%	34.2%

Adapted from "Farmer autonomy in SLCP participation," by M. Bennett, 2008, *Ecological Economics* 65, p.706. Copyright 2007 Elsevier B.V.

This lack of true communication and consultation with local villagers implies various shortcomings of China's environmental programs, including its failure to recognize the diversity of indigenous species, indigenous knowledge or practices, or the ability of local farmers to adapt their land management and livelihood tactics to their changing environment (He et al. 2009, 2010). Lack of communication at the federal level is manifest as well, as the government has delegated the tasks of water and soil conservation, poverty alleviation, and environmental protection to separate ministries and inter-agency coordination is very weak (Cao 2010, 1455). The program's overly simplified top-down, quantitative approach undermines the region's ecological complexity and cultural richness and has promoted a "passive position" by giving farmers various subsidies for items that they can produce for themselves were their practices not

banned (Sturgeon 2009, 502). The value of local insight and cooperation that could benefit environmental programs like NFCP and SLCP, considering that "communities are best able to identify their own needs and constraints," are largely ignored (Bennett 2008, 709).

China's top-down approach and lack of local and indigenous consultation illustrates an underlying flaw within their environmental policies, and perhaps of policymaking worldwide. The roots of environmental degradation are neither simple nor isolated in nature, but are the result of myriad social, cultural, and political forces driving environmental change. Environmental policy must therefore "address the underlying structural aspects of resource use and degradation," which "requires an understanding of the linkages between socioeconomic conditions and resource use—why and how people use resources the way they do, and what the implications of that use are" (Muldavin 2000, 250). In China, the rapid social transformations taking place have made identifying the roots of environmental problems difficult, and policies have tended to be "reactive and detached from the social causes of environmental problems," causing the central government to ignore (Muldavin 2000, 245). Government officials have not addressed environmental degradation as a complex, multi-faceted issue, but rather as a single-dimensioned problem that occurs uniformly across the country's various ecosystems and communities.

Chapter Four

Traditional agricultural cultivation and biodiversity identification systems

Soil integrity and traditional livestock cultivation: pastoralism

Grasslands are one of the most highly degraded ecosystems in China, which constitute a dominant landscape and account for forty percent of the nation's land area. Savanna rangelands are found in climates with hot, rainy summers and mild, dry winters and are characterized by a diversity of perennial and annual grasses and few woody plants (Gunderson 2000, 430). Much of this landscape is meadow and steppe, where livestock grazing has been the traditional livelihood of the regional economy. China's grasslands also play important ecological and social functions by supporting diverse species of plants and animals, serving as the major source of animal products like meat and milk, and comprising the landscape that supports a majority of China's ethnic population (Kang et al. 2007, 997). Pastoralism and transhumance practices, livelihoods characterized by semi-nomadic seasonal migrations of livestock, have characterized the northern provinces of Sichuan, Qinghai, Tibet, Xinjiang, and Inner Mongolia for generations (see Figure 1).

The endurance of these practices can be accounted to their environmental sustainability through adaptation and resilience to changing conditions. Herders are constantly balancing the changing needs of livestock and pastures resulting from daily and seasonal changes in plants, weather, and water availability (Fernandez-Gimenez 2008, 1322). Case studies of herders in the semiarid grasslands of Africa show the periodic pulses of grazing contribute to ecosystem function in this climate and help absorb minor disturbances (Berkes 2000, 1256). Pastoralists can and have attempted to exceed a sustainable herd number; however, in this climate and

environment, year long droughts and occasional disease outbursts can occur and with them the periodic decimation of herds that check any extensive degradation of grassland ecosystems (Fratkin 1997, 238). The characteristics of rangeland climate and the nature of grazing entail that the ecosystem moves between states of grass coverage and woody plant coverage, whereby the more favorable grass coverage can be reestablished through human manipulation of the environment (Gunderson 2000, 430). Customary tenure systems have created norms within nomadic communities that promote social and environmental stability. One of these standards maintains that herders collectively agree to retire certain grazing areas during specific seasons to allow regeneration in these pastures. It is also customary for pastoralists to have a "norm of reciprocity" which requires herders from one community to allow refuge to other herders during an environmental crisis like a drought or storm, thereby creating reciprocal hospitality if circumstances were reversed (Fernandez-Gimenez 2008, 1323). These characteristics have led scholars to conclude that the pastoral lifestyle, based on extensive generational knowledge formed from the difficulties posed by the environment, has created the most efficient and sustainable utilization of the resources of grassland ecosystems in China (Zhang et al. 2007, 22).

The northern temperate grassland ecosystems of China, an already fragile environment with poor conditions for cultivation, have experienced increasing demands for their natural resources and animal products. As a result, the past few decades have brought increased dust storms, accelerated land degradation, and expanding desertification (Kang et al. 1997). Nomadic and pastoral peoples often find themselves in conflict with sedentary communities, who are uncomfortable with the informal, customary systems of the pastoralists and frown upon their lack of high economic output (Zhang et al. 2007, 23). These two groups through their different cultures have developed inherently different values and objectives in reference to grassland

ecosystems, as nomadic peoples value the vast and open steppe while sedentary Han Chinese have traditionally viewed grasslands as "wasteland" that needed to be reclaimed and cultivated (Ho 2000, 348). Today, pastoralists face more threats to their livelihood than ever before due to "loss of herding lands to private farms, ranches, game parks, and urbanization; out-migration by poor pastoralists; increased commoditization of the livestock economy; and periodic dislocations caused by drought, famine, and civil war" (Fratkin 1997, 235).

