forests

MDPI

Review

A Review of Carbon Forest Development in China

Wei Zhou [1,*], Peichen Gong [2] and Lan Gao [1,*]

[1] College of Economics and Management, South China Agricultural University, Guangzhou 510642, China
[2] Center of Environmental and Resource Economics, Department of Forest Economics, Swedish University of Agricultural Sciences, SE-901 83 Umeå, Sweden; Peichen.Gong@slu.se
* Correspondence: zhouw@scau.edu.cn (W.Z.); gaolan@scau.edu.cn (L.G.); Tel.: +86-20-85280216 (W.Z.); +86-20-85285050 (L.G.)

Academic Editor: Timothy A. Martin
Received: 11 May 2017; Accepted: 10 August 2017; Published: 13 August 2017

Abstract: This paper provides an overview of China's climate mitigation policy related to the forestry sector, with a special focus on the development of carbon forests which are established to mitigate climate change. A total of 3.5 million ha of carbon forest were planted in the past decade. In recent years, the number of Voluntary Emission Reduction forest carbon projects has increased rapidly. The main challenges for future development of carbon forests under market mechanisms include increasing costs, uncertainty in the future supply and demand for China-certified emission reduction, and potential disputes between households and project developers.

Keywords: climate change; forestry; carbon forest

1. Introduction

The emission of greenhouse gases (GHGs) in China has increased rapidly in the past decades. The estimated total emission in 2012 was 12.45 Gt CO_2 eq, which was more than three times as high as the total emission in 1990, and accounted for about 23% of the global total emissions [1]. The rapid increase in the emissions of GHGs and the position of being the largest emitter have created enormous pressure for China to effectively control its emissions. The National Development and Reform Commission (NDRC) of China published in 2011 a detailed five-year National GHG Control Work Plan [2], which sets a 17% CO_2 intensity reduction goal for 2011–2015. The 2014 U.S.-China Joint Announcement on Climate Change declared that "China intends to achieve the peaking of CO_2 emissions around 2030 and to make best efforts to peak early" [3].

Forestry is an important part in China's efforts on climate change mitigation. As one concrete contribution to mitigating climate change, China announced in 2009 that it would endeavor to increase the country's forest area by 40 million ha and the forest stocking volume by 1.3 billion m^3 by 2020, relative to the situation in 2005 [4]. In 2015, the NDRC declared that, by 2030, China would increase the forest stocking volume by around 4.5 billion m^3 from 2005 levels [5]. Along with the increasing emphasis of the role of forestry in climate policy, China also started to invest in establishing the so-called carbon forest, referring to forests planted and managed for carbon sequestration following specially designed technical provisions or methodologies [6].

Many researchers have examined various issues related to the development of carbon forest in China. Since the primary management objective for carbon forest is carbon sequestration, how to increase carbon stock on forest land by changing silviculture practices has been an important topic of previous research. Choosing mixtures of broad-leaved local tree species [7,8], and improving tending [9], were found to be effective ways of increasing carbon sequestration. After Guangdong Province initiated its carbon forest project in 2012, a considerable proportion of the studies have focused on assessing the benefits and factors which affect the carbon sequestration target of the project.

Fang and Gao estimated that the carbon benefits, ecological benefits, and economic benefits of carbon forest constitute 52.4%, 26.2%, and 10.7%, respectively, of the total benefits of the project [10]. However, natural disasters, inadequate public engagement, and lack of tending could lead to a significant reduction in the estimated amount of carbon sequestration of the forests [11,12]. After the collective forest tenure reform started in 2003, long-term use rights and disposal rights of collectively-owned forestland have been granted to member households of the collectives [13]. Therefore, the rural households' willingness to participate in forest carbon projects plays an important role in the development of carbon forest. The share of rural households which are willing to participate in carbon forest projects in three investigations is 78.6% [14], 67.7% [15], and 30.3% [16], respectively. Households' income and cognition of climate change [14], acquired forestry training and site condition [15], the area of non-forest land, and households' relationship with the local forestry authority and village community [16] are major factors affecting households' willingness.

