Local perceptions of ecosystem services and protection of culturally protected forests in southeast China

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\textbf{ABSTRACT}

\textbf{Introduction:} Culturally protected forests (CPFs), preserved and managed by local people on the basis of traditional practices and beliefs, have social and ecological functions. Local residents’ perceptions were investigated in three types of CPFs (community forests, ancestral temple forests, and cemetery forests) in five villages in southeast China. In semi-structured interviews (232 questionnaires), residents were asked about their perceptions concerning ecosystem services and protection of CPFs.

\textbf{Outcomes:} The survey results showed that resource utilization was not high in CPFs than in forests without cultural protection. Important ecosystem services provided by CPFs included air quality improvement, water retention, recreation, and aesthetic value. Respondents were satisfied with different cultural services provided by CPFs, including aesthetic value of community forests, ecotourism of ancestral temple forests, and cultural heritage of cemetery forests. Informal rules and traditional customs were used as the main measures to govern forests in daily life; however, the most effective measures, in order of importance, were setting fines or punishment by laws, using informal rules and village regulations, or protection by government agencies. Only half of the respondents were willing to pay for maintaining ecosystem services of CPFs, but 77.8% respondents were willing to spend time on protection. From apolicy perspective, educational programs were as important as traditions, and they are crucial to explain the ecological importance of CPFs.

\textbf{Conclusion:} The conservation of biodiversity and ecosystem services of CPFs will benefit if government agencies consider incorporating CPFs into policy and legislative frameworks, maintain CPFs as collectively owned forests, and introduce ecological compensation mechanisms.

\textbf{Introduction}

Culturally protected forests (CPFs) can be defined as forest areas preserved and managed by local people through traditional cultural practices and beliefs (Jim 2003; Bhagwat and Rutte 2006; Wassie, Sterck, and Bongers 2010; Hu et al. 2011; Gao et al. 2013). Such CPFs have been identified and investigated in many parts of the world, e.g., in Asia (Xu et al. 2005; Bhagwat and Rutte 2006) and Africa (Ceperley, Montagnini, and Natta 2010; Byers, Cunliffe, and Hudak 2001). Local communities apply religious beliefs and cultural taboos as well as traditional ecological knowledge to protect and manage forest resources (Soury et al. 2007; Chun and Tak 2009). Most CPFs are natural growth forests with well-developed vegetation, which gives them significant biodiversity value (Virtanen 2002; Yuan and Liu 2009; Gao et al. 2013). Frequently, they provide cultural services to local communities, and also other services, such as the provision of forest products and the regulation of water flows and microclimate.

CPFs, such as sacred groves, temple forests, and traditional village forests, have received increasing attention in nature policy and conservation science. Four types of development in nature conservation are fueling this attention. First, there is the much-debated trend of participation. Experiences with community-based conservation, integrated conservation, development projects, and similar participatory approaches, have shown that taking local voices and values into account, while not a panacea for success, can contribute substantially to the effectiveness of nature conservation efforts (Wilshusen et al. 2002; Fabricius 2004; Berkes 2007). Second, there is growing awareness that cultural, spiritual, and religious values, in addition to the provisioning and regulating services, can act as major local drivers for nature conservation (Cunningham 2001; Infield 2010; Robson and Berkes 2010). This awareness is reflected in studies on biocultural diversity (Cocks 2006). Third, informal rules and regulations and other traditional systems of protection show significance in biodiversity conservation and forest resources (Allendorf 2007; Tengö et al. 2007).
Fourth, there is emerging evidence from ecological research that not only legally protected areas but also relatively small patches of forests, if well preserved, can significantly add to the protection of local biodiversity (Bruner et al. 2001; Bhagwat and Rutte 2006; Ceperley, Montagnini, and Natta 2010; Hu et al. 2011). CPFs are significant to biodiversity conservation and ecosystem services because of their long history and local people’s willingness to conserve them. However, research has shown that the survival of CPFs strongly depends on social conditions. In situations of economic and social development, they are threatened by increased exploitation and erosion of cultural traditions. Therefore, investigation of their social and ecological dimensions is essential to understand their conservation potential.