In recent decades, pastoral and nomadic groups have been blamed for land degradation, claims that are often substantiated by exaggerated "dire" statistics on the conditions of grasslands due to their practices (Yeh 2005, 19). However, many scholars have evidenced how agricultural intensification is to fault for much of the region's environmental problems. Sandy grasslands are inherently unsuitable for intensive agriculture due to their low biomass productivity, and for this reason, nomadic herdsman have commonly used cattle dung for fuel. Sedentary farmers, on the other hand, require an abundance of fuel in the form of grasses and woody plants and trees. However, such intensive use would be environmentally destructive, as this ecosystem largely lacks woody plants and any uprooting of grasses would certainly provoke soil erosion. For this reason, the unique adaptation of pastoral groups in this region have allowed them to sustainably live on the landscape for generations, however growing agrarian populations in the 1740s gradually transformed China's grasslands into an "agro-pastoral interlocked mosaic" (Zhang et al. 2007, 20). This shift in land use corresponded with the beginning of the ecosystem's many problems, including soil erosion and sandy desertification, which occurs when the surface soil layer is broken up by plowing and underlying sand comes to surface, causing a "blowout" (Zhang et al. 2007, 20). Grassland degradation is exacerbated by the increasing use of marginal lands by agriculturalists, which has reduced and degraded pastoral areas and led to desertification

(Muldavin 1997, 591). Many farmers are only able to plow their lands for a short period of time before they must be abandoned due to desertification and dust storms (Zhang et al. 2007, 24). As a result, from the 1970s to the 1990s, China's officially designated desert area increased from 1.3 million to 1.5 million square kilometers (Muldavin 1997, 594).

The massive land use change in China's grasslands that have taken place in these largely ethnic provinces did not occur naturally but were in fact facilitated by the government to promote reclamation of these "wastelands." For example, in the early 1950s, the regional army of Ningxia Hui Autonomous Region in north-central China pushed land reclamation by deploying soldiers to open up land and dig irrigation ditches, resulting in a fivefold increase in the acreage of wheat from that of 1946 and a tripling of rice over the same period (Ho 2000, 377). Ningxia is a small province situated between two mountain ranges in the north and south. Its only arable land is located along the Yellow River, which runs through the center, and its climate is characterized by long, cold winters and short, hot summers (Sivin 1988, 42). The population of Ningxia Province doubled in the decade following reclamation, which was supported by government-sponsored rural migration from the coastal areas and the construction of Ningxia's first railway in order to develop this area (Ho 2000, 385). Inner Mongolia Autonomous Region, a large province characterized by mid-latitude steppe and desert with low rainfall and frequent droughts (see Figure 1), experienced similar efforts at opening up grassland for cultivation in the 1960s (Sivin 1988, 42). Although these lands had to be abandoned less than a decade later due to severe dust storms and strong opposition by herders, those uncultivated grasslands were able to recover quickly once intensive agriculture ended (Zhang et al. 2007, 20). In the 1980s Heilongjiang Province in northeastern China (see Figure 1) was another site of agricultural intensification and ecological destruction. Heilongjiang is the most northerly

province in China and is characterized by forested mountain ranges and fertile plains where crops thrive despite its severe winters and short growing season (Sivin 1988, 38). Muldavin describes his work in Zhaozhou and Bayan countries of Heilongjiang Province where peasants were encouraged to abandon sustainable crop rotation practices and switch to modern sedentary agriculture, which included the use of chemical fertilizers and the practice of monoculture in order to achieve short-term economic gains. Fallow periods were shortened, organic fertilizers abandoned, and overall soil fertility decline (Muldavin 1997, 591).

Current grasslands management policies in China continue to revolve around these flawed assumptions that indigenous pastoralists have destroyed resources and are ignorant of the ecological consequences of their actions (Fernandez-Gimenez 2000, 1318). These policies include the assignment of carrying capacities to plots of rangeland, the sinking of wells, and regional planning and sedentarization of nomadic people (Ho 2000, 349). Since 2000, one policy put in place to conserve and protect grasslands and "encapsulate" nomadic communities is called *tuìmù huáncǎo* 退牧还草, or "converting pasturelands to grasslands." This program has made extensive efforts to recuperate China's northern grassland with a target of restoring 100 million mu[1] of grassland at a total cost of US $238 million. The program banned grazing on all 2.62 million hectares of grassland in Ningxia Province, removed 8,000 families from restoration areas, and prevented 19,000 more from grazing (Yeh 2005, 18). Xu et al. describe the seminomadic Tibetans of northwest Yunnan and the problems accrued from recent reclamation and sedentarization programs like *tuimu huancao*:

> Fencing programs have tried to limit the seasonal use of rangelands and instead have encouraged the use of silage and controlled breeding. In addition, the

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[1] 1 hectare equals 15 mu.

imposition of burning bans have removed a traditional method by which herders used to maintain local grasslands. These innovations have not been very successful in Yunnan, where many fences are neglected, supposedly protected pastures are illegally grazed, and attempts to encourage farmers to increase livestock numbers are leading to concerns about overgrazing and weed infestation in some alpine rangelands (Xu et al. 2005, 165)

Yeh documents similar narratives from the province of Sichuan (see Figure 1), where the *tuimu huancao* plan called for a total of 10.6 million hectares of pasture, or roughly half the provincial land area, to be restored to grassland within five years and implemented a complete ban on grazing in those areas of the project that lie at an altitude of 4,000 meters or higher or which have grass cover of thirty percent or under (Yeh 2005, 19). Qinghai Province (see Figure 1), a region with 33 million hectares of grassland accounting for fifty-four percent of total land area, was also brought under *tuimu huancao*. Project implementation and resettlement of nomadic people in Qinghai has been more intensive than in other areas because Qinghai is the origin of the headwaters of the Yangtze and Yellow Rivers and home to Sanjiangyuan, the largest nature reserve in China (Yeh 2005, 21). Both provinces have substantial indigenous Tibetan and Mongolian herder populations (see Figure 2), however the government has not promised to subsidize all the financial costs of the plan and expect individual pastoralists to make significant financial contributions to ensure the success of *tuimu huancao* (Yeh 2005, 19). Pastoral households were required to take out RMB 5,000 loans, although the government does not have a plan to develop alternative employment opportunities for residents (Yeh 2005, 21). Furthermore, herders have expressed frustration with the plan because it targets grazing as the source of land degradation despite the fact that current livestock numbers are the lowest in

history, and as a result ninety-nine percent of those surveyed said they would not temporarily retire portions of their grassland (Yeh 2005, 22). It is clear that *tuimu huancao* and China's overall rangeland policies need improvement and inspiration from successful programs in similar environments, like those in neighboring Mongolia. Mongolia is the country with the largest area of common grazing land in the world (nearly eighty percent), and has a unique approach to rangeland policies that combines public ownership of grazing resource with private ownership of livestock that has allowed the continuation of traditional pastoralism while maintaining the integrity of land and soil resources (Fratkin 1997, 249)

