

Article

How Societal Values Determine the Local Use of Forest Resources—Findings from the Rural Community Kegong (Northwest Yunnan, China)

Michael Nassl * and Jörg Löffler

Department of Geography, Bonn University, 53115 Bonn, Germany; joerg.loeffler@uni-bonn.de

* Correspondence: mnassl@uni-bonn.de

Received: 15 April 2019; Accepted: 19 June 2019; Published: 22 June 2019



Abstract: The transition from net deforestation to net reforestation in China has received much scientific attention, in the hope that, by understanding the underlying drivers and processes, it might be reproduced in other regions of the world. The scientific literature has suggested that this process was driven by the creation of off-farm opportunities and huge state afforestation programs by economic growth. Recent publications, however, have noted a lack of inclusion of local dynamics in this analysis. We used the social-ecological interactions (SEI) framework, designed for the assessment of ecosystem services in socio-ecological systems, to trace the causes and patterns of the local use of forest biomass in a village in Northwest Yunnan. Our results suggest that societal values, in particular, are key to understanding the local resource use underlying the forest transition in Yunnan. However, societal values have been neglected, both in the analysis of forest transition as well as in social-ecological systems research, in general.

Keywords: Social-ecological systems; ecosystem services; land use and cover change; forest transition; China

1. Introduction

In the 2005 Global Forest Resources Assessment, the FAO first reported that the steady decrease in forest area in Asia, which had persisted for many decades, had been halted [1]. One of the main contributors to that development was the turnaround from net deforestation to net reforestation that began in the 1990s in China. This ‘success story’ of Chinese forestry has since served as an example for forest transition in developing countries [2,3]. However, the causes, patterns, and environmental implications of forest transition in China are still debated [4–6]. Rudel et al. [7] pointed out two major forest transition pathways, in order to explain the shift from net loss to net increase in forest areas: (a) The economic development pathway, where modernization, urbanization, and economic development ‘pull’ farm laborers off their land, which are subsequently abandoned and then reforested; and (b) the forest scarcity pathway, where scarcity of forest resources and ecosystem services prompts afforestation and reforestation. The pattern of forest transition in China, however, differs from these ‘classic’ pathways. Scholars have emphasized the important influence of economic growth creating off-farm opportunities [8], yet recent publications have shown that the forest transition in China cannot be explained by Rudel’s economic development pathway alone; it, rather, is a mixture of severe natural disasters and consequential development-related modernization and political economy change, which prompted a change of governmental attitude towards forests, consequently leading to the adaptation of forest policies [2,6]. These adjusted national forest policies that were initiated in the late 1970s and culminated with the Six Key National Forest Programs (SKNFPs) in 1998. The SKNFPs include the Natural Forest Protection Program (NFPP), the Sloping Land Conversion Program (SLCP), the Wildlife Conservation and Nature Reserves Development Program, the

Desertification and Dust Storms Control Program in the vicinity of the Beijing and Tianjin Municipalities, the Forest Shelterbelt Development Program in key environmentally fragile regions, and the Fast-growing and High-yield Timber Plantations Program [9]. These programs covered 97% of Chinese counties and targeted over 100 million ha of land for forestation [10].

The SKNFPs are, despite different emphases, regarded as the central driver of forest transition in a majority of studies and, accordingly, many authors have focused on their merits or shortcomings, often remaining at a large geographical scale (see, e.g., [10–15]). Yet, while a growing number of publications have evaluated the outcomes of the SKNFPs, the understanding of important local dynamics shaping these outcomes remains limited. As He et al. [4] have shown for two villages in Yunnan province, the national forest policies, including the afforestation program and tenure reform, contributed only to a limited extent, while local dynamics were the key factors in shaping the forest transition.

While national environmental policies can initiate large-scale changes in, for example, forest use, there has been an increasing recognition that the outcomes of such conservation efforts often depend on socio-political factors; in particular, how people relate to aspects of the environment, including how they value certain places, species, and ecological functions [16–18]. The ‘value of nature’ has recently become a fundamental aspect in environmental decision making, not least with the rising popularity of ecosystem services (ES). How society values the benefits it obtains from nature represents the core idea behind this concept [19,20] and, while it has been criticized for its ‘focus on monetary valuation’ and the ‘commodification’ of nature [21], by including non-material cultural services it has also helped to uncover the ‘hidden values’ of nature and bring them to the attention of conservationists and policy-makers. Values are also an important element in coupled social-ecological systems (SES): By valuing elements of nature, such as natural resources, people develop, both individually and collectively, views as to how these elements should be used and managed. Hence, in an effort to understand how SES are coupled and how their sub-systems interact, the values of people and how they shape their actions towards the natural environment deserve more attention [17,18]. As social values are the cognitive foundation of the behavior of people towards nature, there might be no path from exploitation to sustainability without a shift in values [22].

Shifting social values and their effect on forestry have been documented, for the U.S., since the 1980s [23,24]. In North America, the societal value of effective and sustainable timber production as the main function of forests had steadily declined, in favor of a focus on recreational, aesthetic, scientific, and bio-centric values, such as wildlife and biodiversity protection. This was, however, not reflected in the forest management at the time and, in 1989, sixty-five employees of the US Forest Service stated that the forest management at the time was “out of touch with the public and many of its own employees” [25]. As a consequence of this public critique, forestry had to open up to a wide range of differing values that needed to be balanced [25]. The value shift in U.S. forestry exemplified how a progressive value change across society can draw a critical mass of individuals and, consequently, trigger policy adjustments. Does the forest transition in China, which commenced at about the same time, also reflect a shift in societal values? It was, indeed, based on a changed perception of how forests contribute to livelihoods and the economy [26], yet it was rather the outcome of the search for an adaptive strategy—a response to a national ecological crisis—at the national policy level and informed by ecological science, than a shift in societal values held at local or regional levels; a very different evolution from the situation in North America.

It is in this context that we examine the role that societal values play in shaping the local ecological outcomes of China’s national forest policies. For this, we used the social-ecological interactions (SEI) framework, a tool for the analysis of multi-scale and multi-temporal cause–effect relationships in SES [27], to: (i) Outline the impact of the national forest policies of China on the local use of forest resources in the village of Kegong (Northwest Yunnan, China); (ii) to analyze the roles of societal values in that process; and (iii) to discuss the conclusions that ES and SES research can draw from the results, regarding the integration of societal values into these research fields.

2. Materials and Methods

2.1. Research Area

The village of Kegong ($27^{\circ}33'13''$ N, $99^{\circ}18'35''$ E) lies at about 2220 m above sea level, at the confluence of the Namu and the Kegong stream (which, by the Lapuhe, drains into the Yangtze). It is part of the Tacheng township in the Weixi Lisu Autonomous County, which belongs to the Diqing Tibetan Autonomous Prefecture within the Yunnan province (see Figure 1). At the time of field research, Kegong had 322 inhabitants in 66 households, making it the second-most populous village in the Kegong valley. Kegong has the status of a natural village and, thus, is subordinate to the administrative village Kena, which is situated at the mouth of the valley.