In China, most research in relation to CPFs is conducted by ethnological ecologists and focused on sacred mountain areas in ethnic minority regions, such as Yunnan, Sichuan, and Tibet (Xu et al. 2005; Zou, Xie, and Kun 2005; Luo, Liu, and Zhang 2009; Shen et al. 2012; Shen and Tan 2012). These places have lush mountain forests conserved as cultural and sacred sites where ancestors or deities are worshipped, such as holy hills and sacred groves, and they are mostly found in minority areas in southwest China (Liu et al. 2002, Yuan and Liu 2009). In these CPFs, traditional conservation coexists with government conservation. The local communities establish rules which vary from grove to grove. In general, logging is strictly forbidden in the CPFs and other forms of forest use are bound by limits (Marafa 2003). However, CPFs are also common in southeast China under Han Chinese mainstream culture, and almost every village has cultural forests as ecological and psychological shelters (Guan 2002; Lü et al. 2009; Gao et al. 2013). These forests, which are often small patches around or at the back of villages or temples, have been maintained for decades or even centuries without much disturbance or change. In spite of the frequent occurrence of these CPFs and their potential importance for conservation, there is little research into local villagers’ perceptions, attitudes, and behavior with regard to the ecosystem services of these CPFs, and their ways of protecting them.

This article reports on a research project focused on the protection of local forests in five villages in southeast China with a Han Chinese culture, combining social and ecological approaches. The ecological part of the research assessed the biodiversity of the CPFs, which is fully reported in another article and briefly summarized in the next section (Gao et al. 2013). Central to this article is the social part of the research project, which describes the results of village surveys on the utilization of CPFs, perceptions of CPFs’ ecosystem services, and the opinions and behaviors of villagers with regard to forest protection. The questionnaire focused on three main questions: (1) what are the ecosystem goods and services provided by CPFs? (2) How do local people protect the forests? (3) What are the factors influencing the management of CPFs? Improved understanding of perceptions of ecosystem services and protective measures on the local scale may contribute to better cooperation between local villagers and governmental authorities in protecting local natural forests and ecosystem services.

Methods

Study area

The study was carried out in five villages in Fujian and Jiangxi Province with traditional Chinese Han culture in southeast China (Figure 1 and Table 1). Both provinces have undergone a forest tenure reform; Fujian Province in 2006 (Xu et al. 2010) and Jiangxi Province in 2007. As a result of the reform, village collectives have the option of reallocating forest rights to individual households (Xu et al. 2010). However, in the study area many village committees kept the CPFs in collective ownership and reserved them for collective use and ceremonial activities, while allocating other forests to households.

As mentioned above, in the traditional Han Chinese culture of these provinces CPFs are widespread, with most of them located near the villages or temples. Generally, they can be divided into three types: community forests, cemetery forests, and temple forests (Guan 2002; Gao et al. 2013). In this study, Longtan, Jiangwan, and Fenshui villages have community forests. Ancestral temple forests are located in Xibe village. The cemetery forests are located in Datang village.

Longtan, Jiangwan, and Fenshui are old villages with more than 100 years of history, traditional customs, and with lush forests around them. They are representative of the relationship between forests and villages in southeast China. In Longtan village, a river flows in front of the houses and water also comes from the mountains into the village. Jiangwan village attracts ecotourists with its beautiful forests, rivers, and near 1000 years of history. Fenshui village is a typically traditional village with dense forests and traditional agriculture.

Very old cemetery forests are located at Datang village. According to historical accounts, the first tomb was built before Jiaqing of the Qing Dynasty (1796–1820). Villagers traditionally bury their ancestors in these mountain forests, and hold a memorial ceremony on annual festivals. In addition, Datang has five patches of cemetery forest with tombs throughout the forest area.

The ancestral temple forests investigated in this study are located at the back of Liao’s ancestral temple. The temple was built in 1848 (Daoguang 28 years), but...
According to the interview with the old temple guardian, the forests have a longer history than the temple. The temple is well known, because the Ninth Congress of Fourth Red Army was held here in 1929. At this congress, presided by Chairman Mao, the famous Gutian Conference Resolution was passed, which laid out principles that would guide the Communist Party in the years to come.

