*Forests* **2015**, *6*, 3136-3164; doi:10.3390/f6093136

OPEN ACCESS

*forests*

**ISSN 1999–4907**

www.mdpi.com/journal/forests

*Article*

# Changing Perceptions of Forest Value and Attitudes toward Management of a Recently Established Nature Reserve: A Case Study in Southwest China

**Hua Yang [1,2,3,4,5,†], Rhett Harrison [1,5,6,†], Zhuang-Fang Yi [1,5,6,†], Eben Goodale [7,†], Ming-Xu Zhao [1,2,†] and Jian-Chu Xu [1,5,6,†,*]**

1 Key Laboratory of Economic Plants and Biotechnology, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China; E-Mails: yanghua@mail.kib.ac.cn (H.Y.); r.harrison@cgiar.org (R.H.); yizhuangfang@mail.kib.ac.cn (Z.-F.Y.); zhaomingxu@mail.kib.ac.cn (M.-X.Z.)

2 University of Chinese Academy of Sciences, Beijing 100049, China

3 Sugar Cane Research Institute, Yunnan Academy of Agricultural Sciences, 363 Lingquan East Road, Kaiyuan 661660, China

4 Program for Field Studies in Tropical Asia, Xishuangbanna Tropical Botanical Garden, Menglun, Mengla 666303, China

5 Centre for Mountain Ecosystem Studies, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China

6 World Agroforestry Centre, East and Central Asia Regional Office, Kunming 650201, China

7 Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Menglun, Mengla 666303, China; E-Mail: eben.goodale@gmail.com

† These authors contributed equally to this work.

* Author to whom correspondence should be addressed; E-Mail: jxu@mail.kib.ac.cn; Tel.: +86-871-6522-3355; Fax: +86-871-6522-3014.

Academic Editor: Eric J. Jokela

*Received: 30 April 2015 / Accepted: 29 August 2015 / Published: 9 September 2015*

**Abstract:** Identifying the main sources of conflict and understanding the relationships between protected areas and local communities are critical to conflict resolution related to protected area management. We surveyed and assessed the perceptions of local people related to forest values of the Bulong Nature Reserve (BNR), Yunnan, China, and their attitudes toward forest management of the recently-established nature reserve. Factors

influencing the differences in perceptions and attitudes were investigated. Our results indicated local residents preferred the economic value of forests, and they perceived more forest values after reserve establishment than before, especially for ecological services. Interviewees believed the value of the forests have increased, and predicted that the forest will have increased importance to their livelihoods and health in the future. Nonetheless, the majority of interviewees were dissatisfied with current reserve management. Variation in these perceptions and attitudes were related to several social variables: age, gender, education, and distance from the reserve. Embedding the findings of the present study, specifically the perceptions and attitudes of local people, into management guidelines for mitigation of potential conflicts is proposed and should help managers to achieve biodiversity-related goals. This study offers new insights related to the identification of the underlying sources of conflict in forest management and provides a better understanding of the relationship between local people and protected areas. The study also contributes to the literature on forest values of indigenous populations by examining those of remote, rural populations in China.

**Keywords:** changing perception; China; forest value; nature reserve; protected area

## 1. Introduction

Protected areas (PAs) have been considered as a key to biodiversity conservation [1–4]. Previous studies have shown that protected areas can successfully protect biodiversity over broad geographic areas, through empirical coarse-scale assessments of biodiversity at regional or global scales [1,5–9]. However, finer-scale studies have reported that the effectiveness of protected areas is problematic at a local scale [10–12]. Finer scale studies have often identified problems that were mainly attributed to the interests of local communities during the establishment of protected areas [2,13–16]. In fact, those variable interests often caused conflicts between protected area management and the needs of local people to gain a livelihood. Thus, the effectiveness of nature reserves at a local level has often not been as high as was expected [1,16,17]. Responses to local concerns can help provide the necessary information needed to evaluate the interests of indigenous people and to develop appropriate management strategies [18,19]. Therefore, assessments of protected areas at a local scale are essential to identifying the problems that are often obscured by coarse-scale studies [5,20]. These types of assessments are not only useful for the resolution of conflicts between local people and needs for nature reserves but are also critical to sustainable forest management.

In China, forest conservation efforts date back to the Qin Dynasty (221–207 BCE) when the protected areas were mainly used for imperial hunting and temple grounds [21,22]. The Dinghu Shan Nature Reserve, China's first, was established in Guangdong Province in 1956 [23]. Even though China started to pay attention to its nature reserve system after the establishment of the new China in 1949, the Great Leap Forward (1958–1960) and the chaos of the Cultural Revolution (1966–1976) disrupted the implementation of conservation efforts; this period witnessed extensive environmental degradation resulting from rapid resource exploitation [16,22]. Afterward, the implementation of China's reform and

opening-up policy stressed that environmental policy should not impede economic expansion [16,24]. In this context, the natural resources were depleted by overexploitation, which caused a consequent loss of forested area. This trend continued until the catastrophic downstream flooding in 1998. Since then, some forest programs focusing on environmental protection and restoration have been implemented, including an immediate ban on all commercial logging of state forests and the implementation of the Natural Forest Protection Program (NFPP) and the Sloping Land Conversion Program (SLCP) [25,26]. However, these programs have been criticized for their monolithic approach, particularly in light of their effects on biodiversity [27,28]. The conservation of biodiversity is still threatened by the demands for forest logging and monoculture plantations in support of the livelihoods of rural people.

In an effort to protect biodiversity, protected areas were created by excluding local people from reserves, through the imposition of regulations that restrict resource exploitation requiring a strict approach using "fences and fines" [22,23]. Since the first nature reserve was established in 1956, by 2012 China had created 2669 nature reserves, which cover an area of 149,790,000 ha, accounting for 14.9% of China's territory and exceeding the world average of 12% [29]. Protected areas in China are distributed mostly in remote regions where people have low incomes, and in regions that are often inhabited by diverse ethnic groups whose livelihoods depend heavily on forest resources [30]. Traditionally, local people can collect natural resources from the forests; they have the right to satisfying their basic forest resource demands and use collective management for land tenure. However, to complete their mission and achieve their purposes, local governments have adopted a top-down approach to implementing the rules while ignoring the concerns of local people, who are often negatively affected [28]. The traditional practices and customary rights of indigenous people were severely restricted by regulations of protected areas [31–33]—restrictions not only on their agricultural practices but also in the interest of collective forest tenure such as the use of non-timber forest products (NTFP), firewood collection and livestock grazing [22]. Furthermore, during the process of establishing and managing protected areas in China, authorities have usually only consulted "experts" such as biologists, protected area managers, local and central government officers while excluding local people from the decision-making process [34]. The top-down approach pays little attention to the significant potential role of local participation in protected area planning, management, and decision-making [35,36]; as a result, local people have no rights to freedom of opinion and expression.

Local customary rights to natural resources, if curtailed by the establishment of protected areas and a disregard of those rights by decision-makers, could escalate to open conflicts, such as disagreements over boundaries, disputes over work plans and benefit sharing, and accusations of corruption and illegal logging activities [37,38]. These conflicts have led to difficult management challenges for most reserve authorities in China; these challenges have constrained the effectiveness of many protected areas and jeopardized conservation goals [39]. All stakeholders need to know how to deal with people–park conflicts; this is the challenge faced by local governments and nature reserve managers in their efforts to effectively manage protected areas.

Some researchers have proposed a theoretical framework of co-management as a mechanism of dealing with people–park conflicts in a participatory and equitable manner [40–42]. The concept of co-management has provided a platform for improving communication between protected area managers and local people [43]. Based on this platform, protected area managers can encourage local people to participate in all kinds of training, provide them with information and technical guidance, in a way that

develops management plans that can reflect the opinions of local people. Local participation has been viewed as a prerequisite in the co-management approach because it allows for mitigating the conflicts between local people and the planned management of protected areas [44–48]. In China, a co-management approach involving local participation has sometimes been applied to nature reserve management in an effort to solve conflicts between the needs of both protected areas and local communities. For instance, since the early 1990s, managers of protected areas in China have begun to incorporate the co-management approach [34,36,49]. Xu and Melick [16] reported that the community-based approach to reserve management in China has resulted in better conservation outcomes than a "top-down" management style. In some areas, ecotourism has been promoted as a means for achieving participatory management in nature reserves in a way that allows managers to achieve sustainable forest management, such as in the Wolong Nature Reserve and the Shennongjia National Reserve in China [13,50,51]. The decentralization of forest tenure in 2008, known as Collective Forest Tenure Reform, has prevailed as a method of combining forest management with poverty reduction [22,26].

Successful co-management depends strongly on the relationship between local people and protected area managers [52]. Local people, especially those living in and around protected areas, have important and long-standing relationships with these areas [47,53,54]. Their needs, perceptions, and attitudes contain useful information that could be incorporated into the decision-making process. Considering their knowledge and opinions can lead to the resolution of conflicts and make management systems more effective and more favorable in practice [55–57]. De Boer [58] and Newmark *et al.* [59] showed that access to park-related benefits can positively influence the perceptions and attitudes of local people. However, if local people recognize that the benefits are too small or unevenly distributed, conservation approaches may fail to win their genuine support, and local people may even adopt actions detrimental to the goals of conservation [48,60,61]. In China, people have a philosophy that "those living on a mountain get their living from the mountain," so many local people have the ingrained traditional thought that it is natural to get various kinds of resources from the forest. Furthermore, local poor farmers are more concerned with immediate economic benefits [13], than with preserving long-term forest health. Most important, these people are often the direct users and supposed "protectors" of the natural resources. Their attitudes can affect individual consumer behavior and political action [62], which may influence the implementation of forest policies and management [63]. Therefore, understanding the attitudes of local people toward protected areas can facilitate improvement of the relationship between protected area managers and local residents, which is critical for gaining more positive attitudes and supporting conflict resolution in the co-management approach [64,65].