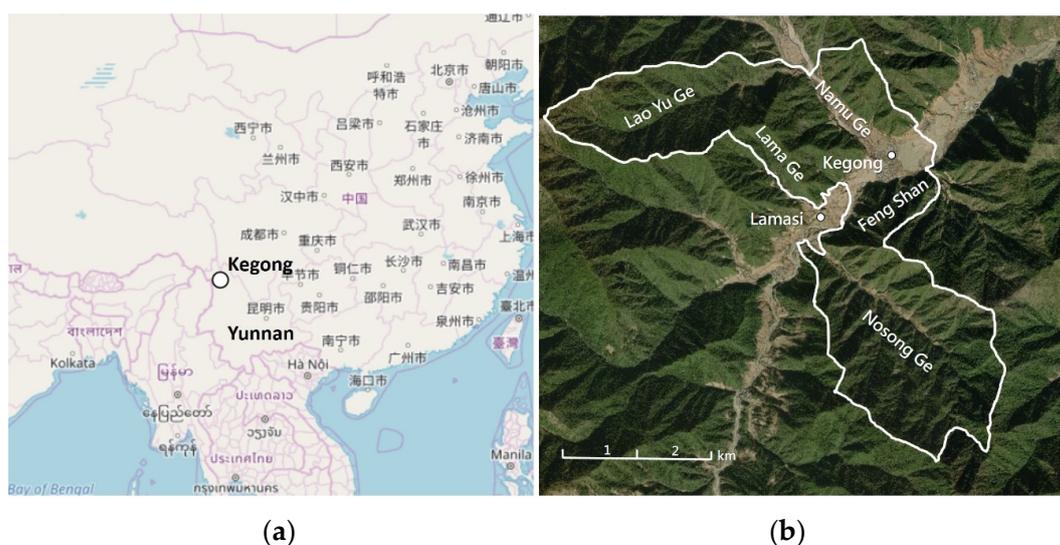


Figure 1. (a) Location of the study area and (b) a satellite image of the community area of Kegong.

2.1.1. Forests in the Research Area

The forests allocated to the municipality cover the slopes of the Namu valley, stretching about 2 km northwest from the confluence, and the adjacent Lao Yue valley, which runs about 3 km west up to 3660 m. Another valley that belongs to the Kegong municipality is the Nosong valley, which runs about 3.6 km in a southeastern direction from the neighboring village Lamasi and reaches 3340 m. Last, but not least, the Kegong villagers have access to the eastern slopes of the Lama valley north of Lamasi. All in all, the forests of Kegong cover an area of about 670 ha. However, since the establishment of the Baima Xue Shan National park, access to the northern parts (i.e., the Lao Yue Ge and the Namu Ge) is restricted.

The Kegong municipal area stretches over the altitudinal vegetation belts of temperate broadleaf and mixed forests and temperate coniferous forests; however, patches of coniferous forests can be found in the upper reaches of the Nosong Ge and Lao Yu Ge. Temperate broadleaf and mixed forests are dominated by *Pinus sp.* (i.e., *Pinus yunnanensis* Franch., *Pinus densata* Mast., and *Pinus armandii* Franch. on dryer slopes) and *Quercus sp.* (mainly *Quercus aquifolioides* Rehd. et Wils.). In addition, *Tsuga dumosa* (D.Don) Eichler is often found on slopes facing north and *Alnus nepalensis* D.Don on the south-exposed slopes. Some *Abies sp.* and *Picea sp.* can be found in higher altitudes, but not in stands. The understory is dominated by broadleaf shrubs, especially *Rhododendron sp.*, but also *Ternstroemia gymnanthera* (Wight et Arn.) Bedd., *Viburnum cylindricum* Buch.-Ham. ex D.Don, *Lyonia ovalifolia* *Lyonia ovalifolia* (Wall.) Drude, and some *Lauraceae*.

2.1.2. Population Growth and Household Sizes

Changes in population growth and structure are one of the main factors underlying the demand for forest biomass in rural areas of China [28]. Population growth not only contributes to increasing

fuelwood consumption, but also increases the levels of food production and income generation activities and, thus, intensifies the conversion of forest use [29]. The population of Kegong has grown particularly quickly over the last 40 years: Household numbers have doubled from 33 in 1970 to 66 in 2011. This has been mainly attributed to the improvement of health conditions. Besides total population numbers, household sizes play a crucial role in wood consumption, as a higher number of small households usually requires more fuelwood and construction timber than a lower number of large households. Household sizes in Yunnan (i.e., 4.4 in 2011) are still larger than the national average; however, there is a trend towards younger marriage and neolocal residence and, thus, smaller households [30], a trend which also manifests in Kegong. However, the average household size in the community (i.e., 4.88 persons per household) is still higher than for the rest of rural Yunnan.

2.1.3. Food Production and Income Generation Possibilities

Food production in Kegong is based on subsistence agriculture, where staple foods are produced on-farm and only supplementary foodstuffs are purchased in Tacheng. Farming is dominated by wet-rice agriculture on terraced fields and pig farming. Thus, the staple foods include rice, vegetables, and legumes, as well as pig meat and poultry. Besides these staple foods, a number of further farm products are cultivated (e.g., apples and pears, buckwheat for the distilling of spirits, and walnuts for their oil). The collection of non-timber forest products (NTFPs) (e.g., nuts, mushrooms, or the seeds of the Chinese lacquer tree) for consumption or income generation complements the agriculture of Kegong. Income generation may play a subordinate role in ensuring the livelihoods of the people of Kegong, yet, for the purchase of farming machinery, fertilizers, vaccines, and concentrated feed for livestock, it is still essential. Thus, many possible sources of income are exploited. Before the implementation of the NFPP, employment in the state forestry was the central source of income for most men in the valley. As this source of revenue was cut off by the ban of commercial logging, many of the farmers resorted to other off-farm work in the lowlands or to animal husbandry. Breeding pigs and (to a slight extent) cattle dominates on-farm income generation in the valley at present. Besides animal husbandry, the sale of walnuts, chestnuts, and NTFPs generates additional income. The highly sought-after pine mushroom (*Tricholoma matsutake*) is the most profitable NTFP to be collected from the forests of Kegong and, although prices have gradually declined since the 1990s, towards the end of the season, mushroom collectors in Kegong can still earn up to 800 RMB/kg.

2.2. Research Approach and Methods Applied

In order to organize the diagnostic and descriptive research procedure, we used the social-ecological interactions (SEI) framework, developed for a comparable inquiry in the Sierra Nevada, Spain [27]. This framework was designed to support the analysis of multi-scale and multi-temporal cause–effect relationships in coupled social-ecological systems (SES) [27]. It integrates the Ecosystem Service Cascade model of Haines-Young and Potschin [31] and the Driver-Pressure-State-Impact-Response (DPSIR) model of the European Environment Agency (EEA). Both the cascade model and the DPSIR individually contribute to the understanding of human–nature interactions in SES: The ecosystem service cascade identifies and allocates the essential elements of service generation and delivery and, thus, links the bio-physical state of the ecosystem to societal conditions and motivations. The strength of the DPSIR, on the other hand, lies in identifying and describing the causes and effects of human-induced changes on the environment. Used separately, both models have proven to be limited analytical tools when it comes to reproducing complex cause–effect relationships in SES [27]. By merging the two models, however, they mutually enhance their comprehensiveness and can overcome their individual conceptual deficits. Under the SEI framework (see Figure 2), impacts and responses describe the linkages between nature and society, in the form of social–ecological interactions (SEIs), which consist of (i) human involvement (e.g., land use, use value attribution, pollution, or environmental protection measures etc.) and (ii) its ‘counterpart’ in the delivery of ES [27]. The resulting SEI framework establishes a causal sequence which is apt to describe the drivers of change in SES, as well as their effects and consequences.