The studied CPFs showed higher biodiversity values than other types of forests outside of official reserves. This was investigated in the abovementioned parallel ecological investigation of the selected CPFs (Gao et al. 2013). According to this investigation, the CPFs are natural growth forests, and contain more species than the other forests around the village. We sampled one patch of CPF in each village, and compared it with nearby forests with no cultural protection (NCPFs). The patch size of the investigated CPFs ranged from 0.3 to 9 ha. A total of 50 plots (20 m × 20 m) were set in the five villages within the patches of CPFs and NCPFs, and each plot was evenly divided into four subplots of 10 m × 10 m \((n = 200)\), where vegetation was inventoried. The dominant species found were indigenous broad-leaved species comparable to the regional well-developed forests (Luo and Li 1996; Kong and Li 2011; Gao et al. 2013), including Castanopsis carlesii, Castanopsis sclerophylla, Tsuga longibracteata, and Cinnamomum camphora. In NCPFs, the dominant species were easily cultivated and conifer dominated mixed broadleaf-conifer forests, such as Cunninghamia lanceolata and Pinus massoniana. Trees in CPFs in average had a larger diameter at breast height and lower density.

**Table 1.** Social and ecological properties of five study villages in southeast China.

| Village        | Type of CPFs     | Patch size of CPFs (ha) | Ownership | Number of questionnaires/households | Location                                                                 |
|----------------|------------------|------------------------|-----------|-------------------------------------|--------------------------------------------------------------------------|
| Longtan        | Community forests| 9                      | Collective| 36/105                              | Longmen Town, Xinluo District, Longyan City, Fujian Province             |
| Jiangwan       | Community forests| 8                      | Collective| 64/1210                             | Jiangwan Town, Wuyuan County, Shangrao City, Jiangxi Province            |
| Fenshui        | Community forests| 6.8                    | Collective| 52/203                              | Xucun Town, Wuyuan County, Shangrao City, Jiangxi Province               |
| Datang         | Cemetery forests  | 0.3                    | Collective| 40/206                              | Minshan Town, Jiujiang County, Jiujiang City, Jiangxi Province          |
| Xibei          | Ancestral temple forests | 2.5                  | Gutian museum | 40/252                              | Gutian Town, Shanghang County, Longyan City, Fujian Province            |

**Figure 1.** Locations of five study villages in southeast China. Longtan village is located in Longyan City, Fujian Province; Jiangwan and Fenshui villages are located in Wuyuan County, Jiangxi Province; Datang village is located in Jiujiang City, Jiangxi Province, and Xibei village is located in Shanghang County, Fujian Province.
than in NCPFs. Alpha biodiversity was analyzed by calculating the Simpson index, Shannon–Wiener index, and Pielou evenness index. With four exceptions, higher alpha diversity was found in the tree, shrub, and herb layer of CPFs. This difference was significant for 20 out of 45 indices values. CPFs are host to 17% of the county’s threatened species. Although these sampled areas of CPFs were only 1 ha in size and covered less than 0.02% of the total forests area of the four counties, because of their species diversity and their spatial distribution, are highly valuable for biodiversity conservation.

**Interviews**

Semi-structured and structured interviews were conducted to investigate the social dimensions of CPFs. Semi-structured interviews were used to obtain qualitative contextual information, while structured interviews were used for a statistically processed survey among villagers (Babbie 2010).

Semi-structured interviews were carried out with key respondents about the history, ownership, location, and boundaries of the CPFs. Key informants were five venerable old men, six current or former village leaders, and one forestry worker. In total, 12 key respondents were interviewed, two in each of the villages with community forests, and three in both Datang (cemetery forests) and Xibei (temple forests).

Structured questionnaires were used to interview villagers about their knowledge, perceptions, and protective behaviors toward CPFs. The questionnaire was divided into four main parts:

1. Resource use of the CPFs and NCPFs.
2. Perceptions of ecosystem services (Millennium Ecosystem Assessment 2005). This part included questions on the importance of CPF services in the daily life of respondents, satisfaction with current services provided, and preferred improvements in the future. Villagers were also interviewed about their willingness to pay and willingness to manage CPFs’ ecosystem services.
3. Protection and management behavior of CPFs. In this part, we inquired about the reasons and measures for protecting CPFs.
4. In addition, we obtained information on age, education level, family income, and distance to the CPFs.

Residents of the five villages were selected for interviews by random sampling with one household representing a sampling unit. The interviews were carried out from 16 May to 8 June 2010 in Fujian Province, and from 19 October to 21 November 2010 in Jiangxi Province. Most of the time, villagers were interviewed in their houses, and occasionally they were interviewed in the street or in a shop. A large majority (>90%) of respondents approached this way were prepared to participate. In total, 232 questionnaires were collected.

The gender of the respondents was 129:103 (male: female). 36.6% of the respondents had primary school education or below, 36.2% had junior middle school education, and 22.0% had high school or technical secondary school education. In most cases, the interviews were taken orally. In some cases, where the respondents had higher education, they filled in the questionnaires themselves, with the interviewer explaining and checking the questionnaires. During the interviews, Mandarin and colloquial language were used to explain ecosystem services to respondents in words familiar to them.