Soil integrity and traditional agricultural systems

Sloping land and sandy fields cultivation systems

Indigenous peoples in China have not only raised livestock while maintaining soil quality in their environment, but have also engaged in agricultural systems designed to prevent soil erosion and maintain ecosystem resilience. He et al. have documented a fascinating traditional agricultural regime in Jianyang County of Sichuan Province that incorporates a drainage system called biān gōu bèi gōu (边沟倍沟) and cultivation operation of tiāo shā miăn tŭ (挑沙免土). Due to fertile soils and a favorable subtropical climate, this area is one of the most populous agricultural regions of China. Slope land accounts for sixty percent of cultivated land, of which twenty percent is located on slope land of more than twenty-five degrees, and as a result, this area is one of the most eroded regions in the upper Yangtze River basin. However, groups indigenous to the region are aware of their environmental constraints and have developed the *biangoubeigou* and *tiaoshamiantu* systems over generations in order to combat their land's propensity for soil erosion and degradation. *Biangoubeigou* is a system of trenches dug

perpendicular to the slope of the land, connected at each end to a hillside ditch, designed to mitigate soil erosion by shortening the land's slope length, reduce the velocity of runoff, and trap valuable sediment in the ditches during the rainy season to be used during cultivation by *tiaoshamiantu*. *Tiaoshamiantu* is simply returning sediments deposited in the trenches to the field, usually by shovels or hoes, because these soils are often very fertile (He et al. 2007, 195). These systems are widely used in southern China where high rainfall and cultivation on sloping lands often provoke massive soil erosion. However, farmers practicing this traditional system praise it to be a "simple, cheap, and practical way to stop soil loss while making a good harvest," and studies have shown that net soil loss is considerably lower in fields where this system is applied. *Biangoubeigou* and *tiaoshmiantu* are so effective and sustainable that net soil loss is considered "negligible" due to the trapping and returning of sediment to the fields that would otherwise be lost (He et al. 2007, 199).

As documented by Gate et al., another farming technique developed by local and indigenous groups to combat soil erosion is the sandy fields (*shā tián* 沙田) cultivation system. The Loess plateau of northwest China is characterized by limited rainfall that has created a landscape of sandy fields that are prone to rapid erosion and degradation and make up approximately 188,500 hectares. The indigenous peoples of this area, which cover Gansu, Ningxia, and Qinghai Provinces (see Figure 2), have long used sand and stones as mulch in order to extend the life of their cultivation lands. The process of creating sandy fields cultivation begins with a layer of manure that is plowed into the soil. The soil is compacted to form a firm surface layer and then layered on top with stones and sand to form what is called "sandstone mulch" (Gale et al. 1993, 475). The stones prevent too much sand from mixing with the soil and also act as a "one-way moisture valve" that allow water to penetrate rapidly to the soil below but

also desaturate quickly to prevent evaporation. Additionally, the sandstone mulch counteracts soil erosion caused by wind and water and also retains heat to protect against frost and accelerate initial plant growth (Gale et al. 1993, 476). Fields eventually become exhausted when too much of the sandy layer becomes mixed with the soil, although these fields are said to be fertile for as long as fifty years, compared to the average four years experienced by irrigated fields in this region. *Sha tian* farmers will remove the sandstone mulch layer and leave the field fallow for three years in order to renew soil fertility (Gale et al. 1993, 475).

Shifting cultivation and agroforestry

Although the examples of *sha tian* cultivation and the *biangoubeibou* and *tiaoshamiantu* system are very specific examples of traditional agricultural systems, there are others practiced in China that are less locally specific and more universal. One such example is shifting cultivation, which has historically dominated agriculture practices. This system is characterized by the clearing of forests for crop production through burning, followed by a fallow period where forests are allowed to regenerate and soil regain fertility. Shifting cultivation, also called "swidden cultivation" and "rotational agroforestry" is often found in subtropical regions that are unsuitable to sedentary agriculture due to hilly landscapes, the frequency of monsoons, and the lack of organic nutrients in the soil. By using a system that is appropriate to the natural environment, shifting cultivators often provide many benefits, including a high rate of forest coverage that promotes carbon sequestration and mitigates soil erosion (Liang et al. 2008, 1993). One example of traditional shifting cultivation in China is the *shan mu* (shān mù 杉木) agroforests in Fujian. *Shan mu* (or shamu) is one of the most important timber species in China and has been cultivated by farmers in the highlands of southern China for as long as 2,000

years (Chandler 1994, 420). Their system illustrates the two integral stages of traditional practice of shifting cultivation and its many ecological and economic benefits.

The cropping phase of shifting cultivation uses polyculture whereby many different species are grown in such a way that mimics the natural diversity of the ecosystem, creates a balanced diet for farmers, and minimizes soil and root disturbance of surrounding trees (Liang et al. 2008, 1989). The fallow phase is highly important to shifting cultivation because it restores soil fertility and regenerates the growth of trees lost during the cropping phase. These trees produce timber and non-timber forest products for farmers to harvest and also provide important watershed protection to China's river valleys (Harkness 1998, 912). The *shan mu* agroforestry system follows the traditional model of shifting cultivation, beginning with burning of the site, followed by planting of *shan mu* and other edible, medicinal, and economic crops, and finally the harvesting of crops during the first three to four years and the harvesting of *shan mu* after ten years (Chandler 1994, 421). Intercropping is an integral part of the *shan mu* agroforestry system because it provides ecological benefits, including increased cycling of nutrients like nitrogen, phosphorus and potassium and improved microorganism activity in the soil surrounding the roots of *shan mu*, which create more advantageous conditions for *shan mu* growth (Chandler 1994, 433). Many of the benefits of the cropping phase are not only in line with published scientific literature, but are also recognized and understood by the peasants of this region (Chandler 1994, 427). Peasants also note that their intercropped *shan mu* plantations create wider spacing between trees than the more densely planted government forests. They recommended government officials plant poor sites at higher densities and better sites at lower densities in order to make the best use of forest soils, a practice employed by scientifically trained foresters worldwide (Chandler 1994, 433).