Glasl [66] stated that successful conflict resolution also relies on knowing how to address its triggers. The specific sources of conflict need to be recognized by conservation planners and policymakers [67]. Understanding the perceptions of local people as they relate to forest value is an important part of gaining a better understanding of major sources of conflict between those who want to emphasize community development and those in charge of nature reserve management [68]. Perceptions of forest value are a valuable source of information on local perspectives, knowledge, and beliefs [69,70]. Forest values play a critical role in identifying sustainable forest management goals, setting the context for decision-making, and guiding the choices of forest managers [71–74]. Buttoud [75] suggested the way local people perceive the value of forests needs to be considered in the sustainable development of forests. Lee and Kant [76] stated that identification and understanding of the value people place on forest resources may assist in

highlighting the true nature of forest management conflicts [72,77]. Dolisca *et al.* [78] and McFarlane [63] also reported that a better understanding of how local people perceive the value of forests is fundamental to the development and implementation of sustainable forest management strategies. Furthermore, changing perceptions of forest values over time can reflect the effects of forest management on local communities. Xu and Bengston [68] claimed that ecosystem management can be viewed as a response to changing values or as a driving force that is creating value change. Gordon [79] argued that a shift in public values is part of the explanation for the declining influence of the multiple-use/sustained-yield paradigm of forest management. However, to understand the changes of forest values more systematically, a need exists to develop resource management approaches that can reflect changing forest values and anticipate the future evolution of forest values [68]. A few studies have analyzed forest values at a particular point in time [74,80], but literature on forest values in the China context are still lacking. At the same time, we found that very few studies exist specifically reporting local perceptions and attitudes toward protected areas in China [2,39,40,53,81].

In this study, we evaluated the variation of the perceptions of local people related to forest values before and after establishment of a nature reserve, as well as assessed their attitudes toward its establishment and current management. These perceptions and attitudes could be incorporated into a co-management approach for finding the main source of conflicts and improving the relationship between the Bulong Nature Reserve and the local community to mitigate potential conflicts. Clear knowledge of factors influencing people's perceptions and attitudes could help authorities to tailor a capacity development program designed to meet the needs of local people. This paper also contributes to the literature on the forest values of indigenous populations by examining remote, rural populations in China. The findings are valuable not only for protected area management designed to achieve biodiversity goals in Yunnan, but also for the broader efforts to conduct sustainable forest management in China and other developing countries that are dependent on forest resources. The overall objectives of this study were: (1) to discern the preferences of local people as they relate to forest values; (2) to compare the changing perceptions of local people related to changes in forest values over time and interpret social factors influencing these perceptions; (3) to identify people's attitudes toward the establishment and current management of the Bulong Nature Reserve.

## 2. Forest Values

The conceptualization of the term "value(s)" varies across disciplines such as psychology, economics, anthropology, sociology, and psychiatry [76,82]; however, forest values are defined here as concepts of the "good" related to forests and forest ecosystems [68,72]. In this sense, the value of a forest is referred to as an ideal or a held value and relates to the functions or purposes forests have in human use [68].

Social scientists have developed two common classification systems of forest values: (1) assigned and held value, and (2) instrumental and non-instrumental value. Lee and Kant [76] have suggested that forest values can be categorized into biocentric and anthropocentric values. In this study, by consulting the literature [68,69] and analyzing the forest services in our study area, we classified the value of forests into three broad types of value: economic/utilitarian, ecological/life supporting, and social values.

The economic/utilitarian value of a forest ecosystem stems from its ability to provide needs related to human subsistence, for example as a source of medicinal products. The economic concept of the value

of forests focuses on the usefulness of natural resources that are directly related to the livelihoods and income of local inhabitants. Generally, the economic/utilitarian value of a forest is easy for local people to understand.

The ecological value is the life-supporting environmental functions and services of a forest, such as the regulation of water resources or restoration of soil fertility. Unlike economic value, the perception of ecological value requires the interviewees to understand why the establishment and maintenance of forests is essential.

A social value is related to the social function of a forest. For example, social education, aesthetics, ethnic customs and culture values are included in this broad category.

To allow local people to have a better understanding for the concept of forest values, each group of values was subdivided into specific values according to the practical "good" related to the forest in the local community (See Table 1). Specific values were explained to the interviewees as "in your daily lives, such as in livelihood, environment, customs or culture, what benefit/good the forest can bring to you, or what you can get from the forest, or what activities can you do in the forest."

**Table 1.** Descriptions and definitions of forest values.

| Category | Code | Forest Value | Description |
|---|---|---|---|
| Economic value | V1 | Food | Local villagers, who are forest-dependent, gain food from forests. |
| | V2 | Medicinal plants | Local villagers still rely on collecting medicinal herbs from the forest instead of growing them. |
| | V3 | Rattan | Rattan was used for weaving baskets, chairs and so on by local villagers, and rattan comes from the forest. |
| | V4 | Bamboo | Bamboo from disturbed forests is used to build houses, walls and also to make furniture. |
| | V5 | Firewood | Firewood for cooking is mainly collected from the forest, especially for wood consumption for tea drying has become the main reason of local deforestation. |
| | V6 | Litter (leaves) | Litter after manually/naturally composting was used for fertilizing in the vegetable/rice fields. |
| | V7 | Building timber | Timber and wood vines were collected from the forests for building houses, bridges, and so on. |
| | V8 | Pasture | Livestock, including cows and pigs, usually search for food from the forest. |
| | V9 | Mine exploitation | There are some mining sites around the BNR, local villagers can gain income from the mine exploitation. |
| | V10 | Seed bank | Forests are still an important source for local villagers to collect seed of fruit trees and high-value timber. |
| | V11 | Cultivation plantation (tea) | Shade-tea, especially under the natural forest, is the main household income source for local villagers. |
| | V12 | Ecotourism | Forest can be developed into ecotourism industry and bring another household income source for local villagers. |
| | V13 | Natural resource | Other utility of nature resources for sustainable use for future generations. |

**Table 1.** *Cont.*

| Category | Code | Forest Value | Description |
|---|---|---|---|
| Ecological value | V14 | Biodiversity conservation | Forests maintain biodiversity. |
| | V15 | Water source | Forests provide water conservation. |
| | V16 | Clean water | Ecologically, forests purify water and improve the water quality. |
| | V17 | Clean air | Forests clarify air dust, reduce $CO_2$ and air pollutants. |
| Ecological value | V18 | Soil protection | Root systems of forests prevent soil erosion. |
| | V19 | Landside protection | Landslides can be prevented by forests. |
| | V20 | Windbreak | Forests reduce wind speeds. |
| | V21 | Fire preventing | Moist content in the forest serves the function of fire prevention. |
| | V22 | Climate regulation | Microclimate adjustment can be provided by forests. |
| | V23 | Increasing fertility | Soil erosion preventing, litter, dead wood composition from the forest, which also improves fertility. |
| Social value | V24 | Bush meat | Local people traditionally live on wildlife long time ago, hunting game is still main activity but it is only for the recreation. |
| | V25 | Coffin timber | Specific timber species for coffin wood mainly gotten from the forest, it is only used for the ethnic funeral. |
| | V26 | Environmental awareness | Forests are the aesthetical and cultural source for local villagers to learn and enjoy nature, and further raise their awareness of environmental protection. |
| | V27 | Aesthetic value | Aesthetic value of forest. |
| | V28 | Cultural value | Cultural value from forest *i.e.*, religious worship. |

BNR, Bulong Nature Reserve.

## 3. Materials and Methods

### *3.1. Study Area*

Our study was conducted at the Bulong Nature Reserve (BNR), located in Mengsong administrative village of Menglong township, Xishuangbanna, Yunnan Province, China, which borders Myanmar (21.47°–21.51° N, 100.47°–100.53° E), and is an important sub-watershed of the Mekong River region. In Xishuangbanna, PAs comprise about 18% of the land area, and a comprehensive network of corridors connecting ecological reserve areas has been proposed. However, monoculture crop plantations, especially rubber and tea, have caused widespread deforestation of areas outside PAs in recent years [83–85]. As with other places in China, most reserves in Xishuangbanna have significant indigenous populations of people living within or near their boundaries [14,16]. The BNR covers an area of 36,000 ha and was established in 2009 as a prefectural-level nature reserve. The elevation of the BNR ranges from 800 m to 1800 m, with a tropical climate influenced by the Indian monsoon. The area has an annual mean temperature of 18 °C (at 1600 m above sea level (a.s.l.)) and an annual rainfall between 1600–1800 mm [86,87]. The seasonal nature of the area's climate, its position at the northern fringe of the Southeast Asian tropics, and its complex topography promote the coexistence of several different

forest types. Evergreen tropical seasonal rainforests dominate the valleys and tropical montane forests occur on ridges, while subtropical evergreen broadleaf forests form a transitional zone on slopes [86,88].

About 90% of the 2600 people living in Mengsong belong to the Akha cultural group (often referred to as "Hani" in Chinese publications) who are mainly farmers [14]. Before the 1950s, Akha farmers mainly practiced shifting cultivation of upland rice and vegetables, herded livestock, hunted wildlife, and collected wild vegetables and fruits from the forest [14,89]. Today, understory shade-tea planted in the forest and in terrace tea plantations have become the main sources of income. In addition, timber, firewood, and NTFPs harvested from the forest remain important components of their livelihoods.

The 11 natural villages in the Mengsong area include four natural villages located inside the boundary of the nature reserve, four natural villages next to the reserve border, and three natural villages located outside the reserve. Nine of these natural villages were selected for this study (Figure 1). The remaining two were not selected since the number of households in one village within the reserve was only eight, and the other one was located too far away from the BNR.