The interview data were processed and analyzed with SPSS 18.0. Utilization of resources, perceptions of ecosystem services, and statements on protection measures were calculated by sum and percentage. To investigate the influence of respondents’ characteristics on general satisfaction, we statistically analyzed the relationship between individual satisfaction of ecosystem services and education level, distance of house to CPFs, family income, age, and gender. We also analyzed the relationship between willingness to manage and satisfaction, education level, distance from forests, family income, and age of respondents. Significance was analyzed with Spearman’s rank correlation test.

**Results**

**Utilization of resources**

The findings on income and forest products obtained from CPFs are presented in Table 2. An average of 30.0% respondents obtained income from forests, although the percentage ranged from 10.0% to 57.5% between different villages. In Jiangwan and Xibei villages, villagers received income from CPFs through ecotourism by selling homemade products and providing services to visitors. In the other three villages, the main sources of income from CPFs were selling mushrooms, medicinal herbs, and wild fruits.

An average of 44.2% respondents obtained forest products from CPFs. Villagers made more use of forest resources in the CPFs without ecotourism. More than half (from 50.0% to 63.9%) of the respondents had obtained forest products from CPFs without ecotourism, while only 20.3–35% respondents had obtained forests products in the villages (Jiangwan and Xibei village) with ecotourism. The main forest products from CPFs were bamboo (around 20 pieces per year per household), medicinal herbs (around 5 kg per year per household), and mushrooms (around 5 kg per year per household). These amounts, based on estimations...
stated by the respondents, suggest that the amount of forest products obtained from the CPFs is relatively low. In comparison, 90.9% respondents obtained forest products from NCPFs, primarily for use and selling.

**Perceptions of ecosystem services**

**Importance of services**

Villagers were asked to identify which ecosystem services they considered as ‘very important’ (maximally three services could be mentioned). Results are presented in Figure 2 and Table 3. Air quality improvement – as a regulating service – was considered by the highest percentage of respondents as important service provided during daily life. This was the case for all villages, with the exception of the ancestral temple forests of Xibei village, which is a tourist site. Here, recreation scored highest among respondents. Water retention was the second priority, particularly in the villages which had water flows from the mountain and river in front of the houses, for instance, in Fenshui village, Longtan village, Datang village (Table 3). Under cultural services, recreation and ecotourism, and aesthetic value were considered third and fourth important (but less satisfactorily developed – see Section “General satisfaction with ecosystem services”). Provisioning services were less important to the villagers.

Villagers were also asked to name the ecosystem services they were most satisfied with (maximally three services). The results are shown in Figure 2 and Table 4. Most respondents considered air quality improvement as a major benefit of living near CPFs. Climate regulation, i.e., shade and moisture for farmers and their animals, was ranked second. Aesthetic value, in the sense of making living conditions better, and creating beauty, ranked third in frequency of being mentioned. However, the cultural value which brought most satisfaction varied between different types of CPFs. In community forests, communities maintain the CPFs at the back or on either side of the village for their aesthetic value. According to the interviews, villagers believe that forests with a diversity of trees and beautiful scenery can bring prosperity and fortune to the village. In cemetery forests, the CPFs provide the means to pass down traditional culture. The villagers respect the area as a holy site to remember their ancestors. They hold ceremonies for ancestors in the cemetery forests on Tomb-sweeping Day and at the Spring Festival, and they believe the spirits of ancestors bless their offspring. Ancestral temple forests are used for tourism but, historically, the temple built by Liao’s clan was used to hold ancestral tablets and it was the place where families were planned and ceremonies for marriage, death, and birth were held. According to traditional beliefs, the temple stands for the clan, and the forests protect the temple, which protects all the people in the village.

In terms of their actual development needs, local communities indicated they would like CPF ecosystem services to be improved (Figure 2 and Table 5) in the following order of importance: recreation and tourism, particularly in community forests, aesthetic value, air improvement, and providing wildlife habitats. Villagers wanted the community forests to provide recreation and ecotourism because it can provide income. Villagers living around ancestral temple forests would most like to improve wildlife habitat provision, because it reflects their respect for life, and because existing ecotourism in the forests damages flora and fauna. In cemetery forests, villagers would most like to improve the forest scenery, since some of the villagers, especially women, felt the tombs impact the beauty of forests.