Based on published statistics and our own investigations conducted in Guangdong Province in 2014, this paper provides an overview of the development and challenges of carbon forests in China, and thus China's climate mitigation policy in the forestry sector. The main purpose of this paper is to review the current status and further challenges of carbon forest development in China.

2. The Forestry Sector in China

According to the 8th National Forest Resource Inventory (2009–2013) [17], the total area of forestland in China is 310 million ha. Forty percent of the forestland is owned by the state, and 60% is owned by collectives. Forested land area in China is 207.69 million ha, and the standing volume of timber is 15.14 billion m^3. Since the first forest resource inventory in 1976, the standing volume has increased from 8.66 billion m^3 to 15.14 billion m^3 [17]. Forest area decreased from 121.86 million ha to 115.28 million ha between the first and the second national forest resource inventories. Thereafter, it increased steadily from 115.28 million ha in 1981 to 207.69 million ha in 2013 (Figure 1). Ecosystem protection is becoming more and more important in China's forest policy. To increase forest coverage and the volume of standing timber and to enhance the carbon sequestration capacity are top priorities of the forestry sector. The planting area within four key forestry programs (the Natural Forest Protection Program, the Sloping Land Conversion Program, the Desertification Combating Program around Beijing and Tianjin, and the Shelterbelt project) was 1.93 million ha in 2014, accounting for 34.74% of the total planting area in 2014 [18]. Investment in China's forestry sector is growing (Figure 2). During 2009–2013, the total investments grew from 135.1 to 366 billion CNY, and the public investments raised from 71 to 134.9 billion CNY (1 CNY = 0.1439 USD as of 21 December 2016).

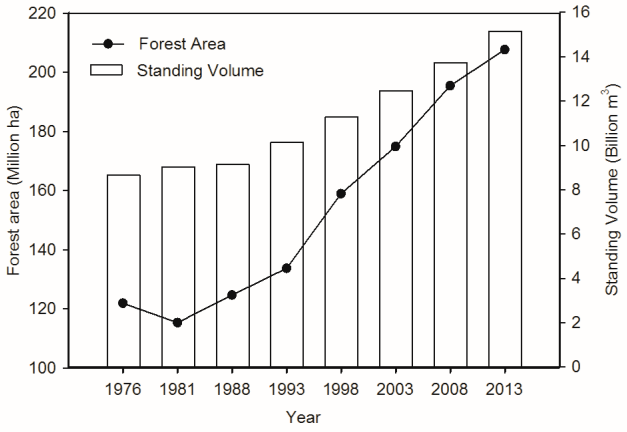

Figure 1. Forest area and growing stock of timber in China during 1976–2013.

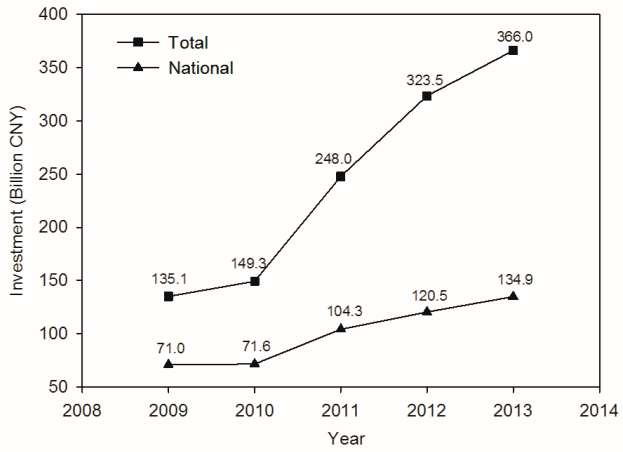

Figure 2. Investment in the forestry sector. Source: China Forestry Statistical Yearbook (2009–2013) [17].