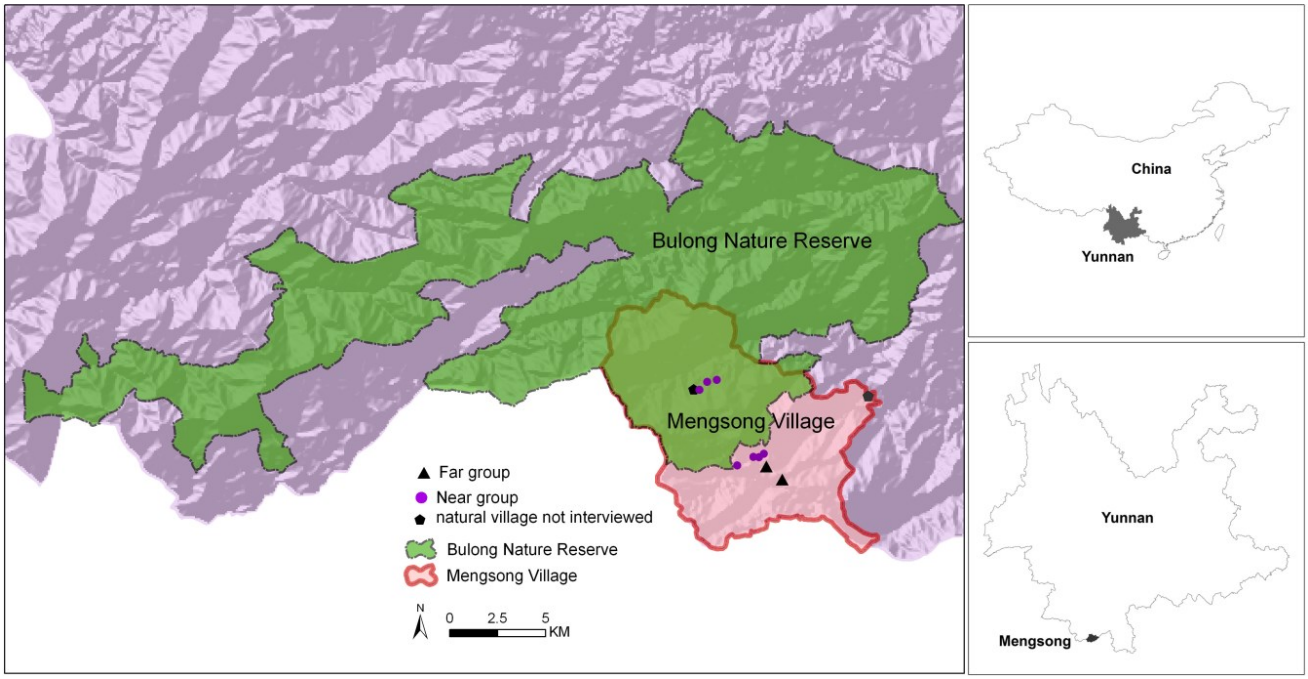


**Figure 1.** Study site: Bulong Nature Reserve (BNR), Mengsong administrative area and the nine villages included in the survey.

Among the selected villages, the three villages within the nature reserve and the four villages next to the BNR border were classified as the "near group." Historically, the BNR was managed as collective land by the near group villages. Residents from these villages cultivated food and harvested timber and NTFP from the forest. Hence, these villagers were directly affected by access restrictions when the BNR was established and continue to illegally extract timber and hunt animals from the BNR.

The two other villages studied were located about 2–3 km outside the BNR, and were recognized as the "far group." Villagers in the far group were only marginally dependent on the forest within the BNR. They used the forest for recreation, hunting, fishing, and collecting NTFP, so they were also affected by access restrictions but to a lesser extent.

### *3.2. Traditional Forest Management of the Local Communities in Mengsong*

Traditionally, the Akha people in Mengsong have two types of forest management objectives. First, they manage community rattan, water source, cemetery and sacred forests for religious uses and these are absolutely protected with limited accessibility [90,91]. Collecting herbs, vegetables and fruits in these forests is allowed; other than that, villagers could only extract rattan and coffin wood from these forests. Beyond that, villagers who ignore these regulations would be penalized by having to provide one pig and one bottle of wine to treat other villagers.

The second objective of forest management is to provide an accessible forest including forestland used for timber harvest and other economic uses. Timber forests include those forests that normally surround the villages; here, people could harvest timber for construction, fuelwood, furniture, and fences, but they cannot trade the timber on the open market [90]. Outsiders must gain permission from the village head for any extraction. In the economic forests, people can plant economic crops such as tea, rattan, bamboo, and indigo for trade. However, with the recently soaring price of tea, local Akha people often violate the old forest management rules. The understory of religious forests was often cleared to plant tea trees and other forests have been cleared for terrace tea plantations. The forest clearing for tea cultivation continued until the BNR was established in 2009.

### *3.3. The Management of BNR*

After the establishment of the BNR in 2009, only coffin wood extraction and NTFP collection were allowed inside the reserve; villagers who violated the regulation would be fined. Forest cleaning for tea cultivation was forbidden, but the owners of tea plantations could continue to collect tea that had been planted prior to the establishment of the BNR. The regulations and rules related to the BNR have been disseminated through booklets, posters, village training and so on. In addition, BNR administrators also invested in building roads and schools for the local community, with the goal of educating local people over the long term [92].

### *3.4. The Challenges in the BNR*

The efforts of the BNR administration provided rewarding results. For example, the forest cover in the area has increased to nearly 86% of the landmass [93], and illegal logging and poaching activities were largely reduced. However, as a new protected area with limited accessibility for the local community, the BNR still faces many challenges. The challenges have led to a potential conflict between community inhabitants and the BNR, which could gradually influence the relationship between the local people and the PA as well as the effectiveness of management of the nature reserve [92]. The main challenges are as follows:

(1) The promising tea market and expansion of tea plantations have put extraction pressure on the BNR. Local people, who did not plant tea inside the nature reserve before 2009, think it is unfair to them that they are not allowed to manage forests for tea cultivation. They asked the reserve to give them permission to plant tea in the reserve, and even illegally planted tea in the reserve. However, the cultivated tea trees were commonly destroyed by the BNR managers reflecting a conflict between the local people and the BNR.

(2) Long-term over exploitation has caused a lack of forest resources. The restriction on access to the forests within the reserve simultaneously intensified the difficulty of the collection of forest resources, which, in turn, caused some illegal logging activities, such as illegal logging for fuelwood and construction timber.
(3) The Akha people refuse to accept burial methods other than the use of coffins; the need for coffin timber leads to a continuous decrease in the number of old trees within the BNR.
(4) One dilemma is caused by the failure of BNR administrators to abide by their own regulations. Some individuals of the BNR administration constantly become involved in hunting and illegal logging inside the nature reserve; these people have set up a poor example for people in the local communities. The inequality of accessibility to the BNR has irritated local people, increased resentment and caused many deliberate destructive activities such as illegal logging and hunting.

### *3.5. Data Collection*

Data for this study were obtained through questionnaire surveys in December of 2012. Ten households were randomly selected from each of the nine villages, and only one person from each household was interviewed. To avoid interference from a third person, the interviewees were interviewed separately by face-to-face conversations in a total of 92 successful individual interviews. Since female villagers were often unwilling to be interviewed, ultimately, fewer women (35) were interviewed than men (57). Of the 92 interviewees, 41 were less than 35 years old; 48 and 44 interviewees had less than or had completed (or more than) a middle school level of education, respectively; 20 and 72 interviewees who lived far from or near to the BNR were treated as the "far group" and "near group", respectively. The questionnaire was composed of three parts.

The first part was designed to record social variables (age, gender, education, and the living distance from the BNR).

The second part of the questionnaire was related to perceptions of forest values, which were collected through the following four steps:

(1) To standardize answers, the interviewees were given a list of 28 forest values (Table 1), and we asked them to choose those values they perceived and rank them in order of importance;
(2) Interviewees were asked to identify what new values they perceived in the most recent three or four years (*i.e.*, after the establishment of the BNR), and confirm what values they had recognized before the establishment of the BNR;
(3) For each value recognized before the establishment, we invited interviewees to assess whether the importance of the value had increased, stayed the same, or decreased in the last three or four years compared with prior to establishment of the BNR;
(4) With respect to new values perceived in the most recent three or four years, we asked interviewees to predict the future variation and trends of the importance (*i.e.*, trend in variation will be more important, no change, or will be less important).

To quantify people's attitudes toward the establishment and current management of the BNR, the third part of the questionnaire consisted of two questions, including:

(1) "Do you think the establishment of the BNR was necessary?" with possible responses of: necessary, unnecessary, or no answer.
(2) "Are you satisfied with the current management of the BNR?" with possible responses of: satisfied, neutral, dissatisfied, or no answer.

A retrospective approach makes it difficult for interviewees to accurately distinguish what forest values they held before and after the establishment of the BNR. To help interviewees recall these values as explicitly as possible, we used a concept of an approximate time period to substitute for the specific time of BNR establishment. Then, we identified the forest values recognized before the establishment using the exclusive method. For example, we first asked the interviewees, what new values they have recognized in the most recent three or four years (after the establishment of the BNR). Then, we marked these new values. Finally, we excluded the marked new values from all the perceived values and asked interviewees to confirm if the remaining values were recognized before the establishment of the BNR.

### *3.6. Data Processing*

We ranked the 28 values by scoring each forest value. The scoring includes three steps: first, since the maximum number of forest values that were mentioned in the order of importance was 25, we scored the order from 25 to 1. The first, second and third places, which were the most-, second most-, and third most-frequently mentioned, were scored 25, 24, 23, and so on, and the least-mentioned was scored at 1. Second, since the same forest value was often mentioned by different interviewees in a different order, the total score of each value was generated through its corresponding order score, multiplied by the frequency of being mentioned at all. Third, we summed across the total score of each value in different places to get a total weighted score for each forest value. Finally, we then ranked the 28 forest values by their total weighted scores. We also ranked the new forest values perceived after the BNR establishment by the frequency each was mentioned.

We counted the total number of forest values that were identified by each interviewee, and analyzed the difference in the number of forest values before and after the establishment of the BNR using conditional inference trees (CIT).

Regarding changes in the residents perceptions related to the importance of forest values recognized before the BNR establishment compared with after, we had several steps to assign appropriate values. First, specific forest value were recorded as +1, 0, or −1 if that value became more important, experienced no change, or became less important. Second, we summed across the scores for each value to get the total change in the importance of scores. This method was used to score the prediction of change in residents' perceptions related to the importance of new forest values perceived after the establishment of the BNR in the future.

### *3.7. Data Analysis*

Interview data were analyzed using two types of modeling: CITs and generalized linear models (GLM). Questions regarding differences of perceptions in the number and importance of forest values were analyzed by CIT using the "ctree" package in R [94]. The total number of mentioned forest values and the total change in scores of importance were treated as responses. Time, age, gender, education

level, and residence distance were treated as independent variables, so as to detect the effects of these factors on the differences in responses. Note that the time factor (before and after establishment of the BNR) was only used for the analysis of differences in perceptions of the number of forest values.