**General satisfaction with ecosystem services**

Respondents were asked to indicate their general satisfaction with CPFs’ services on a five-point scale (from very unsatisfactory to very satisfactory). In five villages, although they showed different perceptions toward ecosystem services provided by CPFs, 98.7% of respondents were satisfied with CPFs’ ecosystem services. Older villagers showed more satisfaction than younger respondents (Spearman’s correlation = 0.34, two-tailed $p < 0.01$).

### Table 2. Income and forest products obtained from culturally protected forests (n = 232).

| Types of CPFs       | Longtan village | Jiangwan village | Fenshui village | Xibei village | Datang village |
|---------------------|-----------------|------------------|-----------------|---------------|---------------|
| **Percentage of respondents who received income from CPFs** |                |                  |                 |               |               |
| Mushrooms (50.0%)   | 10.0%           |                  |                 |               |               |
| Medicinal herbs (25.0%) |              |                  |                 |               |               |
| Touring (91.7%)     | 37.5%           |                  |                 |               |               |
| Medicinal herbs (66.5%) |          |                  |                 |               |               |
| Wild fruit (20.2%)  | 17.3%           |                  |                 |               |               |
| Medicinal herbs (10.1%) |            |                  |                 |               |               |
| Wild fruit (11.4%)  | 57.5%           |                  |                 |               |               |
| Medicinal herbs (85.1%) |          |                  |                 |               |               |
| Tea seed (6.8%)     | 12.5%           |                  |                 |               |               |

### Table 3.

| Main products for house use (percentages of respondents) | Longtan village | Jiangwan village | Fenshui village | Xibei village | Datang village |
|----------------------------------------------------------|-----------------|------------------|-----------------|---------------|---------------|
| Mushrooms (65.3%)                                       | 63.9%           |                  |                 |               |               |
| Medicinal herbs (13%)                                    | 20.3%           |                  |                 |               |               |
| Edible wild herb (24.6%)                                 | 51.9%           |                  |                 |               |               |
| Medicinal herb (28.3%)                                   | 35.0%           |                  |                 |               |               |
| Firewood (8.6%)                                          | 26.0%           |                  |                 |               |               |
| Medicinal herbs (17.4%)                                  | 50.0%           |                  |                 |               |               |
| Tea seed (70.4%)                                         | 70.4%           |                  |                 |               |               |
| Edible wild herb (11.2%)                                 | 50.0%           |                  |                 |               |               |
| Bamboo (11.2%)                                           | 26.0%           |                  |                 |               |               |

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Practices of forest protection

Informal rules and regulations in daily governance were the main measure of protection indicated by more than half of the respondents (51.5%). These rules were usually formulated by the villagers or village committee who had a close connection to their traditional culture or norms. Apparently, these

### Table 3. Villagers’ perceptions of the importance of ecosystem services from culturally protected forests (% of respondents who identified the service (maximally three) most important, n = 232)

| Category               | Ecosystem service                  | Longtan village | Jiangwan village | Fenshui village | Xibei village | Datang village |
|------------------------|------------------------------------|----------------|------------------|-----------------|---------------|----------------|
| **Provisioning services** | Wood                               | 0.0%           | 3.1%             | 9.6%            | 2.5%          | 15.0%          |
|                        | Forest products                    | 2.8%           | 10.9%            | 5.8%            | 12.5%         | 0.0%           |
|                        | Water retention                    | 55.6%          | 25.0%            | 46.2%           | 0.0%          | 42.5%          |
|                        | Soil retention                     | 2.8%           | 9.4%             | 13.5%           | 17.5%         | 10.0%          |
|                        | Air improvement                    | 69.4%          | 54.7%            | 57.7%           | 2.5%          | 70.0%          |
|                        | Microclimate regulation            | 8.3%           | 26.6%            | 26.9%           | 20.0%         | 25.0%          |
|                        | Prevent and mitigate natural disaster | 2.8%        | 21.9%            | 36.3%           | 0.0%          | 22.5%          |
| **Regulating services** | Recreation and ecotourism           | 16.7%          | 35.9%            | 15.4%           | 42.5%         | 35.0%          |
|                        | Aesthetic value                    | 38.9%          | 39.1%            | 38.5%           | 7.5%          | 20.0%          |
|                        | Folklore                            | 0.0%           | 18.8%            | 7.7%            | 5.0%          | 7.5%           |
|                        | Spiritual and religious             | 0.0%           | 1.6%             | 0.0%            | 5.0%          | 0.0%           |
|                        | Cultural heritage                   | 13.9%          | 25.0%            | 5.8%            | 17.5%         | 15.0%          |
| **Cultural services**  | Nutrient cycling                    | 5.6%           | 1.6%             | 11.5%           | 15.0%         | 7.5%           |
|                        | Providing wildlife habitat          | 5.6%           | 15.6%            | 5.8%            | 2.5%          | 15.0%          |
| **Supporting services** | Nutrient cycling                    | 5.6%           | 1.6%             | 11.5%           | 15.0%         | 7.5%           |
|                        | Providing wildlife habitat          | 5.6%           | 15.6%            | 5.8%            | 2.5%          | 15.0%          |