The fallow phase also allows a diversity of plants to flourish, which are often utilized by farmers for medicine, animal fodder, fruits, and vegetables (Liang et al. 2008, 1993). Although long perceived as detrimental to the environment, shifting cultivation appears to enhance species diversity through small-scale and intermediate disturbances (Smith & Wishnie 2000, 495). The fallow stage is referred to by peasants practicing *shan mu* agroforestry as *huǒ shān* (火山), or "burning the mountain," and they cite many of the traditional benefits of this phase, including increased soil permeability and the creation of ash for fertilizing trees and crops. Although site burning is often criticized for decreasing forest cover, this practice is necessary to cultivation in this region, as soils tend to be slightly more acidic and deficient in nutrients, which is often remedied by the resulting ash. Farmers in this region also recognize the possible detrimental side effects of burning and take precautionary steps to minimize them, like planting crops immediately after burning to reduce soil erosion and keeping the fire as cool as possible so as to not destroy all organic matter (Chandler 1994, 429).

While *shan mu* agroforestry exemplifies many of the traditional characteristics of shifting cultivation system, there are other cases that show how local and indigenous peoples have integrated rotational agroforestry practices into the modern economy. The tea agroforests of Yunnan Province, or "ancient forest tea gardens" (gǔ shù chá yuán 古树茶园), consist of areas of forest thinned for tea cultivation or burned via shifting cultivation to create a "multistoried vegetative structure" (Ahmed et al. 2010). Forests are a dominant landscape in northwest Yunnan, accounting for sixty percent of the land area, and play a vital role in major watersheds and the harboring of biological and cultural biodiversity. Major rivers like the Salween, Mekong, and Yangtze all flow through this region and provide year-round water supply for upland and lowland agricultural areas throughout China and Southeast Asia (Weyerhaeuser et al.

2005, 235). Yunnan is also home to 17,000 species of plants, about half of which reside in the region's vast forests (Pei et al. 2009, 2019). For these reasons, this area has been officially recognized as a Global Diversity Hotspot, Global 200 Priority Ecoregion, and a World Natural and Cultural Heritage Site. However, the Salween and Mekong watersheds are in danger of soil degradation, with fifty-two percent and thirty-eight percent of their land areas, respectively, subject to soil erosion (Weyerhaeuser et al. 2005, 237-238). Farmers and peasants have therefore created a system that works to preserve the integrity of this region while capitalizing on its many resources to provide economic benefits.

Although the various systems in Yunnan vary due to cultural and environmental differences, they share many characteristics. Traditional tea gardens are formed by planting tea seedlings under natural forest, which often consist of a variety of plants including tea trees, shade trees, and plants maintained by the garden's owners. These gardens provide many ecological benefits, including maintaining biodiversity and protecting watersheds (Long & Zhou, 2001, 763). This is largely accomplished by using a diversity of plants and species that are suitable to the local environment. For example, fig trees are often incorporated into tea gardens in Jinuo communities due to their local and cultural importance. Farmers in the Tengchong region of Yunnan have adapted their tea gardens to include local alder trees, which facilitate nitrogen-fixing to accelerate soil recovery and whose leaves shade and fertilize the tea (Liang et al. 2009, 1990).

The economic benefits of Yunnan's tea gardens have been far greater than those of similar rotational agroforestry systems in the region. Since the 1980s, local tea farmers have expanded and intensified tea cultivation due to the crop's increased market value. The income received per kilo of tea for local farmers in Akha society has increased from US $1.18 in 2000 to

a high of US $220, and as a result tea today makes up ninety-nine percent of household cash income (Ahmed et al. 2010). Similarly, the rotational agroforestry system accounts for more than two-thirds of cash income for farmers in the northern village of Jietao, and, in Jinuo society, tea now is the third largest cash crop (Liang et al. 2008, 1993; Long & Zhou 2001, 763). Peasants in this region have been careful to balance the economic profitability of their tea gardens and the ecological benefits that can only be derived from their careful management. Many farmers, aware of the importance of the fallow period of tea cultivation, have refused to shorten this phase for food production at the cost of land degradation. Instead, they have used income from the sale of tea and other forest products to purchase supplementary foodstuffs (Liang et al. 2008, 1993). These peasants, like the Akha people of Bajlapuxeevq, have also continued to maintain a diversity of subsistence activities, including home gardening, subsistence agriculture, and foraging, and refused to convert their land to monocultures (Ahmed et al. 2010). This unique combination of indigenous ecological knowledge and an environment with extensive biodiversity makes Yunnan "an attractive region for revitalizing sustainable rural livelihoods with economic liberalization" (Shiro et al. 2007, 69).

Despite its many ecological and potential economic benefits, shifting cultivation and rotational agroforestry have long been under pressure to end their practice of burning forests and convert to modern intensive agriculture. After Deng's agricultural reforms of the 1980s, an estimated two-thirds of all forests in China were redistributed to villagers and households and were considered subsistence resources to be used by local people. However after the 1998 floods, the central Han-controlled government shifted policy to re-centralize strict state control over forests and delegated them as resources to be protected for the national good (Sturgeon 2009, 494). This shift is supported by the many dire statistics on the degradation of China's

forests, which are said to cover only fourteen percent of land area, significantly smaller than the internationally accepted standard of thirty-four percent (Harkness 1998, 912). This concern is reflected in policies like logging bans and the massive conversion of farmland into forests via programs like SLCP. However, such bans are detrimental to ecological function (as has been evidenced by the importance of burning to soil fertility) and economic opportunities because these policies essentially ended shifting cultivation and rotational agroforestry. For farmers who lacked a lucrative alternative income source like tea production, this loss in cultivation lands means some were unable to produce enough grain (Sturgeon 2009, 501).