3. Development of Carbon Forests

3.1. Policy Framework

Carbon forests in China were initially developed within the Clean Development Mechanism (CDM). In 2010, based on CDM methodologies and China's forestry practice realities, the State Forestry Administration (SFA) published the Technical Provisions of Afforestation for Carbon Sequestration (TPACS) and Measures of Inspection and Acceptance of Afforestation for Carbon Sequestration. These two documents provide practical instructions on the establishment and management of carbon forests. The TPACS defines afforestation for carbon sequestration as planting and managing forests for increasing carbon sequestration on land, and requires that carbon sinks and sources should be accounted and monitored during the management period of these forests. Moreover, carbon forest should be planted and managed according to some special methodologies and technical standards [6]. In 2011, the SFA published instructions on carbon accounting and monitoring of forest carbon projects, used for carbon accounting and monitoring.

To achieve China's emission reduction targets for 2020, the NDRC published the Interim Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading [19], which sets the rules for using certified emission reductions, including those generated from forestry projects, as offset credits by enterprises in seven pilot emission trading markets (Hubei Province, Guangdong Province, Beijing, Shanghai, Tianjin, Chongqing, and Shenzhen). The NDRC has approved five forestry Voluntary Emission Reduction (VER) methodologies [20]. These include afforestation and reforestation (AR), afforestation and reforestation with bamboo (ARB), forest management methodology (FM), small-scale ecological restoration in non-coal mine area methodology (SERNMA), and bamboo forest management methodology (BFM). SFA published, in 2015, the guidelines for validation and verification of forest carbon projects for VER carbon forest projects implemented and traded in China.

The regulations of SFA and NDRC on carbon forest differ from the requirements of CDM on several points. Firstly, CDM projects are limited to afforestation/reforestation of land that did not contain any forest by 31 December 1989. This date was postponed to 16 February 2005 in China's VER methodologies. Secondly, the forest management methodology is accepted in China's VER, but not in the CDM. Forest management activities in the methodology refer to forest structural readjustment, replacement of tree species, replanting, stand tending, rejuvenation, and comprehensive activities. This methodology is applicable in young- or middle-aged forest plantations. Thirdly, different carbon pools are recognized in China's VER. Above- and below-ground biomass carbon pools are recognized in all carbon forest projects. Forest or bamboo product carbon pools are suggested to be included for projects following the ARB and FM methodologies, the same for soil carbon pools for ARB and SERNMA projects. In reality, the bamboo products carbon pool in the only validated ARB project

in Hubei Province is included, and the soil carbon pool in the only validated SERNMA project in Beijing is also included. Finally, the technical provisions published by SFA require that carbon forest afforestation should use mixtures of native broadleaf tree species, whereas CDM allows monoculture plantations with non-native species, such as Eucalyptus. The relaxation of land acquirement, the extension of admissible forestry activities, as well as the inclusion of more carbon pools help to increase the amount of certified carbon reduction and, therefore, create more incentives for investment in carbon forest projects.

3.2. CDM Forest Carbon Projects

Clean Development Mechamism project-based carbon forests are intended to take part in carbon trading. The 9th Conference of the Parties (COP) of United Nations Framework Convention On Climate Change in 2003 decided to adopt the modalities and procedures for afforestation and reforestation projects under the CDM for the first commitment period (2008–2012) of the Kyoto Protocol. Project-based carbon forest in China were initially developed within the CDM framework. Figure 3 shows the CDM project cycle-carbon forest projects need to follow these procedures before trading. In 2006, Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin was registered as the first CDM afforestation and reforestation project in China. Additionally, the reforestation of degraded land methodology applied in this project became the first CDM reforestation and afforestation project methodology approved by the CDM Executive Board. Five Chinese afforestation and reforestation projects had been registered in CDM, with a total estimated emission reduction of 4.4 Mt CO_2 eq (Table 1).