Figure 2. Villagers’ perceptions of ecosystem services from culturally protected forests (n = 232).
Table 4. Villagers’ perceptions of their satisfaction with ecosystem services from culturally protected forests (% of respondents who identified the service (maximally three) most satisfied, n = 232).

| Category                | Ecosystem services       | Longtan village | Jiangwan village | Fenshui village | Xibei village | Datang village |
|-------------------------|--------------------------|-----------------|------------------|-----------------|---------------|----------------|
| Provisioning services   | Wood                     | 0.0%            | 0.0%             | 0.0%            | 5.0%          | 0.0%           |
|                         | Forest products          | 5.6%            | 1.6%             | 1.9%            | 10.0%         | 2.5%           |
| Regulating services     | Water retention          | 75.0%           | 28.1%            | 42.3%           | 22.5%         | 42.5%          |
|                         | Soil retention           | 13.9%           | 7.8%             | 15.4%           | 10.0%         | 47.5%          |
|                         | Air improvement          | 86.1%           | 79.7%            | 67.3%           | 65.0%         | 55.0%          |
|                         | Microclimate regulation  | 50.0%           | 43.8%            | 36.5%           | 50.0%         | 62.5%          |
| Cultural services       | Recreation and ecotourism| 8.3%            | 20.3%            | 42.3%           | 27.5%         | 32.5%          |
| Supporting services     | Nutrient cycling         | 5.6%            | 31.3%            | 0.0%            | 70.0%         | 0.0%           |
|                         | Providing wildlife habitat| 22.2%          | 9.4%             | 11.5%           | 27.5%         | 5.0%           |
|                         |                          | 25.0%           | 9.4%             | 13.5%           | 20.0%         | 12.5%          |

Table 5. Villagers’ perceptions for improvement of ecosystem services from culturally protected forests (% of respondents who identified the service (maximally three) needs to be improved, n = 232).

| Category                | Ecosystem services       | Longtan village | Jiangwan village | Fenshui village | Xibei village | Datang village |
|-------------------------|--------------------------|-----------------|------------------|-----------------|---------------|----------------|
| Provisioning services   | Wood                     | 2.5%            | 14.1%            | 25.0%           | 12.5%         | 25.0%          |
|                         | Forest products          | 10.0%           | 10.9%            | 32.7%           | 25.0%         | 20.0%          |
| Regulating services     | Water retention          | 10.0%           | 21.9%            | 21.2%           | 7.5%          | 50.0%          |
|                         | Soil retention           | 2.5%            | 15.6%            | 9.6%            | 2.5%          | 40.0%          |
|                         | Air improvement          | 12.5%           | 20.3%            | 23.1%           | 7.5%          | 50.0%          |
|                         | Microclimate regulation  | 2.5%            | 15.6%            | 11.5%           | 7.5%          | 50.0%          |
| Cultural services       | Recreation and ecotourism| 0.0%            | 9.4%             | 21.2%           | 2.5%          | 30.0%          |
| Supporting services     | Nutrient cycling         | 60.0%           | 51.6%            | 34.6%           | 15.0%         | 62.5%          |
|                         | Providing wildlife habitat| 2.5%            | 6.3%             | 11.5%           | 2.5%          | 20.0%          |

rules have played an important role in conservation of the CPFs even though they have no legal validity. The following rules were mentioned in the interviews. First, tree felling was not allowed in CPFs. Several respondents referred to the 1970s when nails were hit into the trees to make them useless, or when, if someone cut a tree down, the committee would kill the family pig and distribute the meat to other villagers. Other punishments mentioned included being required to make a self-criticism in front of the villagers, replanting trees, or paying fines. In addition, 42.9% of respondents said the conservation of CPFs was based on traditional custom. According to the qualitative interviews, this can be interpreted as traditional ecological knowledge and customs. About one-third of the respondents (29.2%) declared that educational programs were used to promote the protection awareness of local people, and that they were often actively engaged in protection and management of CPFs. Only 21.5% of respondents thought government forest agencies protected the CPFs.