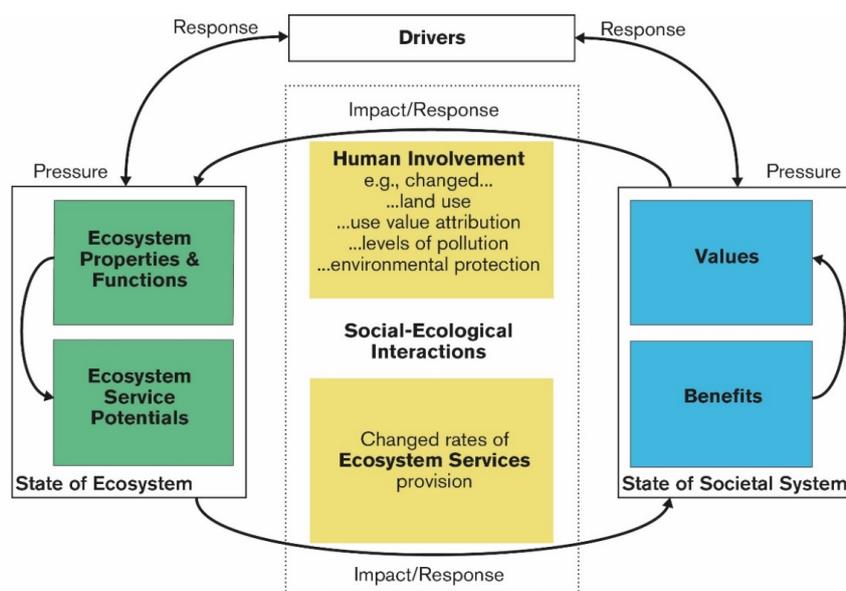


Figure 2. The social–ecological interactions (SEI) framework [27]. Drivers exert pressures, both on the state of the ecosystem and/or on the state of the societal system, which causes impacts through altered SEIs. Depending on the sub-system exposed to the pressure, the impact is expressed either through altered human involvement or through a changed delivery of ecosystem services. Responses to these alterations either affect the drivers directly, and/or the state of the impacting sub-system via SEIs (e.g., altered use value attribution, land-use changes, or changes in environmental service (ES) provision).

Based on the research framework, we first identified the key driver, which, in the case of this paper, was pre-determined by the research aim (i.e., China’s national forest policies). We, then, followed the routine of the framework (i.e., Pressure → State → Impact → State → Responses) to develop the cause-effect sequence. This procedure was conducted twice: Once for the situation before the implementation of the SKNFPs, and once for the situation afterwards.

After identifying the elements of the causal sequence, we used a mixture of bio-physical and social scientific methods to: (Step 1) Assess the legal situation, based on the national forest policies, and identify its effects on local land use (and other SEIs); (Step 2) analyze the state of the ecological sub-system, with regard to the ES provided; (Step 3) analyze the state of the societal sub-system, with regards to the benefits obtained from the ES utilization; and (Step 4) analyze the feedback of the changed societal sub-system on the SEIs.

Interviewees for this research were selected based on stratified purposive sampling [32] and grouped into (i) experts, (ii) administrators, and (iii) local stakeholders. The first group consisted of 22 experts, which were either academics from regional and national universities (e.g., the Chinese Academy of Forestry, the Kunming Institute of Botany, the Kunming University of Science and Technology, and so on) or researchers from non-governmental institutes (e.g., the World Agroforestry Centre, the Nature Conservancy, the Institute for Tibetan Plateau Research, and so on), who were specialists on Chinese forest and environmental policies, governance, and environmental protection. The group of administrators consisted of administrative officials from national to local level, who were involved in forest management and the management of nature reserves (e.g., Ministry of Agriculture, the Yunnan Provincial Environmental Protection Department, Weixi County Forestry Bureau, Tacheng Township Forestry Station, Nature Reserve Station Tacheng Township, and so on). The third group of interviewees, local stakeholders, consisted of the local population in the research area itself. The local interviewees were selected (i) based on their involvement with the management of the collectively owned or state-owned forests (e.g., local forest guards), (ii) their contact with higher administrative levels as part of an administrative position in the village (e.g., village heads), and (iii) farmers that were affected by the state programs.

To assess the legal basis of local forest use and the changes to the underlying legal framework accompanied by the implementation of the SKNFPs (Step 1), we consulted the scientific literature and publicly accessible administrative and statistical documents, as well as conducting semi-structured interviews with the interviewee groups of experts and administrators.

For Step 2—the analysis of the state of the ecological subsystem with regard to the ES provided—we took a forest inventory based on systematic stratified sampling (with rectangular, 30 × 30 m plots). In addition to conventional variables, such as diameter, height, basal area, volume, age, and density, we used further indices (e.g., the Shannon Index for Species Diversity H), which “allow a better reproduction of the condition of the forest in a given moment and of its evolution in time” [33]. Stand density was calculated with Reineke’s Stand Density Index (SDI). Moreover, parameters, such as the thickness of the organic surface layer, surface soils, and vegetation stratification were sampled. Landsat TM data were selected for the GIS-based mapping and volume estimations. For this, a Landsat TM image was classified using a hyper-clustering and labeling approach with an unsupervised K-means algorithm and, in the following, was correlated with the sample data for ground validation. Combined, these data provided an overview of the condition of the forests in the area, as well as rough estimates of the possible stocks of fuelwood, building materials, and animal bedding. To analyze the demand for forest resources, we distributed questionnaires inquiring about consumption behavior (i.e., “how much fuelwood do you consume?”, “how much building material?”, and “how much animal bedding?”) and gauged fuelwood piles, fences, and houses (under construction) at different points in time. Based on these data, we could calculate per capita consumption estimates.

For Steps 3 and 4, we conducted extensive interviews and applied several participatory techniques from the “toolbox” of the participatory rural appraisal (PRA) [34,35].

- We used the Venn Diagram on Institutions to learn the attitudes of key informants towards institutions, organizations, important individuals, and programs (IOIPs) at higher levels of forest management and decision-making. It was based around three leading questions: (i) How high is the importance of the IOPIs to the participants, compared to the frequency and intensity of their contact or co-operation? (ii) With whom is the most contact or co-operation made? Who understand the needs of the local population the best? (iii) Who has the most power in local forest management?
- Matrix Ranking and Scoring was used to assess and study the preferences of key informants for particular ES and forest-uses, thereby uncovering trade-offs and conflicts in use value attribution.
- Community Mapping and Transect Walks were applied to map physical and social parameters of the research area with the values and problems attributed to them by community members. Moreover, it supported data on past land-use and legal access to the different forests, as well as past disturbances (e.g., forest fires) that can still be recognized in the landscape. The transects were selected to cover all different landscape mosaics, as well as all forest areas with different legal statuses. The community maps, drawn by participating key informants, were later used in group discussions and extended by other community members.

3. Results

3.1. Changing National Forest Policies in the Research Area

Forest protection measures were introduced in China as early as the 1950s. However, the period up until the introduction of the Six Key National Forest Programs (SKNFPs) in 1998 was dominated by economically motivated forest policies, rather than forest protection [36,37]. In particular, the reforms under Deng Xiaoping in the late 1970s and early 1980s promoted a heavily yield-oriented forest management. As a result of these reforms, logging became considerably more lucrative to the managers of forest enterprises, with the effect of state-owned timber farms vastly exceeding their quota and (often illegally) clear-cutting large areas in Yunnan [37]. Diqing Prefecture experienced the heaviest commercial logging in the 20 years between 1978 and 1998. After a steep ascent between

1978 and 1981 to about 800,000 m³/a, numbers plateaued at around 400,000 m³/a from the mid-1980s onward [29]. In Kegong, large areas in the Nosong valley were clear-cut in 1993 and 1994; reportedly, to finance the electrification of the upper Kegong valley. Despite the large amount of commercially extracted timber in Diqing Prefecture, Xu and Wilkes [29] estimated that local fuelwood collection and construction timber procurement consumed even more.

In the wake of the disastrous floods along the Yangtze River and waterways in Northeast China in the late 1990s, which claimed the lives of over 3,000 people, the Chinese government initiated a series of environmental protection programs—the SKNFPs. The most distinct implications of these six programs in Yunnan are particularly embodied in three programs: The Natural Forest Protection Program (NFPP), the Sloping Land Conversion Program (SLCP) and (by boosting the expansion of protected areas) the Wildlife Conservation and Nature Reserves Development Program.