Questions regarding attitudes of interviewees toward the establishment and current management of BNR were analyzed by stepwise regression analysis using a generalized linear model with binomial errors employing the"mass" package in R. While constructing the generalized linear model, we used the following factors: frequencies of levels of support and satisfaction were taken by response, age, gender, education level, and residence distance. Only results that showed a significant effect are reported below.

## 4. Results

### *4.1. Top 10 Forest Values Perceived from Our 28 Given Forest Values*

Interviewees were asked to rank their perceived values from 28 forest values, in order of importance with the 10 forest values presented here (Table 2). Note that some ecological values that were mentioned less often (*i.e.*, water source, clean air, and climate regulation) were considered much more important than other social values that were mentioned more frequently (*i.e.*, bush meat and coffin timber). Interestingly, of the 28 forest values, bush meat (V24) and coffin timber (V25) were ranked seventh and eighth, respectively. Evidently, the inhabitants pay attention to the ethnic values among the social values of the forest, probably because the livelihood of Akha people originated from a hunting lifestyle, and they need to extract coffin timber for their traditional burial ceremonies.

**Table 2.** The top 10 forest values mentioned from our 28 given forest values.

| Rank | Code | Forest Value | Category | Interviewees' Votes (%) |
|---|---|---|---|---|
| 1 | V5 | Firewood | Economic value | 100% |
| 2 | V7 | Building timber | Economic value | 100% |
| 3 | V11 | Cultivation plantation (tea) | Economic value | 98% |
| 4 | V15 | Water source | Ecological value | 91% |
| 5 | V17 | Clean air | Ecological value | 78% |
| 6 | V22 | Climate regulation | Ecological value | 82% |
| 7 | V24 | Bush meat | Social value | 97% |
| 8 | V25 | Coffin timber | Social value | 93% |
| 9 | V20 | Windbreak | Ecological value | 75% |
| 10 | V27 | Aesthetic value | Social value | 80% |

With regard to the other values ranked lower than the top ten, the ranking did not attract the interviewees' attention because of the lower frequency or the lower order of importance from different people's perceptions such as soil erosion protection, landslide protection, biodiversity conservation, and cultural value.

### *4.2. The Most Preferentially Identified Forest Values after the BNR Establishment*

Among the forest values identified by interviewees after the establishment of the BNR, from our 28 values given, the top five new perceived values were ranked according to the frequency they were mentioned as follows: environmental awareness (code V26 (from Table 1); frequency 67%) > ecotourism (V12; 43%) > soil protection (V18; 29%) > climate regulation (V22; 28%) > and clean air (V17; 27%). The fact that environmental awareness and ecotourism have a higher frequency than other newly-perceived values, which might be caused by local people being sensitive to the degradation of the environment resulting from deforestation and economic development. At the same time, the dissemination of tourism advertisements has allowed the local people to become more aware of the value of forests for ecotourism.

### *4.3. The Changing Perceptions of Forest Values before and after the Establishment of the BNR*

The CIT analysis results (Figure 2) showed that a highly significant difference exists among perceptions of the number of values before and after the establishment of the BNR ($p < 0.001$). Local residents perceived more forest values after establishment than before.

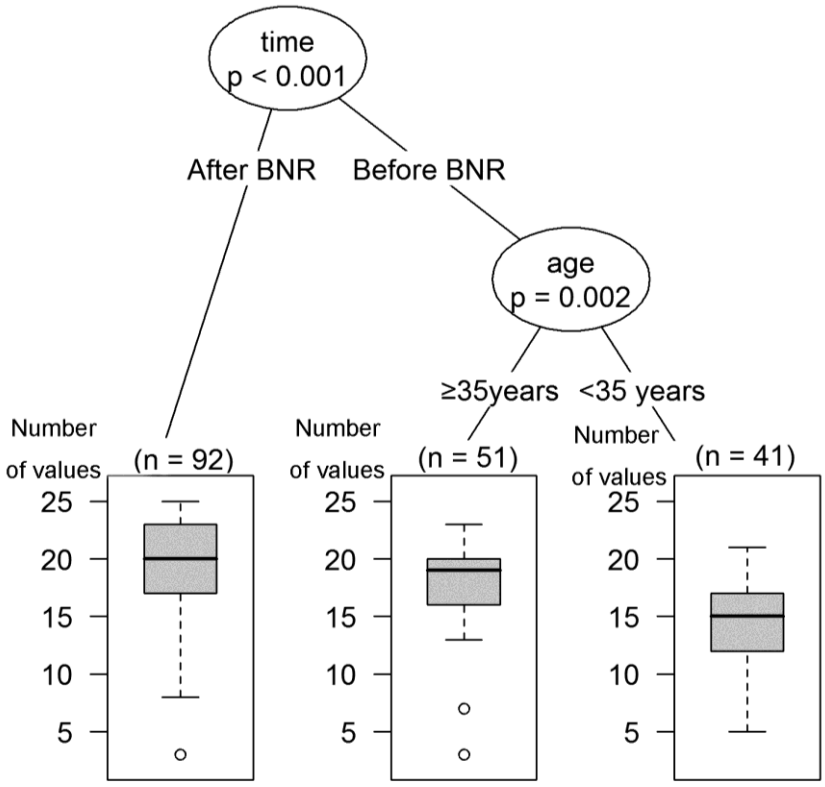


**Figure 2.** The changing perceptions of the number of forest values before and after the Bulong Nature Reserve (BNR) establishment. The number represents the number of forest values perceived by interviewees before and after BNR establishment, which can be identified by the time variable—before BNR and after BNR; *n* is the number of interviewees.

Regarding the effects of social variables on the perception of the number of values, "age" of the interviewee (younger or older than 35 years) played a very significant role before the establishment of the BNR ($p = 0.002$). The older people perceived more forest values than the younger, which most likely occurs because the older generations have had more experience and a longer life history in the forest. However, the age variable does not influence the inhabitants' perception after establishment. This may occur because younger people are more likely to perceive greater numbers of forest values than older people after the establishment of the BNR. In any case, age leads to a reduction of the difference in perception of the number of forest values between the older and younger interviewees. Another possible explanation was attributed to the fact that the younger inhabitants have had more opportunities to leave the community and gain more in-depth environmental education or have more frequent contact with the outside world through various media sources.

### *4.4. Changes in the Perceptions of Residents on the Importance of Forest Values*

As for the change in perceptions of the importance of forest values that were recognized before the establishment of the BNR compared with now, we scored the change of importance for each value as described in Section 3.6 above.

The CIT analysis was used once more to determine the effects of social variables on the total change in scores of importance of values recognized before the establishment for each interviewee (Figure 3); this figure shows that a significant difference exists in the total change in scores of importance of values between the older and the younger residents ($p = 0.035$). The interviewees over 35 years old had higher total changes in scores of importance of values than those less than 35 years old. In addition, the younger people living far from the BNR had significantly higher total changes in scores than those younger residents living nearby ($p = 0.007$).

Our findings indicate that older people were more likely to believe that the forests are more important after the BNR establishment than before, compared with their younger counterparts. Younger people living farther away from the BNR were more likely to believe that the forest values recognized before the BNR establishment were more important after BNR establishment than before, when compared with younger interviewees living closer to the BNR.

### *4.5. Prediction of the Change in Residents' Perceptions of the Importance of New Forest Values Perceived after the BNR Establishment in the Future*

Using the same analysis methods described in Section 4.4, we confirmed the different perceptions of interviewees on the future expected change of importance of new values perceived after the creation of the BNR. The results of the CIT analysis (Figure 4) demonstrated that education level is the main factor related to the perception of future change in the importance of new values ($p < 0.001$). The better-educated interviewees had higher total change scores than those with less education, which indicated that the people with a higher level of education placed more importance on future forest values. This may occur because the better-educated people have learned more about the diverse ecosystem services provided by forests and economic values of forests from school and various media sources. If education levels increase in the future, then these results suggest that the forest will become more

important to local people not only as their source of livelihood but also for various aspects, such as the effects of forest on climate change, ecotourism, and water and soil protection.

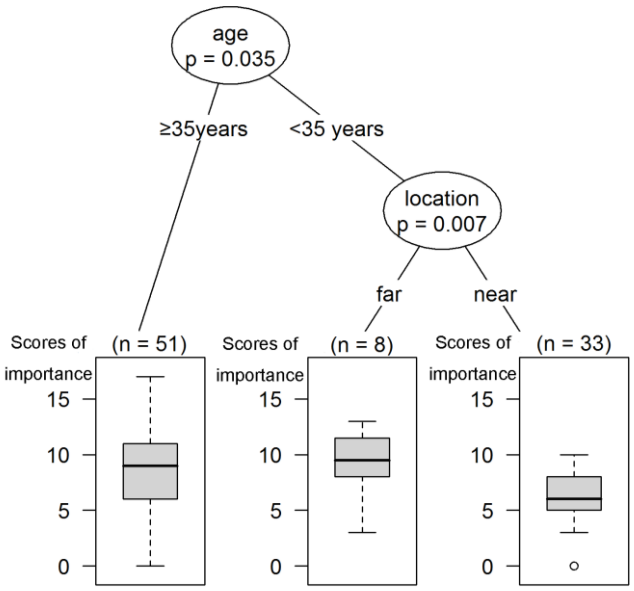


**Figure 3.** Changes in residents' perceptions of the importance of forest values recognized before the Bulong Nature Reserve (BNR) establishment compared with after. Scores of importance are the total change scores of importance of forest values perceived before BNR establishment compared with after, which is generated by summing across the change score of importance of each value; *n* is the number of interviewees.