Population pressure has also aided in the collapse of shifting cultivation in China, which is under pressure to increase production by shortening the fallow period and using modern, less sustainable, resources like chemical fertilizers and monocultures. Monocultures, the cultivation of one species on typically large areas of land, have been encouraged in places that were once dominated by traditional indigenous systems, like shifting cultivation, due to expanding markets for natural resources and the opening of China's economy (Ahmed et al. 2010). Intensified cultivation of monoculture crops like rubber and tea has had negative ecological and social impacts in these communities. Ahmed et al. contend that rubber plantations have replaced an estimated 500,000 hectares of land once dominated by forest and traditional cultivation systems in southern Yunnan and neighboring Southeast Asia and is expected to increase to 1.5 million hectares by 2050 (Ahmed et al. 2010). Monocultures like these have decreased overall environmental biodiversity as well as the diversity of people's livelihoods, which in the past acted as a form of risk management. Shifting cultivation also played a major role in forest regeneration, which often favored the use and preservation of native species and also created natural corridors through which wildlife could migrate (Weyerhaeuser et al. 2005, 249; Xu et al.

2005, 157). In many villages, the pressure to switch to more lucrative forest monocultures has resulted in peasants planting tree seedlings at too high a density and excessively weeding their cultivation areas. Such practices do not allow for wild species to regenerate, and the reduction in forest biodiversity has compromised watershed function and dried streams (Liang et al. 2008, 1993).

Other practices, including modern agriculture technologies like plastic mulches and fertilizers, have been adopted in these areas with dire environmental consequences. As reported by Wittwer (1987), plastic mulches, used primarily in sandy field areas, have simply been piled up in the countryside, causing massive pollution and interfering with tillage operations. Moreover, plastic mulches have proven ineffective at harnessing rainfall, allowing it to run off and providing no benefit to the soil (Wittwer 1987 in Gate et al. 1993, 477). Fertilizers have become widely adopted in intensive agricultural areas due to the shortening or elimination of the fallow period in order to support continuous cultivation (Liang et al. 2008, 1992). These fertilizers act as a drain on the economy, a pollutant to the local water supply, and a negative input on the soil. Overall, intensive agriculture and monocultures have reduced indigenous knowledge of traditional farming and cultivation. Shiro reports that seventy-eight percent of farmers interviewed in two villages in western Yunnan felt that their children had no knowledge of traditional rotation farming (Shiro 2007, 63). This is attributed to the nature of modern agriculture and genetically modified crops, which simplify the knowledge needed to have a successful harvest. Farmers no longer need to have an intimate relationship with their environment or an extensive knowledge of weather conditions, burning practices, and plowing techniques (Shiro et al. 2007, 63). However this loss of diverse and detailed ecological knowledge may prove detrimental to the future of these communities where modern agriculture

and forestry may only deliver short-term economic returns, but whose livelihoods could prosper were they to capitalize on their extensive cultural knowledge and the rich ecological diversity of this region.

Maintaining biodiversity

China's extensive and diverse landscapes, from the vast steppes of the central plains to the tropical rainforests of the southeast, make it one of the richest areas of biodiversity in the world. Although some tend to think of biodiversity as simply an environmental phenomenon, it is in fact far more complex. Hakkenberg defines biodiversity as "the dynamic, multifaceted and complex product of the interactions between natural and social systems, encompassing global ecology…economy…and culture" (Hakkenberg 2008, 75). Rural and indigenous people often live and work in remote areas that have been less affected by loss of biodiversity, and as a result are very knowledgeable about native plant and animal species. Although many countries, including China, have presumed local communities and indigenous people to be ignorant of their natural environment, many of these communities have unique and sophisticated classification systems that are based on the folk names for plants and animals and reflect the uses and management of these species (Khasbagan and Soyolt 2008). These classification systems are often very similar to Western scientific methods in that both incorporate morphological characteristics of plant and animal species, with indigenous classification systems additionally including cultural and ecological aspects (Wang et al. 2004, 1141). Many groups also have cultural and societal norms that help them identify certain species or areas of forests and mark them as "sacred" in order to conserve them for future generations. Analysis of these systems reveals that, despite the national dialogue regarding environmental destruction at the hands of

indigenous communities, their vast knowledge has helped them to identify and preserve ecological biodiversity in China's most remote areas.

Indigenous knowledge systems and biodiversity

There are many indigenous communities in China and around the world that have formed plant and animal classification systems throughout the generations. One example is the plant knowledge system of the Torgod Mongolians living in the Ejina desert of Inner Mongolia, a group that has occupied the area since the mid-18th century. The Torgod Mongolians, descendents of the Mongolian nationalities, are largely nomadic tribes peoples who have identified more than 200 vascular plant species throughout their environment. Studies by Khasbagan & Soyolt show that the Ejina Mongolians traditional plant classification system has a high correspondence to scientific names for the same plant species. This highly specific knowledge has been collected over generations as a result of adaptation to their desert environment, frequent utilization of plant resources, and the necessity for plant biodiversity as risk management. During their research, Khasbagan & Soyolt found one plant species identified by the Torgod Mongolians as *burgas* that did not have a corresponding scientific name; as a result, this indigenous community aided in the identification of this species for the first time (Khasbagan & Soyolt 2008).

Another unique classification system is that of the Dai indigenous group of Xishuangbanna in southwestern China. The Dai people cultivate more than 300 plants using traditional agroecological methods like polyculture and agroforestry (Xu & Melick 2005, 324). In their study of Dai plant nomenclature, Wang et al. found the Dai classify plants in a very different way than Western scientists, differentiating species in a binomial system between

"cultivated" and "wild." Wild plants are distinguished between trees, herbs, vines, ferns, or tubers, and cultivation species are classified as fruit, vegetable, bean, flower, or cereal, with each specific plant also given a particular name (Wang et al. 2004, 1140). Wang et al. also found the Dai to be very knowledgeable, if not as knowledgeable, of their natural environment as Western field botanists. In their survey that sent groups of field scientists and local Dai to identify plants in the area, the Dai group identified more plants and in less time than the trained botanists. Although the scientists had a higher correct identification rate than the Dai (89.73 percent compared to 83.79 percent), this difference appears negligible when one considers their excellent knowledge of local taxonomy (Wang et al. 2004, 1141). Moreover, Wang et al. recommend experienced local Dai and other indigenous groups with extensive plant knowledge by utilized as "folk taxonomists" to supplement study of regional plant resources and aid in rapid assessments of biodiversity (Wang et al. 2004, 1142).