The short-term goal of the NFPP (1998–2000) was to reduce commercial timber extraction by over 60% and to eliminate timber harvesting from natural forests [10,15]. This was to be achieved through a ban on commercial logging in the upper reaches of the Yangtze River. That logging ban was introduced, preliminarily, to Tacheng township in 1998. However, the years 1999 and 2000 were considered a test phase, in order to gain experience in sustainable forest management and the implementation of the NFPP, until the logging ban ultimately came into effect in 2001. From that moment on, commercial logging and timber trading was illegal. A retired representative of the Weixi County Government commented this event with the words “then we were trapped”: The scope of duties of the Forest Bureaus had changed completely, from the exploitation of forest resources to the implementation and enforcement of the new protection policies. At the same time, the administration, as well as the local population, lost their primary source of income and the Forest Bureaus, as well as the forest enterprises, had to lay off or pension off hundreds of their employees. Apart from this cessation of income, the impact of the logging ban on households in Kegong was minor, as they were already not allowed to procure timber from the state-owned forests before the ban. The rearrangement of the access to collectively owned forests under the NFPP, however, had significant consequences—most of all, the restructuring of the quota system for timber procurement. Under the new quota system, the administrative village Kena issues 30 licenses to cut timber for building material per year. To receive such a license, the household files an application describing its construction project, which is decided on by the Weixi Forestry Bureau. Subsequently, the household pays approximately 20 RMB per m³ to the Tacheng Forestry Station. Firewood, however, can be collected from the collectively owned forests without prior application.

The SLCP was designed to reduce soil erosion and expand forest cover by afforesting denuded mountains and wasteland and by converting farmland into forests [10,38]. This was to be accomplished by providing incentives to farmers or landowners, in exchange for converting farmland to forests. Kegong represents one of the target communities for the SLCP: The Kegong River is one of the pre-flooders of the Yangtze and, with elevations between 2000 and 4000 m and many slopes with an inclination over 25%, it fits all criteria of the program. With the goal of convincing farmers to convert their fields to forests and provide them with additional income, several measures were implemented in the village, including the planting of cash-trees, the construction of cement feeders to enhance productivity on the rice fields, and the reinforcement of river-bank vegetation with willows. Most of this work was carried out by the villagers themselves against payments from the SLCP funds. Acceptance of and participation in the SLCP was high and it has been regarded as a success. The villagers criticize, however, a lack of follow-up support, after many of the cash-tree seedlings and cement feeders were destroyed by flooding.

Following the expansion of the Baima Xue Shan Nature Reserve in 2004 and 2005, 650 km² of Weixi County presently lies within the reserve. Twelve villages are directly affected and nine of them lie within the protected area. In Kegong, all forests north of the Kegong River (i.e., in the Lama Ge, Lao Yu Ge, and Namu Ge) are located within the protected area and only those in the Nosong valley and on the slopes of the Feng Shan are not part of the nature reserve. As cutting wood is prohibited in the reserve and only the collection of dead wood for firewood is allowed, only one of the mountains (formerly three) is accessible to the farmers of Kegong. Thus, the expansion of the Baima Xue Shan nature

reserve severely reduced the amount of legally accessible forest biomass. Moreover, it contributed negatively to the attitude towards administration and local participation in forest protection, as it abruptly withdrew already granted access rights.

3.2. Acceptance and Participation

The impact of protective forest policies depends on a positive public attitude towards such administrative measures and the will to participate at the local level. However, a lack in public trust in governmental land-use policies is “particularly acute in rural China” [39]. The main source of this public mistrust lies in the frequent changes in and the lack of clear of enforceable tenure rights. China has a very distinct land tenure system: Under the household responsibility system, land is officially owned by village collectives and, to use it for food production or resource extraction, individual households have to lease single plots [40]. This system was, however, subject to frequent legal adjustments throughout the history of the People’s Republic, as phases of collectivization were followed by de-collectivization and reallocation [41]. The high frequency of these changes has thoroughly undermined the confidence of local farmers in tenure security and, thereby, contributes to unsustainable and even destructive resource extraction [39,41]. ‘Land-grabbing’ for construction projects or the installment of protected areas has exacerbated this dilemma, as the loss of legal access to productive resources often triggered illegal (and, therefore, unplanned and unsustainable) resource extraction. The latter could be observed in the case of national park expansions in Northwest Yunnan. Xu and Wilkes [29] reported that the enforcement of illegal logging and hunting or over-collection of NTFPs is costly and often ineffective, making some nature reserves “an unmanaged open-access area”.

As in the rest of Northwest Yunnan, insecurity regarding forest tenure is also an issue in Kegong. In the course of the introduction of the household responsibility system, large parts of the collectively owned forests in the Namu and Kegong valleys were divided into family plots (*ziliushan*) and responsibility lands (*zerenshan*) and, thereby, were distributed to the responsibility of single households. At that time, three forms of forest tenure or forest management existed in Kegong: (i) Privately managed forests (such as *ziliushan* or *zerenshan*), which were mainly located in the Namu valley. These consisted of plots sized 2–3 mu (2000–2500 m³) and were usually managed by two families. Wood-cutting for firewood, as well as for building material, was allowed in these parcels. (ii) The collectively managed or common forests comprised plots on the slopes of the Nosong valley, the Lama valley, and the Lao Yu valley, which were used by the whole community. Wood cutting, in these regions, for building material was regulated by a quota system. (iii) The Feng Shan (“protected mountain”) takes a special position, as it is not managed according to Chinese law, but rather following traditional Tibetan rules. It is sacred to the villagers and any wood extraction is forbidden on its north-facing slopes. The introduction of the Organic Law of Village Committees in 1998 granted the elected village committee further far-reaching land autonomy, regarding the collectively owned forests and further enactments to strengthen forest tenure security followed in 2002 and 2007. In reality, however, most of these laws were overruled by the SKNFPs and the villagers feel that the decision of how to use which forest is still nationally imposed. The best example for this is the expansion of the Baima Xue Shan nature reserve in 2004 and 2005: It divested the households of Kegong of their tenure rights in the Lao Yu valley, as all forests there changed into state property and are presently managed under the regulations of the nature reserve. Additionally, the quotas for construction timber for Kegong were lowered, as they were not calculated on the basis of population size but relative to the legally available forest area. Moreover, a poor state of information also contributes to illegal forest use. Several villagers reported on transect walks, saying that they were not sure about the exact borders or detailed regulations of the nature reserve. A lack of political voice, a lack of clear and enforceable tenure rights, lacking or low compensation for imposed restrictions, and poor information; these all leave an imprint on public trust and reduce the efficiency of forest policies and the willingness to participate. However, on the whole, the villagers acknowledge the purpose and the meaningfulness of the initiatives, including the restrictions, and participate—as long as it is compatible with their livelihoods.

3.3. Effects on Local Forest-Use and Forest-Change

Before the implementation of the SKNFPs, forest management (P^1) was driven by policies (D^1) focused on timber output above all, and logging in the area increased drastically. This increase in logging activities depended on a large number of forest workers and, thus, created considerable income generation possibilities in Weixi County, with the effect that, by the 1990s, local people and the county government heavily depended on this source of revenue. As a consequence, environmental aspects were of secondary importance. At the same time, the household responsibility system and further land reforms strengthened tenure security at the local level (see SSS^1 , Figure 3).