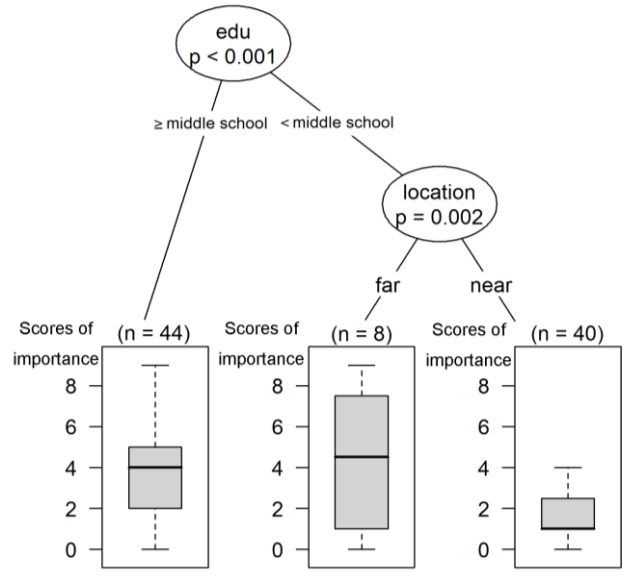


**Figure 4.** Prediction of residents' perceptions change on the importance of new forest values perceived after the Bulong Nature Reserve (BNR) establishment in the future. Scores of importance are the total change scores of importance of new forest values recognized after BNR establishment predicted in the future, which is generated by summing across the change score of importance of each new value; *n* is the number of interviewees.

Among the less-educated respondents, the interviewees living far away from the BNR had higher total change scores than those living nearby ($p = 0.002$). This may be partly explained by the fact these villages that are located far from the BNR are experiencing serious environment pollution as a result of mining exploitation. Thus, the residents in these villages believed the forest values, especially the ecological values, are salient to them and that forests will become more and more important in the future.

### *4.6. Support of Local People for the Establishment of the BNR*

Interviewees were asked about their support for the establishment of the BNR by the question "Do you think the establishment of the BNR was necessary?" About 70% out of the 92 interviewees admitted that the establishment of the BNR was necessary (Table 3). Among three groups, the female interviewees, those less than 35 years old, and those living farther away from the BNR, the results of supporting attitudes were less than 70% (69%, 66% and 40%, respectively).

**Table 3.** Frequency of attitude levels towards the establishment and current management of the Bulong Nature Reserve (BNR).

| Groups | Variables | Frequency of Support to BNR Establishment | | | Frequency of Satisfaction with BNR Management | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Necessary | Unnecessary | No answer | Satisfied | Neutral | Dissatisfied | No answer | |
| Gender | Males | 43 (75%) | 5 (9%) | 9 (16%) | 29 (51%) | 15 (26%) | 5 (9%) | 8 (14%) | 57 |
| | Females | 24 (69%) | 2 (6%) | 9 (26%) | 14 (40%) | 5 (14%) | 6 (17%) | 10 (29%) | 35 |
| Age | <35 years | 27 (66%) | 4 (10%) | 10 (24%) | 14 (34%) | 12 (29%) | 5 (12%) | 10 (24%) | 41 |
| | ≥35years | 40 (78%) | 3 (6%) | 8 (16%) | 29 (57%) | 8 (16%) | 6 (12%) | 8 (16%) | 51 |
| Education | <middle school | 34 (71%) | 5 (10%) | 9 (19%) | 25 (52%) | 7 (15%) | 7 (15%) | 9 (19%) | 48 |
| | ≥middle school | 33 (75%) | 2 (5%) | 9 (20%) | 18 (41%) | 13 (30%) | 4 (9%) | 9 (20%) | 44 |
| Location | Near | 59 (82%) | 6 (8%) | 7 (10%) | 39 (54%) | 20 (28%) | 9 (13%) | 4 (6%) | 72 |
| | Far | 8 (40%) | 1 (5%) | 11 (55%) | 4 (20%) | 0 | 2 (10%) | 14 (70%) | 20 |
| Mean value | | 70% | 7% | 23% | 44% | 23% | 12% | 25% | |

About 7% of interviewees believed the establishment of the nature reserve was not necessary. Interviewees less than 35 years old and those with less education accounted for a high proportion (10% each) of these responses. More than 20% of interviewees gave no answer, especially women, the interviewees who were less than 35 years old, and those who lived farther away from the BNR did not express an opinion related to if it was necessary to establish the BNR, and their respective percentages were 26%, 24%, and 55%.

Table 4 presents the results of the regression analysis of the effects of social variables on the supportive attitudes toward the establishment of the BNR. The results demonstrated that the levels of "unnecessary" and "no answer" had significant differences among the groups by age, education, and location.

**Table 4.** Factors influencing people's attitudes toward the establishment and current management of the Bulong Nature Reserve.

| Attitudes | Levels | Variables | Estimate | Standard error | *Z* value | *P* value |
|---|---|---|---|---|---|---|
| Supportive attitudes | No answer: | age ≥ 35years | −2.37992 | 0.89597 | −2.656 | 0.01 ** |
| | Unnecessary: | age ≥ 35years | −2.24877 | 1.04276 | −2.157 | 0.03 * |
| | Unnecessary: | edu ≥ middle school | −2.26579 | 1.10657 | −2.048 | 0.04 * |
| | No answer: | location near | −5.03524 | 0.90968 | −5.535 | 0.00 *** |
| Satisfaction attitudes | No answer: | gender male | −1.8968 | 0.8109 | −2.339 | 0.02 * |
| | Dissatisfied: | gender male | −1.8999 | 0.8970 | −2.118 | 0.03 * |
| | Satisfied: | age ≥ 35years | 1.5395 | 0.7346 | 2.096 | 0.04 * |

Significance: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Older inhabitants were less likely than younger people to hold unsupportive attitudes (Table 4). Compared with the older interviewees, younger people were more likely to not express their opinions about the necessity of establishing the BNR.

Furthermore, more well-educated interviewees were less likely to have unsupportive attitudes than their counterparts. This may have occurred because more well-educated people have gained a greater level of environmental awareness from conservation education courses in schools. They have broader insights relate to the benefits from the restriction of deforestation, especially as it concerns biodiversity conservation and environmental protection.

Compared with those living near the BNR, the interviewees living farther away were more likely to not express their opinions about the need for establishing the BNR. This may occur because the livelihoods of those living near the BNR were obviously influenced by the limitation on the extraction of forest resources; therefore, they pay more attention to the establishment of the BNR. In contrast, those living farther from the BNR felt unaffected by the protected area and are less concerned about the establishment of the BNR, and do not want to express their opinions.

### *4.7. Satisfaction of Local People with the Management of the BNR*

Less than half (44%) of the interviewees were satisfied with the current management of the BNR; 23%, 12%, and 25% of the interviewees showed a "neutral, dissatisfied, and no answer" response to the

current management of the BNR, respectively (Table 3). The interviewees over 35 years old were most satisfied with the management of the BNR, while women were most dissatisfied.

The GLM step regression analysis results show that men were less likely than women to be dissatisfied with the performance of the BNR management (Table 4). In contrast to men, women were more likely to not express their opinions about the management of the BNR. This may have occurred because of the fact that most men are the head of a household in China's rural areas, and they have more opportunities to participate in various educational activities related to forest conservation. Another explanation is attributed to a tradition that most women had lower rates of literacy in China, especially in remote rural areas. Consequently, women may have fewer opportunities to learn about environmental protection.

Age also affected attitudes related to satisfaction with the management of the BNR. Residents over 35 years old were more satisfied than their younger counterparts. This was because the older people have observed a reduction of deforestation after the establishment of the BNR and were satisfied with the positive results and effectiveness in limiting deforestation. In contrast, younger residents in our study were dissatisfied with the limitation of extraction from forests because they have more economic demands than older residents, such as the desire to marry, build a new house, and to become parents.

Note that a higher frequency (70%) of interviewees living farther from the BNR did not express their opinions about management of the BNR, while no significant differences in satisfaction levels were found between residents living farther or closer to the BNR. This may have occurred because the frequency of the interviewees living farther from the BNR was abnormal (*i.e.*, the frequency of "no answer" is 70%, while neutral is 0), and the residence location factor was not included in the final model of the general stepwise regression analysis. However, we can infer that there should be a significant difference in the level of "no answer" of satisfied attitudes with BNR management between people residing farther from and those living closer to the BNR based on the frequency of knowledge about the BNR from the attitudes of interviewees.

## 5. Discussion

The results of this study indicated that indigenous residents appear to be mostly concerned about the economic values that are directly connected to their livelihoods (*i.e.*, the availability of firewood, timber for construction, and the cultivation plantations), as well as the ecological values that are associated with their survival and health (*i.e.*, water sources, clean air, and climate regulation). Aside from these values, local people also pay attention to the social values associated with traditional culture and religious beliefs, such as the availability of bush meat and coffin timber. These findings are somewhat consistent with the study of Meijaard *et al.* [69], who found that forest use and cultural values are highest among people in Borneo who live close to the forest, with high levels of concern over increasing temperatures, air pollution, and the loss of clean water sources. However, many studies have produced contrasting findings. For instance, Lee and Kant [76] identified recreation, environment, and spirituality as three dominant value themes that were consistent across the four groups: aboriginal peoples, non-governmental environmental organizations, the forestry industry, and the Ontario Ministry of Natural Resources, in northwestern Ontario, Canada. McFarlane and Boxall [63] confirmed that campers and hunters were primarily biocentric in the orientation of their forest values and were not in favor of

economic development. This may occur because different people always perceive the value of forests from their own perspective. Steel *et al.* [74] stated that an individual's work environment is associated with forest values. Those who are dependent on the timber industry for their livelihood especially have a more anthropocentric forest value orientation. Our study is at the local scale where the livelihoods of local inhabitants were heavily dependent on the forest, such as the desire of people to cut trees for building, cultivate tea plantations and log firewood for heating, cooking, and processing tea. Therefore, the preferences of these local people and the way they value forests are reasonable.

The findings show that local inhabitants have positively changing perceptions on the number and importance of forest values over time. They perceived significantly more forest values following the creation of the BNR. Based on Sections 4.1–4.2, the increase of the number of forest values after the establishment of the BNR mainly reflected the acknowledgment of the ecological services provided by the forest. This finding suggests that local people have increasingly recognized the value of ecological services provided by the forest and are concerned about ongoing environmental degradation over time. Cao *et al.* [40] reported similar findings by selecting policymakers and the public as respondents and found that 91% of the interviewees in 2009 believed that the environment had deteriorated severely during the past decade, compared with 44% in a 1999 survey. Xu and Bengston [68] also found a similar increasing trend in the loss of ecological services of the forest in their research, which studied the changes in four forest values (utilitarian, life support, aesthetic, and spiritual) of three groups of observers (forestry professionals, environmentalists, and members of the news media) from 1982 to 1993. Xu and Bengston [68] reported a decline in the relative frequency of expression of utilitarian values and the simultaneous increase in a concern related to life-supporting (ecological service) values among forestry professionals and environmentalists. However, in our study, the utilitarian values are not declining; they are still the most important forest values in the opinions of local residents, although local people perceived ecological values more strongly than in the past. This may occur because our research objective differed from that of Xu and Bengston [68]. Our research focused on local residents, while Xu and Bengston [68] studied from the perspective of forestry professionals and environmentalists.