The Dai indigenous group also extends their folk classification system to include areas of land, particularly forests, which hold particular religious and cultural meaning. The Dai's "holy hills" (or *Nong*) usually consist of paddy fields, home gardens, and cultivated forests, which they believed to be inhabited by gods and spirits of revered chieftains. All of the plants located in these hills are considered sacred because they inhabit the "gardens of the gods," and improper use of these areas, like logging and hunting, are believed to result in misfortune and wrath brought about by the deities. As a result, the Dai have always strived to live in harmony with their environment, a practice that has made significant contributions to conservation of endangered species located in the "holy hills" (Xu et al. 2005, 161). These contributions have been particularly beneficial since the intense logging and erosion of Yunnan's watersheds in the 1960s and 1970s because much of the region's biodiversity was preserved in these protected sites

(Hakkenberg 2008, 82). The Plant Red Data List of China has identified fifteen endemic and endangered species in Dai sacred forests, including *Magnolia henryi* and *Antiaris toxicaria*, which has encouraged the government to recognize the wisdom of indigenous conservation methods (Xu et al. 2005, 161).

The protection of areas of land for religious or cultural reasons is not unique to Dai society. Another group with sacred forests is the Baima Tibetans, a group living in the steep mountain valleys extending from Sichuan to Gansu Provinces in western China (see Figure 2). Research by Luo et al. shows how, like the Dai people, the Baima Tibetans believe the cutting of sacred trees to be an act of desecration that disrupts harmony and have social mechanisms that prescribe punishments depending on the degree of the offense. The Baima Tibetans worship the animals who inhabit the sacred mountains, including monkeys, black bears, tigers, snakes, and eagles, regarding them as their ancestors and the "livestock and poultry of God" (Luo et al. 2009, 1997). One animal of particular importance to Baima Tibetan culture is the giant panda, which they believe has a spirit protected by God and has therefore remained a protected animal in the Baishuijiang Nature Preserve in southern Gansu. In 1976, when the giant panda was threatened by a lack of bamboo, the Baima Tibetans saved eight of the eleven pandas rescued in the area (Luo et al. 2009, 1999). Luo et al. argue that the Baima Tibetan's acute awareness of ecological ethic and harmony support arguments for community-based management of nature preserves (Luo et al. 2009, 2000).

The Yi people, an indigenous group located in southwest China (see Figure 2), is another unique case of how indigenous religious practices have helped shape conservation and preservation efforts. In Yi society, all humans and wildlife, including plants and animals are offspring of the snow clan, and as a result the Yi pay tribute to the many gods and spirits of the

water, sky, trees, earth, and forests. In his study of the Yi people and their worship system, Xu et al. found at least twenty-one plant species that were widely worshiped and protected by local Yi communities. The Yi are traditionally located in Yunnan, Guizhou, Sichuan, Guangxi, a region that includes a multitude of sacred mountains and areas, including the Meli Snow Mountain, or *Khabadkapo* (Xu et al. 2005, 166). At over 6700 meters high and covering an area of over 200 kilometers, Khabadkapo is one of the eight most important sacred mountains on the Tibetan Plateau. At a certain elevation, a boundary called the *ri-ygag* marks the mountain, which demarcates community-use forests from sacred areas. Botanical studies of Khabadkapo by Anderson and Salick (2007) reveal that forest growth above the *ri-ygag* line is far more robust than other areas, both in terms of tree cover and tree girth. Overall, ecosystem of Khabadkapo appears to be in good health, due to religious taboos against logging, hunting, and even washing in some of the mountain's holy streams (Anderson & Salick 2007 in Hakkenberg 2008, 84). Areas like Khabadkapo are natural choices when establishing new nature reserves, and the Chinese government has begun to recognize the ecological importance of many of these religious sites by restricting or prohibiting their access (Xu et al. 2005, 166).

The Yi community has also been an integral part of the conservation of bamboo and the establishment of bamboo germplasm resources in central Yunnan, as illustrated by Long et al. Bamboo is very important in Yi society because it represents their ancestors and is used for religious and cultural purposes. However, the protection of bamboo is different from Yi's sacred forests because they are allowed to cultivate and harvest bamboo for economic reasons, like weaving, cooking, and construction (Long et al. 2008, 6). Villagers surveyed by Long et al. in Hongqiang village showed that households earn fifteen percent of its total income from selling the shoots of the species *Fargesia yunnanensis* each year (Long et al. 2008, 10). Bamboo also

plays an important ecological role when grown in patches along waterways to protect paddy fields from flood damage (Long et al. 2008, 9). Although local Yi people only specialize in growing a few bamboo species and have no real conservation strategies in place, they understand the importance of bamboo resources in their community. They have welcomed the establishment of local bamboo germplasm collections to better understand bamboo management techniques for agricultural and economic purposes and create a valuable resource for future generations (Long et al. 2008, 10).

Current biodiversity policies: exclusion & "reclamation

Indigenous communities have lived in and alongside their diverse environments for generations. It is apparent that successful biodiversity conservation policies and programs must approach this issue in a multi-faceted manner and address both its ecological functions and social and cultural importance. Although central and regional governments have made steps to acknowledge and appreciate some of the valuable aspects of indigenous knowledge and practices within the realm of biodiversity, the prevailing attitude of biodiversity management is one of exclusion and reclamation.

> Rather than include people, modern conservation policies in China generally deem the exclusion of people as necessary for the preservation of the landscape. They often blame indigenous people and their traditional ways of resource use for threatening biodiversity (Xu et al. 2005, 153).