When asked about correction of individual actions, respondents (57.1%) preferred to denounce an individual caught destroying CPFs to the responsible governmental agency. This reflects the important role played by Chinese government institutes in governing individual action; many respondents expressed their needs for government as an authority. But many villagers also see an active role for themselves; 43.4% of the respondents preferred to take self-action to stop individuals harming a CPF. Other 36.1% of the respondents would punish him according to village rules and regulations. 22.8% of the respondents would ask other relatives in the village to stop him together.

Respondents hoped for more government involvement in CPFs conservation. They believed that effective measures to govern CPFs in daily governance were setting fines or punishment by laws (17.3%), using informal rules and village regulations (14.3%), and specifying a CPF management agency or responsible officer (13.4%).

**Willingness to pay and willingness to manage**
The large majority of respondents (97.9%) thought that CPFs deserve more protection. The remainder (2.1%) thought that other forests were equally important. However, willingness to pay for the maintenance of CPFs ecosystem services varied, with villagers with ecotourism relatively less willing to give monetary support. In Gutian and Jiangwan villages, for example, the percentage of villagers who were willing to pay was 15.0% and 35.9%, respectively, while willingness to pay in the three villages without ecotourism was higher, and ranged from 53.8% to 89.5%. Unwillingness was primarily due to small family
income which does not cover daily expenses (29.3%). Parts of villagers felt that government agencies should pay, not the village households (28.7%). Other villagers thought that the forestry agency should take responsibility for forest management (12.2%).

The percentage willingness to manage CPFs was much higher than willingness to pay. 77.8% respondents stated they were willing to devote time to forest protection; respondents who were unwilling to devote time gave reasons of being too old or needing to work outside the area.

**Influencing factors**

Willingness to manage forests showed a positive correlation with satisfaction about the CPFs’ ecosystem services, and with educational level. Respondents who felt more satisfied with ecosystem services were more willing to devote time to forest management, and villagers with higher educational achievement tended to spend more time managing the forests. Distance from forests, family income, age, and gender had no correlation with willingness to manage (Table 6).

Respondents cited improved awareness (30.7%) as a main factor that could influence the conservation of CPFs. A fair number of respondents mentioned that existing educational programs were not sufficient to maintain awareness of residents (28.3%). Also, several respondents considered a lack of financial support from government as important influential factor (27.8%), and several felt that the government should pay more attention to conservation of CPFs (24.1%).

**Discussion**

This research has shown that CPF ecosystem services were valued and recognized by the local communities investigated. As mentioned, small patches of forest are also crucial to the more general aim of biodiversity conservation (Hu et al. 2011; Mo et al. 2011; Gao et al. 2013). Thus, these small patches protected by local communities conserve biodiversity and indigenous species, and can be seen as important regional species pools, as has been confirmed by other research (Liu et al. 2002; Virtanen 2002).

CPFs also contribute to the generation of ecosystem services for the welfare of local people. However, providing forest products was not the main function, neither in terms of income received, nor in terms of products for household use, at least when compared with NCPFs. Regulating services and cultural services, particularly air improvement, water retention, recreation, and aesthetic value were more significant reasons for CPFs conservation. For two of the villages, tourism is a fairly important source of income. Also, villagers wanted cultural services to be improved. Recreation and ecotourism were considered important but they had not reached a level of villagers’ satisfaction, and local residents felt strongly that they needed ecotourism for increasing income. Although people could receive extra income by the provision of services to tourists, it may not be the best option for CPFs conservation as the results showed that willingness to pay for CPFs was relatively low in those villages with well-developed tourism. Also, tourism can lead to negative environmental and social impacts (Christ, Hillel, Matus, and Sweeting 2003; Kiss 2004). In conclusion, CPFs provide both tangible (e.g., medicine, and non-timber forest products) and intangible value (e.g., spiritual, aesthetic value, and ecotourism) to local communities. This intangible value can play an important role in people’s relationship with CPFs and can contribute to long-term conservation (Infield 2010; Shen et al. 2012). However, the cultural and traditional meanings of these forests are not fully taken up by younger generations. Young people felt less satisfied with ecosystem services and this may be because they do not as much appreciate the cultural meaning of forests as does the older generation.