In our study, generally, most interviewees expressed their supportive attitudes toward the establishment of the BNR. This result is in line with many previous studies [53,70] that have reported that a large proportion of local respondents support the establishment of nature reserves. However, many people remain who did not express their options about the establishment and management of the BNR and a few people expressed strong unsupportive attitudes. Furthermore, the overall satisfaction of local residents towards the management of the BNR was not positive. Only a few people are satisfied with the current management system, while a large proportion of interviewees are still dissatisfied with the performance of management. This most likely occurs because of the restrictions on the extraction of forest products and the punishment of those who break the law. Guthiga *et al.* [54] reported similar findings. It is important to note that another possible explanation exists that can be attributed to resentment of the behavior of BNR rangers and abuse of the authority of the BNR Administration Bureau. In informal discussions, the interviewees complained about irregularities in the BNR rangers' actions, such as improper hunting of birds and logging. This finding concurs with the study of Fiallo and Jacobson [47].

Local people's dissatisfaction with the management of the BNR suggests that a conflict exists between the local community and the managers of the BNR. In practice, local people are still involved

in small-scale illegal logging and tea plantations in the BNR, which reflects this existing conflict. Glasl [66] and Yasmi *et al.* [38] provide eight stages of conflict escalation that can be categorized into four areas: restrained conflict (1. feeling anxiety, 2. debate and critique, 3. lobby and persuasion); open conflict (4. protest and campaigning, 5. access restriction, 6. involvement of courts and lawsuits); violent conflict (7. intimidation and physical exchange); and geographical expansion of conflict (8. nationalization and internationalization). The eight stages have direct parallels with conflict intensity. According to the aforementioned criterion of conflict, the conflict between the BNR and local members of the community can be categorized into the first stage as restrained conflict (feeling anxiety). Therefore, the most important next step for the management of BNR is how to address this conflict so as to avoid a further escalation of the conflict.

Understanding the main source of conflict is critical to the resolution of conflict [38]. Understanding the perceptions of the local people as they relate to forest value and attitudes toward the reserve is a key to gaining a better understanding the central issue of the conflict between community development and nature reserve management [68]. A preference of exploiting the economic values of the forest in this study suggests that the needs of local people for firewood, timber for construction, and tea plantations are a source of conflict. This is consistent with the evidence provided by the illegal logging by local people and the development of unauthorized tea plantations that present challenges to the sustainable management of the BNR. The indigenous inhabitants in Mengsong remain dependent on forest resources; local people have the right to satisfy their basic demands for forest resources. However, the establishment of the BNR has imposed restrictions on the inhabitants' customary rights to access those forest resources. To mitigate the conflict between biodiversity conservation and the rights of local people to access forest resources, the twin tasks conservation and economic development should be tackled simultaneously, which is an essential element of providing sustainable livelihoods at local scales [40–42,67]. Therefore, a conflict-resolution approach in the BNR requires balancing conservation goals and local livelihoods in an integrated strategy.

Previous studies have proven that co-management approaches implemented in many protected areas are more effective than top-down approaches [52]. Co-management provides a wide-participation platform so that local people, protected area managers and other stakeholders can join in the management of protected areas while improving the livelihoods of local people [43]. We suggest that a need exists to consider the use of the co-management approach during management of the BNR, in which win-win mechanisms for biodiversity and local livelihoods should be the co-purposes. Specifically, the concept of environmental justice should be considered to reconcile the responsibility of local people to conserve biodiversity while considering the customary rights of access for those people to forest resources [22,28,33,42], such as grazing rights, rights to sacred places, rights to forests, rights to participate in decision-making and rights to express their opinions. The perceptions of local people related to forest values in this study reflect their main demands for forest resources, which should be considered in the decision-making process. For instance, a flexible exploitation of forest resources within the BNR should be allowed to some extent to meet local needs, such as deadwood and litter collecting and small-scale logging permits for timber needed for construction. With regard to tea plantations, establishment of new plantations should be strictly prohibited because of the negative effects of this action on biodiversity. In this study, the increasing perception of ecological values and most supportive attitudes towards the establishment of the BNR also suggest that local people may support BNR

management if their livelihood needs are met [52]. This situation offers a possibility of mediating environmental protection and livelihood improvement. We promote the co-management approach in support of the resolution of conflicts between the BNR and local people; neither over restriction nor over decentralization is encouraged. Restriction of access rights to forest resources has led to a potential conflict [22,37,38], while over decentralization could also cause some potential problems. For instance, although the implemented collective forest tenure reform in China had made substantial progress in providing for sustainable forest management and a reduction of poverty through a power transfer to the local inhabitants, it also caused negative effects on forest management [22,26,28]. Because forest use and ownership in the course of decentralization are the arenas of conflict and struggle, implementation of forest tenure reform involved commercial transactions, which led to a small number of rich people occupying a much larger amount of forest. Consequently, with regard to most of the local inhabitants, they still lack adequate forest resources to support their livelihood needs. In particular, most private forests have been eliminated because the owners needed to gain a return for their investment and simultaneously planted monocultures of economically valuable tree species [26]. This management approach is not applied with the goal of benefitting biodiversity conservation in protected areas. The success of implementation of co-management in the BNR depends on knowing how to design and implement regulations that balance the interests of biodiversity and local livelihoods.

Co-management is a negotiated management system, which offers an efficient communication platform designed to allow different stakeholders to participate [43]. Communication is the foundation of understanding and the implementation of various regulations [38]. When the stakeholders participate in the decision-making, the principle of free, prior and informed consent should be respected, which is relevant for the prevention of conflict and for peacebuilding [45]. Specifically, indigenous people should participate in communication through freely chosen representatives or other institutions. Community workers in representative institutions need good community management skills and knowledge related to environmental protection so that they can communicate information related to protected areas on behalf of the opinions and will of local people. Based on the communication with the protected areas, local people's dissatisfaction with the BNR may be mitigated by establishment of a harmonious relationship between them.

Co-management in the BNR needs to involve indigenous traditional knowledge, which may be valuable for decision-making and for simplifying conflict resolution [14,41,45]. Indigenous people in Mengsong traditionally divided the forests into different parts according to the function of forests in the economy, the provisioning of ecological services and cultural beliefs [90,91]. Different types of forest correspond to different management regulations, such as forest reserved for the production of rattan by the community, as water sources, and to provide forestland for cemeteries and sacred sites in like with the traditional cultural beliefs and customary institutions of local people. This traditional knowledge reflects the understanding and perception of Akha people related to the interaction of forest-water-agriculture and its sustainable management. The application of this indigenous knowledge and traditional practices has contributed to local traditional forest management and sustainable economic development. This skill has potential value for biodiversity conservation; it may provide a reference for the management of the BNR, such as the division and management of the core area, and designation of buffer and test areas. However, indigenous knowledge should retain its essence and discard its dross. For example, the soaring price of ancient tree tea has led to an expansion of tea plantations; in this context, traditional management

without restrictions on economic forest is not feasible for the current situation, so planting tea in the BNR should continue to be banned.

In addition, as an alternative to mitigating conflict, local government and protected area managers should help local people to diversify their livelihoods so they can replace monoculture tea plantations; this could be done through the development of fisheries and animal husbandry and the transition from on-farm to non-farm activities [28]. The demands of local for forest resources also can be reduced by transitioning to energy-saving stoves, installing biogas sources and stoves, providing people with solar energy and electricity and so on. These projects have been applied in many protected areas [18,43,47,50,53] and progress has been made in the reduction of the dependency of local people on forest resources.

Understanding factors influencing the perception of local people as it relates to forest values and attitudes toward PAs is critical to the long-term sustainability of forests [44,52,59]. Previous studies have found that education, gender, age, and distance between a residence and a forest can significantly influence the perceptions of local residents as it relates to forest values and attitudes toward protected areas [53,63,68,69]. Our study supports this idea. Graham *et al.* [44] argued that all stakeholders should have a voice in decision-making. In this study, younger people, less-educated people, and women hold overall negative perceptions of forest values and attitudes toward the establishment and current management of the BNR. In particular, women and those people living in villages farther from the BNR generally failed to express their opinions about the establishment and management of the BNR. A need exists to enhance environmental education opportunities for these people, and their opinions should be respected as the main group of people involved in forest resource protection; this will help to decrease negative and oppositional emotions related to the forest reserve.

## 6. Conclusions

This study provides a better understanding of the perceptions of local people related to the value of forests and their attitudes toward a recently established protected area. We propose that these findings be used in co-management by allowing managers to identify the main source of conflict and to improve the relationship between the BNR and the local community with the goal of mitigating potential conflicts. The study was designed to facilitate both the conservation of biodiversity and community development, which is valuable not only to the management of protected areas in Yunnan but also for the sustainable forest management in China and other developing countries that are dependent on forest resources. Although a single case study obviously cannot yield a general explanation for the sources of conflicts between local communities and forest management bureaus, the present study provides new insights into the identification of sources of conflict and suggests methods that can be used to improve the relationship between protected area managers and local communities. This paper also contributes to the literature on forest values of indigenous populations by examining remote, rural populations in China. We expect this study could provide an improvement and extension of the concept of a co-management theoretical framework.

However, this study has its limitations that we wish to address in future efforts, such as the accuracy of examining differences in forest values before and after the creation of the BNR using a retrospective

approach and a lack of analysis of the effects of economic factors (e.g., forest-dependence) on the inhabitants' perceptions and attitudes.