Many communities living in or near areas rich in biodiversity often depend on the natural resources for fuelwood, housebuilding, fishing, hunting and other activities that are believed to threaten biodiversity (Luo et al. 2009, 1999). Current biodiversity conservation programs favor

the use of modern knowledge and technologies to facilitate economic and social development in communities near protected areas. The central government believes biodiversity should be preserved in state-controlled nature reserves in isolation from local communities who lack the scientific knowledge to understand the issues (Sturgeon 2007, 145). However, the importance for inclusion of local and indigenous knowledge is growing more critical, as overreaching and often illogical central policies make local communities frustrated and complacent. For example, case studies from Naxi and Maio communities in northern Yunnan show villages are often confused by policies that restrict efforts to thin and improve forest structure and are unclear about household allowances for timber and fuelwood, leading peasants to disregard these policies altogether (Xu et al. 2005, 168). Moreover, most existing biodiversity on Earth is found in areas inhabited by indigenous people, so the incorporation of indigenous knowledge will encourage local people to participate in the conservation of biodiversity and ensure the success of conservation programs (Wang et al. 2004, 1142).

Chapter Five

Integration solutions and problems

TEK integration on the international stage

The idea of integrating traditional ecological knowledge and indigenous communities into natural resource management is not new for the international community. The Convention on Biological Diversity (CBD), signed by all parties of the 1992 Rio Earth Summit, including China, is a global agreement that addresses all aspects of biological diversity. Article 8 of CBD, entitled *Traditional Knowledge, Innovations and Practices*, calls for national governments to:

> respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyle relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices (Convention on Biological Diversity in Khasbagan & Soyolt 2008).

Indigenous peoples are also observers within the CBD and participate in negotiations on indigenous issues, although many groups have argued for more involvement in the convention (Mauro & Hardison 2000, 1265). In the absence of significant government efforts on this front, many nongovernmental organizations have established programs aimed at putting the CBD's ideas into action. Many of these NGOs work in the ecologically and cultural rich region of Yunnan, which houses more than 18,000 vascular plant species and where one-third of the population belongs to twenty-five different ethnic minority groups (Pei et al. 2009, 2019; Ahmed

et al. 2010). The Center for Biodiversity and Indigenous Knowledge, located in Kunming, Yunnan, has published studies on indigenous knowledge and biodiversity, identifying land use changes and the diversity of trees and crops in various traditional farming systems (Sturgeon 2007, 146). The Yunnan Great Rivers Project (YGRP) is a plan devised by the Yunnan provincial government and the American NGO, The Nature Conservancy, to catalogue indigenous knowledge and innovate solutions to local environmental programs (Hakkenberg 2008, 78). The YGRP has taken an alternative approach to traditional ecological knowledge "as a mechanism for, and not an impediment to, biological and cultural conservation" (Hakkenberg 2008, 84). The YGRP site encompasses fifteen counties and harbors 10,000 of Yunnan's plant species, 500 species of birds, and endangered species like the snub-nosed monkey and black-necked crane. In the future, it is hoped the YGRP would be established as a national park to allow visitors to enjoy the region's beautiful landscapes and display indigenous knowledges that have protected and managed the area's biodiversity for centuries (Litzinger 2004, 494).

Integration of TEK in modern resource management

Programs like the Yunnan Great Rivers Project have paved the way for further discussion of the integration of TEK and resource management policies. Participatory monitoring and evaluation (PM&E) is a joint effort between researchers and local stakeholders like farmers and government workers to monitor and evaluate various research activities. Participatory approach has been shown to increase the effectiveness and efficiency of research and empower local communities by strengthening their capacity to make decisions in their environment (Vernooy et al. 2006, 400). PM&E is a departure from typical top-down and exclusionary management practices because it deemphasizes the dichotomy between scientific and indigenous knowledge

and promotes knowledge innovation to achieve locally sustainable development (He et al. 2009, 2015). Moreover, knowledge integration has been bilateral, as many communities have sought modern resource management practices to improve their understanding of their own environment and practices and learn about modern practices like renewable energy sources. They have also been intrigued by political aspects of environmental policy like higher-level decision making and nature reserve establishment as well as economic facets like ecotourism and fruit processing techniques (Liu 2010, 278).

There have been numerous case studies in China involving PM&E and local indigenous communities. In Qinghai Province, the Snowland Great Rivers Environmental Protection Association was founded to work with local herders to achieve more participatory environmental protection in the reserve and teach the local community about the region's ecology to improve the management system (Yeh 2005, 24). In their study of local communities in Longyang District, Yunnan Province, He et al. found that PM&E greatly aided local mapping of the watershed to identity land use and land cover. Farmers from the local community, foresters from the government agency, and facilitators from the project worked together to identify problems and solutions in forest policy and improve implementation of SLCP. The process was farmer-led and location specific and, as a result, selected adaptive management practices for local species and farm-specific agroforestry systems (He et al. 2009, 2012). The participatory approach provided a learning experience for all parties involved: farmers learned how to market their medicinal plants; the research group studied the interrelationships within agroforestry systems; and government foresters gained knowledge of the ecological benefits of polyculture and agroforestry (He et al. 2009, 2014).

Community nature reserves are another effort at integrating TEK and resource management and providing services for reserves that lack financial resources. Many nature reserves are located in poorer, rural areas that lack the budget and staff to maintain these areas. In the isolated Tibetan village of Bazhu in Diqing Tibetan Autonomous Prefercture in Yunnan Province, strong traditional beliefs have maintained the forest's rich natural biodiversity that includes 205 species of birds, 96 species of mammals, and hundreds of species of plants. The village has a history of community cooperation to protect its natural resources, even forcing out a logging company in 1994, and have since transformed their collective action into an effort to develop a Community Nature Reserve owned and managed by the community rather than by the government (Liu 2010, 276). Since the early 1990s, the county government in Wuyuan County of Jiangxi Province (see Figure 1) has taxed hydropower stations and redistributed the revenue to villages managing community based nature reserves, and the county has become a destination for tourists seeking to experience its diverse cultures and natural environment (Yuan & Liu 2009, 2009). These community forests have also partnered with community learning centers that hold local history, culture, biodiversity, and traditional knowledge as an exhibit for visitors and a valuable resource for community members. The centers are often used as large meeting and activity rooms where villagers can discuss ideas, make collective decisions, and connect with regional institutions to participate in workshops and conferences (Liu 2010, 279).