As the largest GHG emission trading system, the European Union Emission Trading Scheme announced that all CDM and Joint Implementation (JI) project types are eligible, except those from land use, land-use change, and forestry activities during the second phase (2008–2012). Since 2013, no new CDM forest project has been implemented in China.

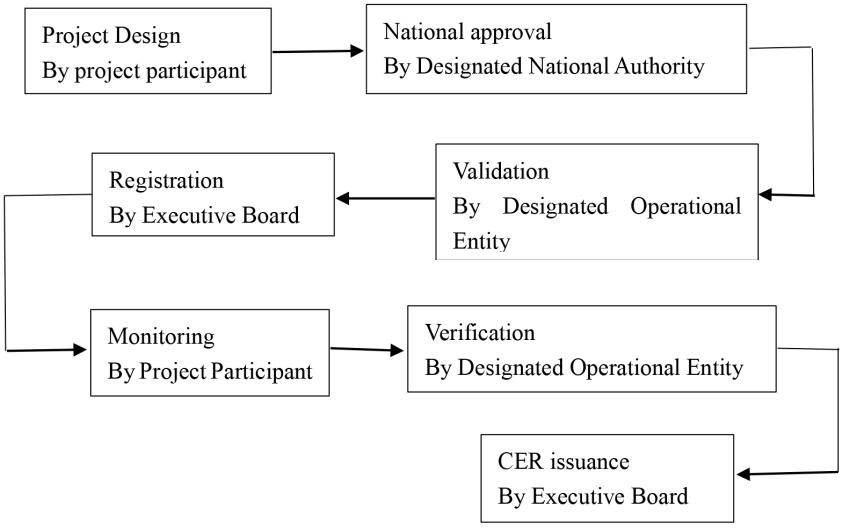

Figure 3. The Clean Development Mechanism (CDM) project cycle [21]. CER: Certified Emission Reduction.

Table 1. Registered CDM afforestation and reforestation projects from China [22].

Project Title	Registration Date	Project Period (Years)	Area (ha)	Total Estimated Emission Reductions (Ton CO_2)
Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	10 November 2006	30	2000	773,842
Afforestation and Reforestation on Degraded Lands in Northwest Sichuan, China	16 November 2009	20	2252	460,603
Reforestation on Degraded Lands in Northwest Guangxi	15 September 2010	20	8671	1,746,158
Afforestation of Degraded Shengle Ecological Zone in Helinge'er of Inner Mongolia, China	17 January 2013	30	2191	201,759
Afforestation/Reforestation on Degraded Lands in Southwest Sichuan, China	05 Febeuary 2013	30	4197	1,206,435
Total			19,281	4,388,797

3.3. Government Investment in Carbon Forests

Government investment has been one of the most important ways to develop carbon forest in China. Both the central and provincial governments have invested in planting carbon forests. In 2010, the SFA initiated a pilot carbon forest plantation project, aimed to establish 11,000 ha of carbon forests in six provinces (Inner Mongolia, Shanxi, Shaanxi, Zhejiang, Yunnan, and Guangxi) [6]. The funds came from the SFA's budget for the national key forest ecological projects and donations from society. By the end of 2013, the project had been expanded to over 20,000 ha carbon forest plantations in 18 provinces [23].

In 2011, the government of Guangdong Province launched a carbon forest plantation program. Guangdong Province, located in Southern China, is the wealthiest province in China. Guangdong's Gross Domestic Product in 2014 was 6.78 trillion CNY [24]. At the end of 2014, the forest land area in Guangdong Province was 10.96 million ha, the area of forested land was 10.83 million ha, and the standing timber volume was 547 million cubic meters [25]. The goal of the program is to establish 0.99 million ha forests devoted to carbon sequestration during 2012–2015. The program consists of artificial afforestation on 0.27 million ha, supplementary plantation on 0.22 million ha understocked forest stands, regeneration of 0.17 million ha harvested sites, and natural regeneration of 0.33 million ha barren hills. The total investment of the program was estimated to be 6.65 billion CNY, to be financed jointly by the provincial government and local governments. By the end of 2015, a total of 1 million ha carbon forests had been established within this program [26].