**Acknowledgments**

We would like to thank the resource staff of 2012 Advance Field Course in Ecology and Conservation (AFEC-X 2012) and the local people of Mengsong. We also thank the staff from International Center for Research in Agroforestry, Kunming Office: Jonathan L. Teichroew, Huafang Chen, Nani Maiya Sujakhu and Mingcheng Wang. We also thank Li Jie, a manager of the BNR. Finally, we thank the editor and two anonymous reviewers for their constructive suggestions on this manuscript.

**Author Contributions**

Hua Yang collected the data and prepared the manuscript. Rhett Harrison analyzed the data and assisted with the project design and manuscript preparation. Zhuang-Fang Yi assisted with data analysis and manuscript preparation. Eben Goodale assisted with the data analysis. Ming-Xu Zhao assisted with the data collection. Jian-Chu Xu conceived the idea and funded the experiment.

**Conflicts of Interest**

The authors declare no conflict of interest.

**References**

1. Bruner, A.G.; Gullison, R.E.; Rice, R.E.; Da Fonseca, G.A. Effectiveness of parks in protecting tropical biodiversity. *Science* **2001**, *291*, 125–128.
2. Liu, J.; Ouyang, Z.; Miao, H. Environmental attitudes of stakeholders and their perceptions regarding protected area-community conflicts: A case study in China. *J. Environ. Manag.* **2010**, *91*, 2254–2262.
3. Ormsby, A.; Kaplin, B.A. A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environ. Conserv.* **2005**, *32*, 156–164.
4. Pimbert, M.P.; Pretty, J.N. Parks, people and professionals: Putting participation into protected area management. *Soc. Chang. Conserv.* **1997**, 297–330.
5. Barber, C.P.; Cochrane, M.A.; Souza, C.; Veríssimo, A. Dynamic performance assessment of protected areas. *Biol. Conserv.* **2012**, *149*, 6–14.
6. Chambers, J.Q.; Asner, G.P.; Morton, D.C.; Anderson, L.O.; Saatchi, S.S.; Espírito-Santo, F.D.; Palace, M.; Souza, C. Regional ecosystem structure and function: Ecological insights from remote sensing of tropical forests. *Trends Ecol. Evol.* **2007**, *22*, 414–423.
7. De Fries, R.; Hansen, A.; Newton, A.C.; Hansen, M.C. Increasing isolation of protected areas in tropical forests over the past twenty years. *Ecol. Appl.* **2005**, *15*, 19–26.
8. Nepstad, D.; Schwartzman, S.; Bamberger, B.; Santilli, M.; Ray, D.; Schlesinger, P.; Lefebvre, P.; Alencar, A.; Prinz, E.; Fiske, G. Inhibition of amazon deforestation and fire by parks and indigenous lands. *Conserv. Biol.* **2006**, *20*, 65–73.

9. Peres, C.A.; Barlow, J.; Laurance, W.F. Detecting anthropogenic disturbance in tropical forests. *Trends Ecol. Evol.* **2006**, *21*, 227–229.
10. Curran, L.M.; Trigg, S.N.; McDonald, A.K.; Astiani, D.; Hardiono, Y.; Siregar, P.; Caniago, I.; Kasischke, E. Lowland forest loss in protected areas of Indonesian Borneo. *Science* **2004**, *303*, 1000–1003.
11. Liu, J.; Linderman, M.; Ouyang, Z.; An, L.; Yang, J.; Zhang, H. Ecological degradation in protected areas: The case of Wolong nature reserve for giant pandas. *Science* **2001**, *292*, 98–101.
12. Pedlowski, M.A.; Matricardi, E.; Skole, D.; Cameron, S.; Chomentowski, W.; Fernandes, C.; Lisboa, A. Conservation units: A new deforestation frontier in the Amazonian state of Rondônia, Brazil. *Environ. Conserv.* **2005**, *32*, 149–155.
13. Chen, Z.; Yang, J.; Xie, Z. Economic development of local communities and biodiversity conservation: A case study from Shennongjia National Nature Reserve, China. *Biodivers. Conserv.* **2005**, *14*, 2095–2108.
14. Sturgeon, J.C. Pathways of "indigenous knowledge" in Yunnan, China. *Altern. Glob. Local Polit.* **2007**, *32*, 129–153.
15. Wallner, A.; Bauer, N.; Hunziker, M. Perceptions and evaluations of biosphere reserves by local residents in Switzerland and Ukraine. *Landsc. Urban Plan.* **2007**, *83*, 104–114.
16. Xu, J.; Melick, D.R. Rethinking the effectiveness of public protected areas in southwestern China. *Conserv. Biol.* **2007**, *21*, 318–328.
17. Lü, Y.; Chen, L.; Fu, B.; Liu, S. A framework for evaluating the effectiveness of protected areas: The case of Wolong biosphere reserve. *Landscape Urban. Plan.* **2003**, *63*, 213–223.
18. Chen, X.; Viña, A.; Shortridge, A.; An, L.; Liu, J. Assessing the effectiveness of payments for ecosystem services: An agent-based modeling approach. *Ecol. Soc.* **2014**, *19*, 7.
19. Lise, W. Factors influencing people's participation in forest management in India. *Ecol. Econ.* **2000**, *34*, 379–392.
20. Mehta, J.N.; Heinen, J.T. Does community-based conservation shape favorable attitudes among locals? An empirical study from Nepal. *Environ. Manag.* **2001**, *28*, 165–177.
21. Edmonds, R.L. *Patterns of China's Lost Harmony: A Survey of the Country's Environmental Degradation and Protection*; Routledge: London, UK, 2012.
22. Robbins, A.S.; Harrell, S. Paradoxes and challenges for China's forests in the reform era. *China Q.* **2014**, *218*, 381–403.
23. Jim, C.; Xu, S.S. Recent protected—Area designation in China: An evaluation of administrative and statutory procedures. *Geogr. J.* **2004**, *170*, 39–50.
24. Jahiel, A.R. The organization of environmental protection in China. *China Q.* **1998**, *156*, 757–787.
25. Zhang, P.; Shao, G.; Zhao, G.; Le Master, D.C.; Parker, G.R.; Dunning, J.B.; Li, Q. China's forest policy for the 21st century. *Science* **2000**, *288*, 2135–2136.
26. Luo, Y.; Liu, J.; Zhang, D.; Dong, J. Actor, customary regulation and case study of collective forest tenure reform intervention in China. *Small-scale For.* **2014**, *14*, 1–15.
27. Xu, Z.; Bennett, M.T.; Tao, R.; Xu, J. China's sloping land conversion programme four years on: Current situation, pending issues. *Int. For. Rev.* **2004**, *6*, 317–326.
28. He, J.; Sikor, T. Notions of justice in payments for ecosystem services: Insights from China's sloping land conversion program in Yunnan Province. *Land Use Policy* **2015**, *43*, 207–216.

29. Ministry of Environmental Protection of the People's Republic of China. National Environment Statistic Report 2012. Available online: http://zls.mep.gov.cn (accessed on 15 June 2015)
30. Weckerle, C.S.; Yang, Y.; Huber, F.K.; Li, Q. People, money, and protected areas: The collection of the caterpillar mushroom ophiocordyceps sinensis in the Baima Xueshan nature reserve, southwest China. *Biodivers. Conserv.* **2010**, *19*, 2685–2698.
31. Alcorn, J.B.; Royo, A.G. Conservation's engagement with human rights: "Traction", "slippage", or avoidance. *Policy Matters* **2007**, *15*, 115–139.
32. West, P.; Igoe, J.; Brockington, D. Parks and peoples: The social impact of protected areas. *Annu. Rev. Anthropol.* **2006**, *35*, 251–277.
33. Campese, J. *Rights-Based Approaches: Exploring Issues and Opportunities for Conservation*; Center for International Forestry Research (CIFOR): Bogor, Indonesia, 2009.
34. Han, N. A policy study on sustainable management for China's nature reserves. *J. Nat. Resour.* **2000**, *15*, 201–207.
35. Rei, L. Research on mutual management model of the resource conservation and community economy development for China's nature reserves. *Resour. Sci.* **2008**, *6*, 870–875
36. Harkness, J. Recent trends in forestry and conservation of biodiversity in China. *China Q.* **1998**, *156*, 911–934.
37. Gritten, D.; Mola-Yudego, B.; Delgado-Matas, C. Media coverage of forest conflicts: A reflection of the conflicts' intensity and impact? *Scand. J. For. Res.* **2012**, *27*, 143–153.
38. Yasmi, Y.; Anshari, G.Z.; Komarudin, H.; Alqadri, S. Stakeholder conflicts and forest decentralization policies in west Kalimantan: Their dynamics and implications for future forest management. *For. Trees Livelihoods* **2006**, *16*, 167–180.
39. Jim, C.; Xu, S.S. Stifled stakeholders and subdued participation: Interpreting local responses toward Shimentai nature reserve in south China. *Environ. Manag.* **2002**, *30*, 327–341.
40. Cao, S.; Chen, L.; Liu, Z. An investigation of Chinese attitudes toward the environment: Case study using the grain for green project. *J. Hum. Environ.* **2009**, *38*, 55–64.
41. Castro, A.P.; Nielsen, E. Indigenous people and co-management: Implications for conflict management. *Environ. Sci. Policy* **2001**, *4*, 229–239.
42. Nepal, S.K.; Weber, K. Managing resources and resolving conflicts: National parks and local people. *Int. J. Sustain. Dev. World Ecol.* **1995**, *2*, 11–25.
43. Ting, Z.; Shivakoti, G.P.; Haiyun, C.; Maddox, D. A survey-based evaluation of community-based co-management of forest resources: A case study of Baishuijiang national natural reserve in China. *Environ. Dev. Sustain.* **2012**, *14*, 197–220.
44. Graham, J.; Amos, B.; Plumptre, T.W. Governance Principles for Protected Areas in the 21st Century. Institute on Governance, Governance Principles for Protected Areas. In Proceedings of the fifth World Parks Congress, Durban, South Africa, 8–17 September 2003.
45. Cariño, J. Indigenous peoples' right to free, prior, informed consent: Reflections on concepts and practice. *Ariz. J. Int. Comp. Law* **2005**, *22*, 19.
46. Borrini-Feyerabend, G. Collaborative Management of Protected Areas: Tailoring the Approach to the Context. In Proceedings of the World Conservation Union (IUCN), Gland, Switzerland, 13–23 October 1996.