Ecosystem services were the main motivations for the local community to conserve forests, and traditional culture and informal rules contributed to CPFs conservation practices, as reported in other literature as well (Thaman et al. 2013; Ouédraogo et al. 2014; Boafo et al. 2016; Camacho et al. 2016; Parrotta, Yeochang, and Camacho 2016). Informal rules and regulations played a predominant role in protection and daily management of CPFs at the community level. In other parts of China, studies have shown that informal rules and village regulation are widely used (Luo and Li 1996; Luo, Liu, and Zhang 2009; Hu et al. 2011). The role of self-discipline has been reported in other research (Pacheco et al. 2008; Yuan and Liu 2009). These results may indicate that informal regulations can be more effective in managing small forest damage than government intervention. However, many respondents expected a stronger involvement of government in CPFs conservation. Individuals’ protective behaviors relied on laws and the power of government, which suggests that government plays an important role in encouraging self-discipline as an authority in rural areas. Effective management and support from government and village communities are essential for long-term protection of CPFs. In addition, local residents were willing to spend time on managing the forests, and willingness was closely correlated with satisfaction in ecosystem services and educational level. Improving

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**Table 6.** Spearman’s correlation between willing to manage with satisfaction, educational level, and distance from forests, family income, and age of respondents.

| Willingness to manage | Satisfaction | Education level | Distance from forests | Family income | Age |
|-----------------------|--------------|-----------------|----------------------|--------------|-----|
|                       | 0.14*        | 0.15*           | −0.04                | −0.04        | 0.002 |

*Correlation is significant at 0.05 levels (two-tailed)
In China, the state controls policy, forestry operations, and ownership of forests. Yet, local people also self-govern and have their own principles, norms, informal rules, and practices (Shukla and Sinclair 2010; Waylen et al. 2010). Government is not the only instigator of conservation policy for CPFs. Institutional legitimacy and the perspective of local residents may greatly influence the capacity for conservation. There is a need for government to be more open to listening to local people and to take their views into consideration in decision-making. The results of the survey suggest that informal regulation, based on cultural values and embedded in a formal system, could promote effective nature governance. This is in accordance with studies emphasizing the importance of community management and local participation in rule making, monitoring, and enforcement in the protection of nature (Margules and Pressey 2000; Sinclair, Ludwig, and Clark 2000; Wilshusen et al. 2002).

The deployment of local, informal regulations is under growing pressure from globalization and state economic modernization, and there is evidence that community-level customs and cultural practices decrease with increasing social and economic development. Government officials often assume that rural people who lack education, in general, and scientific knowledge, in particular, have little interest in modern conservation (Rijsoort and Jinfeng 2005). However, studies have shown that if local people in China are allowed to participate in resource management, they become motivated to protect wild habitats (Plummer and Taylor 2004; Menzies 2007; Câmara-Leret et al. 2014). In addition, conflicts between formal and informal regulations can be mitigated if conservation aims are consolidated and shared between state authorities and communities. Traditional culture holds significant heritage value if local communities can meet the challenges posed by the modern word and adapt to social and economic changes. Recognizing the cultural value of CPFs may help to maintain the traditional practice of conservation (Grumbine and Xu 2011; Xu et al. 2005; Marafa 2003). Clear boundaries and use rights could add to local control and bring greater benefits. However, further studies are necessary to develop these perspectives on forest resource management and land-use policy for better conservation of CPFs.

Conclusions and recommendations

The results of this study have shown that a substantial proportion of residents are very satisfied with their CPFs’ ecosystem services. CPFs conserve both biodiversity and ecosystem services. Local communities benefit from ecosystem services, particularly from regulating services and cultural services, such as air quality improvement, water retention, aesthetic value, and recreation. CPF management is based on traditional belief and culture, and informal regulations at the community level. However, government plays a critical role in protection against individual harmful activities. This research also suggests that improved education for local residents can contribute to better CPFs protection. From a policy perspective, we suggest that a balanced combination of traditional cultural practices and informal regulations enforced within communities on one hand, and enabling governmental frameworks based on modern conservation science on the other hand could be an optimal approach to nature conservation. It is recommended that central government considers incorporating CPFs into its policy and legislative framework, keeping CPFs as collectively owned forests and introducing social and economic compensation mechanisms for local nature protection activities.

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