3.4. Carbon Forest Established Using Social Donations

In 2007, the predecessor of the China Green Carbon Foundation (CGCF) was founded and raised 300 million CNY to specifically support carbon forestry. The CGCF is the first and largest foundation in China which is targeted at increasing carbon forests to mitigate climate change. During 2010–2014, the CGCF received donations of 450 million CNY from companies, legal people, or other agencies and physical persons (Table 2). In 2008, under the sponsor of CGCF, over 800 ha of carbon forests were established in Gansu, Zhejiang, and Guangdong Provinces, and in Beijing, following the CDM methodology. By the end of 2014, CGCF had spent over 500 million CNY in planting and managing about 80,000 ha carbon forest in more than 20 provinces in China [27].

Table 2. Donations to China Green Carbon Foundation [28–32].

	Total Donations (CNY)	Physical Persons	Enterprises or Other Organizations
2014	103,259,148	7,605,748	95,653,400
2013	92,765,019	861,770	91,903,250
2012	114,919,680	701,892	114,217,788
2011	61,093,863	1,211,253	59,882,610
2010	80,034,046	5350	80,028,696

3.5. VER Carbon Forest Projects

The basic project cycle of the VER mechanism is the same as CDM projects, except that the NDRC takes the responsibility of registration and issuance of carbon credits [33]. The number of carbon forest projects validated in China's VER shows a sharply increasing trend since 2013 (Figure 4). A total of 2682 projects had been registered in the China Certified Emission Reduction (CCER) Exchange Info-platform by the end of 2016, of which 85 projects are forestry-related [34]. The total area of these 85 projects is 2,419,022 ha. The largest project (295,227 ha) is based on the forest management methodology, the smallest one (311.4 ha) is an afforestation and reforestation project located in Beijing. According to the project design documents, these projects will lead to a total amount of CO_2 reduction of 477 million ton (Table 3). Before trading in the carbon market, the CCERs need to be registered in the National Voluntary GHG Emission Reductions Transaction Registration System, which was formally launched in January 2015. This is the information management system for recording CCER's issue, transfer, and cancellation [35]. Owners of CCERs could choose to exchange in any regional carbon market in China.

The project registration and CCER issuance are the two most important steps in the project cycle. This is because the success of these two steps are directly decided by the NDRC, and other steps are the necessary conditions of these two steps. Project validation is one of the prerequisites for applying for registration. Of the 85 validated forestry projects, only 12 had been registered by the NDRC (the total number of formally registered projects was 861) by the end of 2016. The reason for this may be the long-time period of the registration process. For the first two forestry projects registered by the NDRC, the time interval between project validation and registration is over one and a half years.

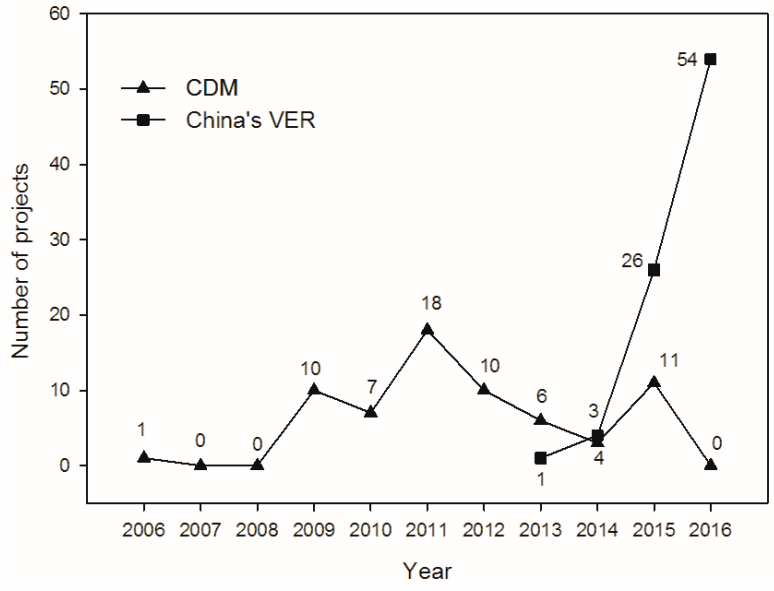

Figure 4. Number of validated CMD and China's VER (Voluntary Emission Reduction) forest carbon projects.