47. Fiallo, E.A.; Jacobson, S.K. Local communities and protected areas: Attitudes of rural residents towards conservation and Machalilla national park, Ecuador. *Environ. Conserv.***1995**, *22*, 241–249.
48. Mehta, J.N.; Kellert, S.R. Local attitudes toward community-based conservation policy and programmes in Nepal: A case study in the Makalu-Barun conservation area. *Environ. Conserv.***1998**, *25*, 320–333.
49. Herrold, M. The cranes of Caohai and other incidents of fieldwork in southwestern China. *Geogr. Rev.* **1999**, *89*, 440–448.
50. He, G.; Chen, X.; Liu, W.; Bearer, S.; Zhou, S.; Cheng, L.Y.; Zhang, H.; Ouyang, Z.; Liu, J. Distribution of economic benefits from ecotourism: A case study of Wolong nature reserve for giant pandas in China. *Environ. Manag.* **2008**, *42*, 1017–1025.
51. Li, W.; Han, N. Ecotourism management in China's nature reserves. *J. Hum. Environ.* **2001**, *30*, 62–63.
52. Karanth, K.K.; Nepal, S.K. Local residents perception of benefits and losses from protected areas in India and Nepal. *Environ. Manag.* **2012**, *49*, 372–386.
53. Xu, J.; Chen, L.; Lu, Y.; Fu, B. Local people's perceptions as decision support for protected area management in Wolong biosphere reserve, China. *J. Environ. Manag.* **2006**, *78*, 362–372.
54. Guthiga, P.M.; Mburu, J.; Holm-Mueller, K. Factors influencing local communities' satisfaction levels with different forest management approaches of Kakamega forest, Kenya. *Environ. Manag.* **2008**, *41*, 696–706.
55. Harrison, C.M.; Burgess, J.; Clark, J. Discounted knowledges: Farmers and residents understandings of nature conservation goals and policies. *J. Environ. Manag.* **1998**, *54*, 305–320.
56. Notzke, C. A new perspective in aboriginal natural resource management: Co-management. *Geoforum* **1995**, *26*, 187–209.
57. Trakolis, D. Local people's perceptions of planning and management issues in Prespes lakes national park, Greece. *J. Environ. Manag.* **2001**, *61*, 227–241.
58. De Boer, W.F.; Baquete, D.S. Natural resource use, crop damage and attitudes of rural people in the vicinity of the Maputo elephant reserve, Mozambique. *Environ. Conserv.* **1998**, *25*, 208–218.
59. Newmark, W.D.; Leonard, N.L.; Sariko, H.I.; Gamassa, D.G.M. Conservation attitudes of local people living adjacent to five protected areas in Tanzania. *Biol. Conserv.* **1993**, *63*, 177–183.
60. Gillingham, S.; Lee, P.C. The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous game reserve, Tanzania. *Environ. Conserv.* **1999**, *26*, 218–228.
61. Maikhuri, R.; Nautiyal, S.; Rao, K.; Saxena, K. Conservation policy—People conflicts: A case study from Nanda Devi biosphere reserve (a world heritage site), India. *For. Policy Econ.* **2001**, *2*, 355–365.
62. Stern, P.C. Psychological dimensions of global environmental change. *Annu. Rev. Psychol.* **1992**, *43*, 269–302.
63. McFarlane, B.L.; Boxall, P.C. Factors influencing forest values and attitudes of two stakeholder groups: The case of the foothills model forest, Alberta, Canada. *Soc. Nat. Resour.* **2000**, *13*, 649–661.
64. Bandara, R.; Tisdell, C. Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka: Empirical evidence. *Biol. Conserv.* **2003**, *110*, 327–342.
65. Haule, K.; Johnsen, F.; Maganga, S. Striving for sustainable wildlife management: The case of Kilombero game controlled area, Tanzania. *J. Environ. Manag.* **2002**, *66*, 31–42.

66. Glasl, F. *Confronting Conflict: A First Aid Kit for Handling Conflict*; Hawthorn Press: Stroud, UK, 1999.
67. Adams, W.M.; Aveling, R.; Brockington, D.; Dickson, B.; Elliott, J.; Hutton, J.; Roe, D.; Vira, B.; Wolmer, W. Biodiversity conservation and the eradication of poverty. *Science* **2004**, *306*, 1146–1149.
68. 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.
69. Meijaard, E.; Abram, N.K.; Wells, J.A.; Pellier, A.S.; Ancrenaz, M.; Gaveau, D.L.; Runting, R.K.; Mengersen, K. People's perceptions about the importance of forests on Borneo. *PLoS ONE* **2013**, *8*, e73008.
70. Silori, C.S. Perception of local people towards conservation of forest resources in Nanda Devi biosphere reserve, north-western Himalaya, India. *Biodivers. Conserv.* **2007**, *16*, 211–222.
71. Allendorf, T.; Yang, J. The role of ecosystem services in park–people relationships: The case of Gaoligongshan nature reserve in southwest China. *Biol. Conserv.* **2013**, *167*, 187–193.
72. Bengston, D.N. Changing forest values and ecosystem management. *Soc. Nat. Resour.* **1994**, *7*, 515–533.
73. Sodhi, N.S.; Lee, T.M.; Sekercioglu, C.H.; Webb, E.L.; Prawiradilaga, D.M.; Lohman, D.J.; Pierce, N.E.; Diesmos, A.C.; Rao, M.; Ehrlich, P.R. Local people value environmental services provided by forested parks. *Biodivers. Conserv.* **2010**, *19*, 1175–1188.
74. Steel, B.S.; List, P.; Shindler, B. Conflicting values about federal forests: A comparison of national and Oregon publics. *Soc. Nat. Resour*. **1994**, *7*, 137–153.
75. Buttoud, G. How can policy take into consideration the "full value" of forests? *Land Use Policy* **2000**, *17*, 169–175.
76. Lee, S.; Kant, S. Personal and group forest values and perceptions of groups' forest values in northwestern Ontario. *For. Chron.* **2006**, *82*, 512–520.
77. Kearney, A.R.; Bradley, G.; Kaplan, R.; Kaplan, S. Stakeholder perspectives on appropriate forest management in the Pacific Northwest. *For. Sci.* **1999**, *45*, 62–73.
78. Dolisca, F.; McDaniel, J.M.; Teeter, L.D. Farmers' perceptions towards forests: A case study from Haiti. *For. Policy Econ.* **2007**, *9*, 704–712.
79. Gordon, J.C. *The New Face of Forestry: Exploring a Discontinuity and the Need for a Vision*; Grey Towers Press: Milford, PA, USA, 1994.
80. Vining, J.; Ebreo, A. Are you thinking what I think you are? A study of actual and estimated goal priorities and decision preferences of resource managers, environmentalists, and the public. *Soc. Nat. Resour.* **1991**, *4*, 177–196.
81. Xu, J.-Y.; Chen, L.-D.; Lu, Y.-H.; Fu, B.-J. Sustainability evaluation of the grain for green project: From local people's responses to ecological effectiveness in Wolong nature reserve. *Environ. Manag.* **2007**, *40*, 113–122.
82. Kant, S.; Lee, S. A social choice approach to sustainable forest management: An analysis of multiple forest values in northwestern Ontario. *For. Policy Econ.* **2004**, *6*, 215–227.
83. Li, H.; Aide, T.M.; Ma, Y.; Liu, W.; Cao, M. Demand for rubber is causing the loss of high diversity rain forest in Southwest China. *Biodivers. Conserv.* **2007**, *16*, 1731–1745.

84. Yi, Z.-F.; Wong, G.; Cannon, C.H.; Xu, J.; Beckschäfer, P.; Swetnam, R.D. Can carbon-trading schemes help to protect China's most diverse forest ecosystems? A case study from Xishuangbanna, Yunnan. *Land Use Policy* **2014**, *38*, 646–656.
85. Ziegler, A.D.; Bruun, T.B.; Guardiola-Claramonte, M.; Giambelluca, T.W.; Lawrence, D.; Lam, N.T. Environmental consequences of the demise in Swidden cultivation in Montane mainland southeast Asia: Hydrology and geomorphology. *Hum. Ecol.* **2009**, *37*, 361–373.
86. Xu, J.; Grumbine, R.E.; Shrestha, A.; Eriksson, M.; Yang, X.; Wang, Y.; Wilkes, A. The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods. *Conserv. Biol.* **2009**, *23*, 520–530.
87. Zhu, H.; Xu, Z.; Wang, H.; Li, B. Tropical rain forest fragmentation and its ecological and species diversity changes in southern Yunnan. *Biodivers. Conserv.* **2004**, *13*, 1355–1372.
88. Zhang, J.; Cao, M. Tropical forest vegetation of Xishuangbanna, Southwest China and its secondary changes, with special reference to some problems in local nature conservation. *Biol. Conserv.* **1995**, *73*, 229–238.
89. Rerkasem, K.; Lawrence, D.; Padoch, C.; Schmidt-Vogt, D.; Ziegler, A.D.; Bruun, T.B. Consequences of Swidden transitions for crop and fallow biodiversity in southeast Asia. *Hum. Ecol.* **2009**, *37*, 347–360.
90. Wang, J.; Xu, J.; Pei, S. Study on Indigenous Knowledge System for Management of Ecosystem Diversityin Mengsong Hani Community, Xishuangbanna. *Chin. J. Ecol.* **2000**, *19*, 36–41.
91. Chen, S.-Y.; Pei, S.-J.; Xu, J.-C. Traditional Management and Utilization of Rattan resources by Hani People in Mengsong, Xishuangbanna, Yunnan. *Acta Bot. Yunnanica* **1993**, *15*, 285–290.
92. Regulations of Xishuangbanna Nature Reserve Administration in Yunnan Province. The Government of Xishuangbanna Dai Autonomous Prefecture. Available online: http://www.xsbn.gov.cn/ (accessed on 18 June 2015).
93. Cheng, M.; Zhu, H. *Xishuangbanna Bulongzhouji Ziran Baohuqu Kexue Kao Cha Bao Gao*; Yunnan Science and Technology Press: Kunming, China, 2013.
94. R Core Team 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available online: http://www.R-project.org/ (accessed on 12 March 2015).

© 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).