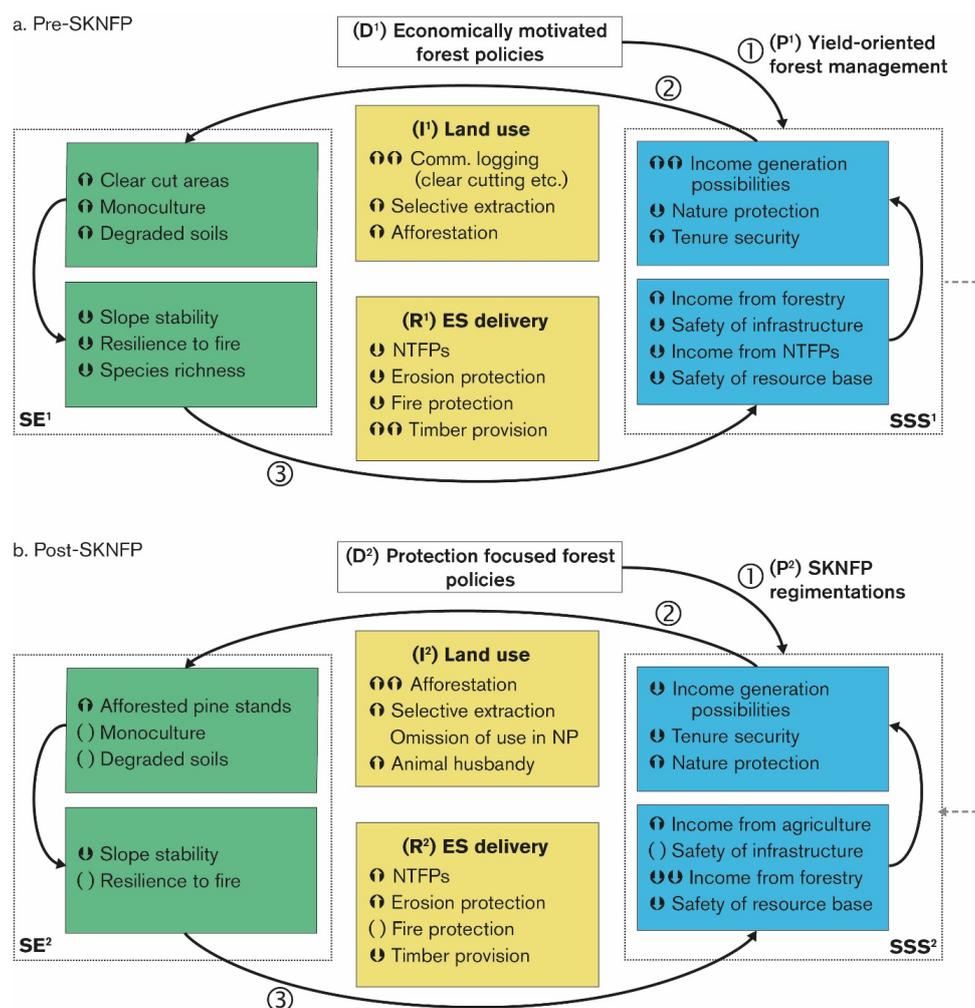


Figure 3. Graphic representation of the past development of the research area, related to the influence of the driver ‘forest policies’ (D-boxes). The numbers (1)–(3) indicate the causal sequences Pressure (1) → State → Impact (2) → State → Responses (3) at two different points in time (i.e., before and after the implementation of the Six Key National Forest Programs (SKNFPs). Pressures, impacts, and responses affect the system simultaneously and constantly, yet their intensity gradually changes over time. The dashed arrow indicates this gradual change over time, of both the state of the ecosystem and of the social system. Green-colored boxes indicate components of the state of the ecosystem (SE): Ecosystem properties and functions (upper box) and ES potentials (lower box). Blue-colored boxes indicate components of the state of the societal system (SSS): Benefits (lower box) and values (upper box). Yellow colors indicate social–ecological interactions: Changed ES delivery (lower box) and changed human involvement as a response to it (upper box). The arrows ☑/☐ indicate an increase/decrease in intensity, and () indicates an unchanged intensity. NTFP, non-timber forest product.

The selective extraction of forest biomass for fuel wood and building material changes the density and structure of forest in patches, rather than in large areas. It is regulated by accessibility and effort and, thus, the effect of fuelwood collection manifests the most intensely close to Kegong and near the valley floors. In close proximity to the village and the adjacent valleys, the forest stands show very similar features as in the formerly clear cut areas: Poor and highly eroded soils, very young and homogenous stands (DBH < 10 cm), and almost no herb layer (see Figure 4). The collection of the litter layer for animal bedding exacerbates the soil conditions further, as it suppresses soil regeneration.



Figure 4. Erosion in the forests of Kegong. Collection of the litter layer for animal bedding (**left**). Afforested pine stands (**middle**). Gullies in the pine stands close to the village (**right**).

With greater distance from the valley bottoms, soil conditions, especially the herb layer and topsoil, improve significantly. Age compositions and species diversity also improve, yet, depending on exposition, *Pinus*-dominated young stands are still the most common.

These ecosystem properties, resulting from past land-use, have had considerable repercussions on the provision of ecosystem services (R^1). Except for the provision of timber, which was intensified through de-collectivisation and commercial logging, all other essential forest services (i.e., NTFP provision, erosion protection, fire protection, biodiversity protection, and so on) have declined, with lasting negative consequences for benefits such as the safety of infrastructure from flooding and fires, income from NTFPs, and the safety of the forest biomass resource base.

With the implementation of the SKNFs, flood and erosion protection became the central objective of the forest policies for the upper reaches of the Mekong (D^2). Nature protection was promoted as a central societal value, while the preservation of job opportunities was considered secondary to that goal. In response to the ban of commercial logging and the consequent discontinuation of income from that sector, many farmers in Kegong turned to animal husbandry as an income source (I^2). The installment of the NP effectively interdicted timber extraction in the protective areas and, thus, caused the most distinct land-use change. Along with the afforestation measures under the SLCP, it initiated a period of soil and forest recovery in the designated areas. The remaining collectively owned forest, however, were thereby exposed to increasing pressure, as selective extraction is presently concentrated in these areas. Moreover, the shift to animal husbandry exacerbated this by increasing the consumption of wood, as it requires a higher amount of building material for stables, pens, and fencing and an increased amount of wood is used for heating livestock feed during the winter. As reported by the villagers, up to 35% of firewood is used for heating animal fodder.

The slopes and forests in the NP show signs of recovery, due to the omission of land-use: Ground and field layers are denser and interspersed with diverse tree shoots, and the under-storey shows a higher diversity. However, in close proximity to Kegong and in large areas of the Nosong valley, soils are still highly eroded and slope stability has not improved significantly, due to overuse. In summary,

the protected areas are recovering while, at the same time, any recovery is prevented in non-protected areas due to the concentration of use. Slope stability is improved in the NP and on the afforested slopes, yet is still critical in other areas. The same holds true for resilience to forest fires, yet, as the patches adjacent to the NP are still highly prone to fires, overall fire resilience has not improved. In regards to ecosystem services, the new state of the ecosystem is capable of providing better protection against erosion, and thus, flooding. The provision of fuelwood and construction material is, however, significantly limited in the current situation.

4. Discussion

4.1. Values in SES and ES Research

As McIntyre et al. [42] expressed, “many natural resource conflicts are more about values than they are about facts”. Hence, understanding the values of the relevant stakeholders is a key component of effective environmental management [17], which can help ecological managers to maximize the social acceptability of their actions and to minimize potential conflict [16]. However, diverse groups of stakeholders commonly hold a heterogeneity of (often apparently contrasting) values. Uncovering and considering these can be challenging, in practice, and requires theoretical guidance [17]. Hence, a theoretical integration of social values into research informing environmental management is necessary. However, in different fields of the research on human–nature interactions, such as social-ecological systems and ecosystem services research, social values are mostly under-represented and often mean different things.

‘Value’ is a term used frequently in studies on social-ecological systems. It has been linked to central themes of SES, including governance [43], adaptation [44], and resilience-based management [45], and it has often been identified as a key element in this field [17]. However, in most of the frameworks for analyzing SES (see, e.g., [46–48]) social values play hardly any role in understanding the linkages between the two sub-systems.