Critiques of TEK and integration

Recently, local Chinese governments appear more willing to recognize and utilize PM&E and other integration approaches in resource management policies. Some officials have begun to recognize the benefits of traditional knowledge systems and the importance of local participation

and support in management initiatives. There have been cases of shifts away from large, unsustainable monoculture plantations and toward smaller mixed agroforestry systems and other practices that include traditional plant species (Xu et al. 2005, 168). However, many government officials, particularly at the regional and national levels, appear reluctant to extensively utilize PM&E due to the level of negotiation they must undertake with local communities. Furthermore, some participatory projects are poorly implemented or simply maintain the appearance of participation while, in reality, are very coercive or inefficient, importing models from elsewhere rather than researching locally appropriate solutions (Yeh 2005, 24).

The critique of TEK and modern resource management integration goes far beyond the idea of participatory approach and extends to problems inherent in TEK itself, including its simplification, its shortcomings, and its rapid extinction. Many researchers and government agencies are under pressure to transform indigenous knowledge and practices into models or blueprints that can be applied to other situations. As a result, TEK is sometimes simplified and decontextualized into a "packageable commodity" and loses the dynamism that makes it so valuable and insightful (Ellen & Harris 2000, 18). Instead of distancing themselves from narratives that describe indigenous societies as timeless and non-dynamic, such policies actually reinforce them by "drawing back to antiquated visions of indigenous society living in ecological Edens, by now proven erroneous and anachronistic" (Hakkenberg 2008, 77). However, policymakers that seek to legitimize their environmental policies by turning indigenous knowledge integration into a "fashionable trend" or simply a "box-ticking exercise" primarily foster this view (Castillo 2009). Croll (1993) notes how post-revolutionary China reworked decontextualized knowledge with the effect being that "local populations came progressively to

be defined as backward and ignorant…not as agents but as objects to be changed" (Croll 1993 in Ellen & Harris 2000, 18).

The simplification of TEK has created a dichotomy between local traditional knowledge and Western science, whereby some have blindly dismissed all Western technology and models as failures to environmental management and adopted indigenous knowledge as the newest and best way to fight hunger, poverty, and underdevelopment (Agarwal 1995 in Hakkenberg 2008, 77). Some scholars have begun to resist integration on the grounds that indigenous knowledge and Western science are inherently incompatible. Moreover, those who advocate TEK integration often believe the failure to achieve integration is merely a technical problem and ignore the power relations, cultural prejudices, and social realities between indigenous people and the state (Bohensky 2010, no p.n.). The politicization of indigenous rights and environmentalism has also polarized scholars and advocates, causing many to go on the defensive against those who critique TEK and accuse others of working against local resource control and management (Smith & Wishnie 2000, 494). However, many of these critiques present legitimate concerns and problems of the use of local knowledge. Some question its ability to evolve quickly to changes in social and ecological systems (Bohensky 2010).

Others, like Smith & Wishnie, point to examples of "nonconserving behavior," including "anthropogenic faunal extinctions and habitat degradation, as well as patterns of subsistence behavior that seem to conform to economic optimization rather than to resource or habitat conservation" and have questioned even the existence of indigenous conservation ethics (Smith & Wishnie 2000, 494). Smith & Wishnie point out that many factors can contribute to resource conservation, including low human population density, low demand for a resource, or limited technology, and that it is important to distinguish between deliberate conservation designed for

this purpose from unintended sustainability (Smith & Wishnie 2000, 502). Like many other aspects of our modern world, TEK is often devalued of meaning and stripped of its complicated and dynamic characteristics to create a more tolerable view of indigenous and local knowledges. In reality, to take TEK as a monolithic solution to the complex issue of environmental sustainability would be to discard the “multiple global sources of inspiration” and “many nodes of global reworking” that, when considered together, could provide a holistic and appropriate pathway for environmental management (Hakkenberg 2008, 78).

Conclusion

Traditional ecological knowledge holds many beneficial aspects to answer China's most perplexing environmental degradation and social justice issues. Its inherent holistic perspective, acceptance of ecological change and adaptability, and appreciation for environmental and social resilience make it one of many epistemologies to be considered under new alternative resource management and rural development policies focused on qualitative assessments and place-specific programs. Moreover, TEK acts as a compelling empowerment tool for local and indigenous groups, whereby their right to self-determination and decision-making in their own communities is strengthened rather than diminished by government officials or outside organizations that are often detached and unaware of the unique issues faced by each locality. In their research on participatory evaluation, He et al. noted this shift in thinking by local officials, "from 'what we know' to 'what farmers know', from 'tree planting' to 'livelihood development', and from 'top-down' to 'bottom-up'" (He et al. 2009, 2015).

However, TEK and similar knowledge pathways cannot be decontextualized or considered a "golden bullet" solution to the myriad social and environmental issues facing China or any nation. Many have criticized TEK for its lack of connection to the modern world, but proponents stress that, although alternative management practices and ecological farming should play a role in a sustainable future, "we do not believe that the keys to sustainability are the technologies of the past" (She 2009, 362). China and other nations seeking sustainable policy should not necessarily adapt specific characteristics of TEK to its management practices, but rather consider some of the epistemology's universal applications: focus on long-term effects rather than short-term gains; integrated and holistic resource management instead of fragmented programs that lack coordination; social and environmental welfare as critical to policy rather

than an intense focus on economic growth. Today, China has done little to genuinely develop and encourage TEK, and many of its policies criticize local and indigenous groups for unconventional practices. Integration of TEK into mainstream environmental policy, in the words of Sturgeon, appears to be more of an "urban dream" than a "rural reality" and will necessitate much more scholarly research until it can be fully accepted and utilized (Sturgeon 2007, 133). Encouragingly, however, the Chinese characters for "crisis" (wéijī 危机) mean "danger" and "opportunity," which gives hope to ecosystems suffering from inappropriate policies and national mismanagement and to rural indigenous groups experiencing discrimination and a lack of social justice, that these parts may become part of the holistic resource management policy of the future.

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Appendix

Figure 1 Provincial Map of China (Central Intelligence Agency).

Figure 2 Map of Largest Minoritiy Nationalities in China. Adapted from "Distribution of the Largest Minority Nationalities," by N. Silvin, 1988, The Contemporary Atlas of China, p. 100. Copyright 1988 Marshall Editions Limited.