Values are also fundamental to the field of ecosystem services research, as how society values the benefits it obtains from nature, represents the core idea behind this concept [19,20]. The concept of ES emerged from a long-standing debate between those who base our duty to protect species or ecosystems solely based on their inherent value (see, e.g., [49]) and those who base it on the vital value nature has for our survival and prosperity (see, e.g., [19]). The notion of ES aims at uncovering the benefits nature provides to society and how these are valued by its members. As the benefits derived from ES are often valued in economic or physical terms, ES have been criticized for ‘selling out on nature’ [50] and a growing number of publications made the case for a more comprehensive inclusion of social values, in addition to physical and economic values (see, e.g., [51–53]).

To depict the causal chain along which ES evolves from natural structures and processes until they generate gains in human well-being, Haines-Young and Potschin [31] drafted the ‘ecosystem service cascade’, which includes values as the ‘end link’ of this chain. Spangenberg et al. [54] further developed the cascade metaphor by highlighting the importance of human involvement in the process of ES generation and delivery; particularly the act of value attribution, which turns biophysical ecosystem functions into ecosystem service potentials. Hence, in the concept of ES, the formation of societal values represents the ‘end point’—the final result of the appropriation of natural services. At the same time, the act of assigning value is crucial to the generation of ES themselves. This differs fundamentally from the use of the term ‘value’ within the field of SES literature. While the former focuses on how nature and its elements are valued by people (i.e., assigned values), the latter is characterized by a focus on the values of people (i.e., held values). Held values reflect our ideals of what is desirable [23]. This is expressed in our preferences for particular modes of conduct (e.g., honesty), end-states of existence (e.g., freedom), or qualities (e.g., beauty) [55]. Held values are usually more broad, generic principles and ideas of how things ought to be, whereas assigned values are attached to particular places or activities, species, or other features of the natural world [23,55].

Assigned values are the relative importance or worth an object has to us [23] and, while ES are a very useful tool for (pro-)environmental management as they help to disclose and evaluate the importance or worth of ecosystems, the concept falls short of clarifying how these assigned values manifest in society and, thereby, shape the use of natural resources. However, the imperative to uncover the relative importance and worth of ‘overlooked’ ecosystem components to stakeholders and policy makers is convincing, as the hope for initiating widespread change in held social values to tackle the numerous modern ecological crises by providing scientific knowledge has not fulfilled [18]. Hence, we argue, it is of urgent importance to develop research frameworks that integrate both assigned and held values into social-ecological research. The approach to embed ES into a broader SES conception—as realized in the SEI framework applied in this case study—is a step in the right direction. However, due to the strong position that ES holds in this framework, assigned values seem to be over-represented and interactions between external drivers of change and societal values need better explaining.

4.2. Societal Values and Their Impact on Forest Use in the Research Area

We found four qualities of societal values to be significant in shaping the ecological outcomes of the SKNFPs in the case study area: (i) Societal values are both slow (held values) and fast (assigned values) variables in SES; (ii) multiple values can be assigned to the same element of the ecological subset; (iii) value attribution is a means of adaptive behavior; and (iv) values shape the judgement of management decisions.

Held values specified by the villagers (i.e., their ideals of what is desirable) included desired states of existence, such as secure food and income generation and safe living environments; desired entitlements, such as decision autonomy on village-owned land, tenure rights, and participation in decision-making; and desired forest qualities, such as ‘intactness’ of culturally important forest-lands and natural beauty, in general. These values underlie and form the way the locals use their forests and, through land-use and value attribution, ‘create’ the values assigned to the delivery of the forest services (and functions) (i.e., timber provision, erosion protection, protection from wildfires, the provision of NTFPs, and cultural and aesthetic services). Held values are broad and rather static principles, whereas assigned values are more prone to fluctuations and are adapted to new situations frequently. Income and food security, as well as the safety of their homes and infrastructure from hazards, are stable and central held values of most people. The behavior towards their natural environment that is triggered by these values is, however, very situational and includes frequent trade-offs in value attribution (e.g., the value assigned to timber provision versus erosion protection). Hence, in order to support their held values, the interaction of locals with their forests is shaped by ‘balancing’ the values assigned to their forest services and adapting their behavior.

The values assigned to Yunnan’s forest by the state, however, were very static and focused on single major outcomes: Before the implementation of the SKNFPs, its main value was seen solely in the provision of raw materials for the industry and the building sector whereas, afterwards, its central value to the state consisted in protecting downstream infrastructure and livelihoods from flooding. This, of course, comes into conflict with the local, more multi-faceted value attribution and the legal situations resulting from the national forest policies did not manage to embrace the ‘multi-functionality’ that forests have for local people.

This narrows the ability of local people to adapt and may, as in the case study area, exacerbate unsustainable forest exploitation: To support their income and, despite their knowledge of the negative impacts on slope stability and soil quality, many locals took part in logging operations that resulted in clear-felling in close proximity to their villages. Similarly, the unsustainable ‘rush’ to selective extraction of building material and firewood following the de-collectivisation of several slopes, again, was a trade-off between timber provision and forest protection. However, the decision for the clear-felling was made at a county level and the negative effects of the selective extraction were exacerbated by, for instance, the insecure and ever-changing tenure rights, the maladjusted quota system, and the installment of the national park. After the implementation of the SKNFPs and in response to the ban of

commercial logging and the consequent discontinuation of income from that sector, many farmers of Kegong turned to animal husbandry as an income source, which, due to the higher demand in fuelwood and building material, again increased the pressure on forest resources.

The adaptive strategies of the villagers are based on a reassessment of their assigned values and how these support their held values. In cases where fundamental held values, such as income and food security, are affected, self-interest tends to over-rule concern for the welfare of the environment. However, the majority of the interviewed locals expressed great concern regarding the condition of their forests and acknowledged the purpose and the meaningfulness of the protective initiatives by the state. In the case of the SLCP, incentives, such as the support for cash tree planting and terracing, supported the adaptive process by aligning locally held values, such as income/food security and infrastructure safety, with the values assigned to converted forest areas by the state. This, of course, was not the case with the expansion of the national park into formerly village-owned forest slopes. In addition, the acceptance of the national park expansion was low, because there was no adequate transition phase. The abruptness of the changes that the SKNFPs triggered in the case study area added to the cross-level value conflict.

5. Conclusions

The case in China shows how value shifts may happen on different societal or political levels and at different temporal scales, yet these different values at different levels influence each other and the system as a whole. We still understand little of how changed values at one level mobilize or retard value changes at another level, or how value shifts at one level may alter the entire system. Moreover, there is still not enough knowledge about the impact of social values on the adaptive capacity of SES. When do social values contribute to adaptive choices and when do they de facto constrain peoples' capability to adapt to change? Furthermore, under which circumstance have social value shifts to be considered an actual driver of change and when are they a response to a changing world?

A necessary first step, however, is for researchers to specify the theoretical basis of the use of the term 'values' to enable a constructive dialogue between disciplines. The next step is to better integrate social values into the design of frameworks for analyzing SES. For this, instruments to evaluate or uncover social values can be helpful. Ives and Kendal proposed a number of tools for applying values research to ecological management [16]. These include Psychometric Scales (e.g., a scale to measure environmental value orientations [56], the 'model of eight basic wildlife value orientations' developed by Fulton et al. [57], or Winter and Lockwood's 'natural area value scale' [58]) and approaches for the Spatial Mapping of Values using Public Participation GIS (PPGIS). These instruments can be ideally combined with approaches for mapping (cultural) ecosystem services (see, e.g., [59,60]).

Practitioners in the field of forest management can benefit from the study of societal values in multiple ways [17]. Analyses of values can enrich bottom-up or participatory decision-making: Acknowledging and including the multiplicity of values connected to, for example, a protected area, and aligning conservation efforts with these values, strengthens public support and participation. Moreover, societal value assessments can support building acceptance for top-down decisions by identifying potential misalignments between conservation goals and locally held or assigned values in advance. In that case, conservation managers can design communication strategies that address the diversity of and conflict between the values involved, which shows transparency and conveys the consideration of the interests of all stakeholders. Furthermore, a communication strategy based on value analyses can lead to adaptive strategies supporting held values while changing the value attribution of certain assigned values.

Author Contributions: Conceptualization, M.N. and J.L.; Methodology, M.N. and J.L.; Writing—original draft, M.N.; Writing—review & editing, J.L.; Visualization, M.N.; Supervision, J.L.

Funding: This research received no external funding.

Acknowledgments: We would like to thank the Kunming Institute of Botany, Chinese Academy of Sciences (KIB/CAS) for field work and logistics support. We are especially grateful for the collaboration and fruitful

discussions with the members of the Mountain Research Group (i.e., Sebastian Homm, Lennart Kümper-Schlake, Florian Sander, and Till Rockenbauch), of which our special thanks goes to Lennart Kümper-Schlake and Sebastian Homm for the conduction of interviews and PRA activities.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. FAO. *State of the World's Forests 2016. Forests and Agriculture: Land-Use Challenges and Opportunities*; State of the World's Forests: Rome, Italy, 2016.
2. Gutiérrez Rodríguez, L.; Hogarth, N.J.; Zhou, W.; Xie, C.; Zhang, K.; Putzel, L. China's conversion of cropland to forest program: A systematic review of the environmental and socioeconomic effects. *Environ. Evid.* **2016**, *5*, 24. [[CrossRef](#)]
3. Mather, A.S. Recent Asian forest transitions in relation to foresttransition theory. *Int. For. Rev.* **2007**, *9*, 491–502. [[CrossRef](#)]
4. He, J.; Lang, R.; Xu, J. Local Dynamics Driving Forest Transition: Insights from Upland Villages in Southwest China. *Forests* **2014**, *5*, 214–233. [[CrossRef](#)]
5. Rodríguez, L.G.; Pérez, M.R. Recent changes in Chinese forestry seen through the lens of Forest Transition theory. *Int. For. Rev.* **2013**, *15*, 456–470. [[CrossRef](#)]
6. Zhang, K.; Song, C.; Zhang, Y.; Zhang, Q. Natural disasters and economic development drive forest dynamics and transition in China. *For. Policy Econ.* **2017**, *76*, 56–64. [[CrossRef](#)]
7. Rudel, T.K.; Coomes, O.T.; Moran, E.; Achard, F.; Angelsen, A.; Xu, J.; Lambin, E. Forest transitions: Towards a global understanding of land use change. *Glob. Environ. Chang.* **2005**, *15*, 23–31. [[CrossRef](#)]
8. Xu, J.; Yang, Y.; Fox, J.; Yang, X. Forest transition, its causes and environmental consequences: Empirical evidence from Yunnan of Southwest China. *Trop. Ecol.* **2007**, *48*, 137–150.
9. Démurger, S.; Hou, Y.; Yang, Y. Forest Management Policies and Resource Balance in China: An Assessment of the Current Situation. *J. Environ. Dev.* **2009**, *18*, 17–41. [[CrossRef](#)]
10. Delang, C.O.; Yuan, Z. *China's Grain for Green Program. A Review of the Largest Ecological Restoration and Rural Development Program in the World*; Springer International Publishing: Cham, Switzerland, 2015; ISBN 3319115057.
11. Wang, G.; Innes, J.L.; Lei, J.; Dai, S.; Wu, S.W. China's forestry reforms. *Science* **2007**, *318*, 1556–1557. [[CrossRef](#)]
12. Liu, Z.; Lan, J. The Sloping Land Conversion Program in China: Effect on the Livelihood Diversification of Rural Households. *World Dev.* **2015**, *70*, 147–161. [[CrossRef](#)]
13. Mullan, K.; Kontoleon, A.; Swanson, T.M.; Zhang, S. Evaluation of the impact of the natural forest protection program on rural household livelihoods. *Environ. Manag.* **2010**, *45*, 513–525. [[CrossRef](#)] [[PubMed](#)]
14. Liu, Z.; Henningsen, A. The effects of China's Sloping Land Conversion Program on agricultural households. *Agric. Econ.* **2016**, *47*, 295–307. [[CrossRef](#)]
15. Ren, G.; Young, S.S.; Wang, L.; Wang, W.; Long, Y.; Wu, R.; Li, J.; Zhu, J.; Yu, D.W. Effectiveness of China's National Forest Protection Program and nature reserves. *Conserv. Biol.* **2015**, *29*, 1368–1377. [[CrossRef](#)] [[PubMed](#)]
16. Ives, C.D.; Kendal, D. The role of social values in the management of ecological systems. *J. Environ. Manag.* **2014**, *144*, 67–72. [[CrossRef](#)] [[PubMed](#)]
17. Jones, N.A.; Shaw, S.; Ross, H.; Witt, K.; Pinner, B. The study of human values in understanding and managing social-ecological systems. *Ecol. Soc.* **2016**, *21*. [[CrossRef](#)]
18. Manfredo, M.J.; Bruskotter, J.T.; Teel, T.L.; Fulton, D.; Schwartz, S.H.; Arlinghaus, R.; Oishi, S.; Uskul, A.K.; Redford, K.; Kitayama, S.; et al. Why social values cannot be changed for the sake of conservation. *Conserv. Biol.* **2016**, *31*, 772–780. [[CrossRef](#)] [[PubMed](#)]
19. Daily, G.C. (Ed.) *Nature's Services. Societal Dependence on Natural Ecosystems*; Island Press: Washington, DC, USA, 1997; ISBN 9781559634762.
20. Costanza, R.; d'Arge, R.; de Groot, R.; Farber, S.; Grasso, M.; Hannon, B.; Limburg, K.; Naem, S.; O'Neill, R.V.; Paruelo, J. The value of the world's ecosystem services and natural capital. *Ecol. Econ.* **1998**, *25*, 3–16. [[CrossRef](#)]

21. Gómez-Baggethun, E.; Ruiz-Pérez, M. Economic valuation and the commodification of ecosystem services. *Prog. Phys. Geogr.* **2011**, *35*, 613–628. [[CrossRef](#)]
22. Schultz, P.W.; Zelezny, L. Reframing environmental messages to be congruent with American values. *Hum. Ecol. Rev.* **2003**, *10*, 126–136.
23. Bengston, D.N. Changing forest values and ecosystem management. *Soc. Nat. Resour.* **1994**, *7*, 515–533. [[CrossRef](#)]
24. Xu, Z.; Bengston, D.N. Trends in national forest values among forestry professionals, environmentalists, and the news media, 1982–1993. *Soc. Nat. Resour.* **1997**, *10*, 43–59. [[CrossRef](#)]
25. Rolston, H.; Coufal, J. A forest ethic and multivalue forest management. *J. For.* **1991**, *89*, 35–40.
26. Liu, J.; Diamond, J. China's environment in a globalizing world. *Nature* **2005**, *435*, 1179–1186. [[CrossRef](#)] [[PubMed](#)]
27. Nassl, M.; Löffler, J. Ecosystem services in coupled social-ecological systems: Closing the cycle of service provision and societal feedback. *Ambio* **2015**, *44*, 737–749. [[CrossRef](#)] [[PubMed](#)]
28. The State Forestry Administration People's Republic of China. *People's Republic of China Forestry Outlook Study*; Working Paper Series APFSOS II/WP/2009/11; Food and Agriculture Organization of the United Nations: Bangkok, Thailand, 2009.
29. Xu, J.; Wilkes, A. Biodiversity impact analysis in northwest Yunnan, southwest China. *Biodivers. Conserv.* **2004**, *13*, 959–983. [[CrossRef](#)]
30. Glauben, T.; Herzfeld, T.; Rozelle, S.; Wang, X. Persistent Poverty in Rural China: Where, Why, and How to Escape? *World Dev.* **2012**, *40*, 784–795. [[CrossRef](#)]
31. Haines-Young, R.; Potschin, M. The links between biodiversity, ecosystem services and human well-being. In *Ecosystem Ecology: A New Synthesis*; Raffaelli, D.G., Frid, C.L.J., Eds.; Cambridge University Press: Cambridge, UK, 2010; pp. 110–139.
32. Patton, M.Q. *Qualitative Research & Evaluation Methods. Integrating Theory and Practice*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2015; ISBN 9781412972123.
33. Calderón, O.A.A.; Pérez, J.J.; Kramer, H. Assessment and monitoring of forest ecosystem structure. In *Assessment and Monitoring of Forest Ecosystem Structure*; Aguirre-Bravo, C., Pellicane, P.J., Burns, D.P., Draggan, S., Eds.; Monitoring Science and Technology Symposium: Unifying Knowledge for Sustainability in the Western Hemisphere Proceedings RMRS-P-42CD; US Department of Agriculture, Forest Service, Rocky Mountain Research Station: Fort Collins, CO, USA, 2006.
34. Chambers, R. Participatory rural appraisal (PRA): Challenges, potentials and paradigm. *World Dev.* **1994**, *22*, 1437–1454. [[CrossRef](#)]
35. Kumar, S. *Methods for Community Participation. A Complete Guide for Practitioners*; ITDG Publishing: London, UK, 2006; ISBN 1853395544.
36. Yin, R.; Yin, G.; Li, L. Assessing China's Ecological Restoration Programs: What's Been Done and What Remains to Be Done? In *An Integrated Assessment of China's Ecological Restoration Programs*; Yin, R., Ed.; Springer: Dordrecht, The Netherlands, 2009; ISBN 904812655X.
37. Trac, C.J.; Harrell, S.; Hinckley, T.M.; Henck, A.C. Reforestation programs in Southwest China: Reported success, observed failure, and the reasons why. *J. Mt. Sci.* **2007**, *4*, 275–292. [[CrossRef](#)]
38. Xi, W.; Wang, F.; Shi, P.; Dai, E.; Anoruo, A.O.; Bi, H.; Rahmlow, A.; He, B.; Li, W. Challenges to Sustainable Development in China: A Review of Six Large-Scale Forest Restoration and Land Conservation Programs. *J. Sustain. For.* **2014**, *33*, 435–453. [[CrossRef](#)]
39. Xu, J.; Melick, D.R. Rethinking the effectiveness of public protected areas in southwestern china. *Conserv. Biol.* **2007**, *21*, 318–328. [[CrossRef](#)]
40. Yan, X.; Bauer, S.; Huo, X. Farm Size, Land Reallocation, and Labour Migration in Rural China. *Popul. Space Place* **2014**, *20*, 303–315. [[CrossRef](#)]
41. Liu, D. Tenure and Management of Non-State Forests in China since 1950: A Historical Review. *Environ. Hist.* **2001**, *6*, 239–263. [[CrossRef](#)]
42. McIntyre, N.; Moore, J.; Yuan, M. A Place-Based, Values-Centered Approach to Managing Recreation on Canadian Crown Lands. *Soc. Nat. Resour.* **2008**, *21*, 657–670. [[CrossRef](#)]
43. Olsson, P.; Gunderson, L.; Carpenter, S.; Ryan, P.; Lebel, L.; Folke, C.; Holling, C.S. Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems. *Ecol. Soc.* **2006**, *11*, 18. [[CrossRef](#)]

44. Folke, C.; Carpenter, S.R.; Walker, B.; Scheffer, M.; Chapin, T.; Rockstrom, J. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecol. Soc.* **2010**, *15*, 20. [[CrossRef](#)]
45. Chapin, F.S.; Kofinas, G.P.; Folke, C.; Carpenter, S.R.; Olsson, P.; Abel, N.; Biggs, R.; Naylor, R.L.; Pinkerton, E.; Stafford, D.M.; et al. Resilience-Based Stewardship: Strategies for Navigating Sustainable Pathways in a Changing World. In *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World*; Folke, C., Kofinas, G.P., Chapin, F.S., Eds.; Springer: New York, NY, USA, 2009; pp. 319–337. ISBN 978-0-387-73033-2.
46. Chapin, F.S.; Lovcraft, A.L.; Zavaleta, E.S.; Nelson, J.; Robards, M.D.; Kofinas, G.P.; Trainor, S.F.; Peterson, G.D.; Huntington, H.P.; Naylor, R.L. Policy strategies to address sustainability of Alaskan boreal forests in response to a directionally changing climate. *Proc. Natl. Acad. Sci. USA* **2006**, *103*, 16637–16643. [[CrossRef](#)] [[PubMed](#)]
47. Ostrom, E. A general framework for analyzing sustainability of social-ecological systems. *Science* **2009**, *325*, 419–422. [[CrossRef](#)] [[PubMed](#)]
48. Collins, S.L.; Carpenter, S.R.; Swinton, S.M.; Orenstein, D.E.; Childers, D.L.; Gragson, T.L.; Grimm, N.B.; Grove, J.M.; Harlan, S.L.; Kaye, J.P.; et al. An integrated conceptual framework for long-term social-ecological research. *Front. Ecol. Environ.* **2011**, *9*, 351–357. [[CrossRef](#)]
49. Soulé, M.E. What is conservation biology? *BioScience* **1985**, *35*, 727–734.
50. McCauley, D.J. Selling out on nature. *Nature* **2006**, *443*, 27–28. [[CrossRef](#)]
51. Bryan, B.A.; Raymond, C.M.; Crossman, N.D.; MacDonald, D.H. Targeting the management of ecosystem services based on social values: Where, what, and how? *Landsc. Urban Plan.* **2010**, *97*, 111–122. [[CrossRef](#)]
52. Chan, K.M.A.; Guerry, A.D.; Balvanera, P.; Klain, S.; Satterfield, T.; Basurto, X.; Bostrom, A.; Chuenpagdee, R.; Gould, R.; Halpern, B.S.; et al. Where are Cultural and Social in Ecosystem Services? A Framework for Constructive Engagement. *BioScience* **2012**, *62*, 744–756. [[CrossRef](#)]
53. Iniesta-Arandia, I.; García-Llorente, M.; Aguilera, P.A.; Montes, C.; Martín-López, B. Socio-cultural valuation of ecosystem services: Uncovering the links between values, drivers of change, and human well-being. *Ecol. Econ.* **2014**, *108*, 36–48. [[CrossRef](#)]
54. Spangenberg, J.H.; von Haaren, C.; Settele, J. The ecosystem service cascade: Further developing the metaphor. Integrating societal processes to accommodate social processes and planning, and the case of bioenergy. *Ecol. Econ.* **2014**, *104*, 22–32. [[CrossRef](#)]
55. Brown, T.C. The Concept of Value in Resource Allocation. *Land Econ.* **1984**, *60*, 231–246. [[CrossRef](#)]
56. Stern, P.C. New environmental theories: Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [[CrossRef](#)]
57. Fulton, D.C.; Manfredi, M.J.; Lipscomb, J. Wildlife value orientations: A conceptual and measurement approach. *Hum. Dimens. Wildl.* **1996**, *1*, 24–47. [[CrossRef](#)]
58. Winter, C.; Lockwood, M. The Natural Area Value Scale: A New Instrument for Measuring Natural Area Values. *Australas. J. Environ. Manag.* **2004**, *11*, 11–20. [[CrossRef](#)]
59. Plieninger, T.; Dijks, S.; Oteros-Rozas, E.; Bieling, C. Assessing, mapping, and quantifying cultural ecosystem services at community level. *Land Use Policy* **2013**, *33*, 118–129. [[CrossRef](#)]
60. Ungaro, F.; Häfner, K.; Zasada, I.; Pierr, A. Mapping cultural ecosystem services: Connecting visual landscape quality to cost estimations for enhanced services provision. *Land Use Policy* **2016**, *54*, 399–412. [[CrossRef](#)]