Table 3. Validated projects registered on the China Certified Emission Reduction Exchange info-platform [34].

Methodology	Number of Projects	Project Period (years)	Area (ha)	Estimated CO_2 Reduction (t CO_2 eq)
AR	54	20–60	539,812	149,093,678
FM	25	30–60	1,829,246	324,154,106
ARB	2	20	29,041	4,512,370
SERNMA	1	60	595	44,409
BFM	3	30	20,328	4,062,659
Total	85		2,419,022	481,867,222

Abbreviations: AR = afforestation and reforestation; ARB = afforestation and reforestation with bamboo; FM = forest management methodology; SERNMA = small-scale ecological restoration in non-coal mine area methodology; and BFM = bamboo forest management methodology. Total estimated reductions are from the project design document.

After registration, monitoring processes are required by the project participant according to the PDD. The main purpose of the monitoring process is to monitor the change of the forest carbon pool. Project monitoring and verification are one of the prerequisites for applying for CCER issuance. The Designated Operational Entity (DOE) would do the verification process when it comes to the end of each monitoring period. Among the 12 registered forestry projects, only one project had been verified and issued CCERs. Since it does not come to the end of the first monitoring period of other registered projects, according to the verification report, the CCERs verified of this project during the first monitoring period (four years) are 5208 t CO_2 eq, which is lower than the estimated CO_2 reduction in the validation report [36]. Only the emission reductions issued and generated from the registered projects by NDRC could be traded in the carbon market.

4. Challenges of Further Development of Carbon Forests

The total area of carbon forests established by the end of 2016 is about 3.5 million ha, corresponding to less than 2% of the total forest area in China. In 2014, the SFA published instructions on improving carbon forest project trading [37], aiming to increase carbon forests and fulfill the standing volume target by the end of 2030. With the development of China's emission trade system, the number of voluntary emission reduction carbon forest projects is expected to increase rapidly in the coming years, because policy-makers in China have strong motivations to make the development of carbon forests a successful story and investors remain optimistic about the profitability of carbon forests [37]. In a longer perspective, the development of carbon forests in China relying on market mechanisms is highly uncertain. According to the 8th National Forest Inventory and forestry VER methodologies, there is a great potential to expand the area of carbon forests. However, increasing costs from AR projects, uncertainty in future CCER demand and supply, and potential disputes between households and project developers would all have negative impacts on the expansion of carbon forests.

4.1. The Increasing Cost of China Certified Emission Reduction Generation from AR Projects

The cost of planting carbon forests is significantly higher than non-carbon forests in China, and is likely to increase in the future. According to our investigation in Guangdong Province, the average establishment cost is 15,000 CNY/ha for carbon forests compared to 10,500 CNY/ha for carbon forests in 2014. The higher cost for carbon forests is due to two factors. First, the administration cost of carbon forests (including project design and validation, carbon accounting and monitoring, and so on) is much higher than for non-carbon forests. Secondly, a large share of carbon forests are planted on barren mountains located in remote places. In general, the productivity of land which is available for afforestation is low. Continuous expansion of carbon forests would imply that land with even lower productivity has to be used. According to the 8th National Forest Inventory [17], two-thirds of the land available for afforestation are located in Northwest and Southwest China, with harsh site conditions and very low productivity. The cost of producing CCER credits by planting carbon forests increases as

the site productivity decreases, which would decrease the willingness of project developers to invest in forest carbon projects. Although the total of land available for afforestation is 40 million ha according to the 8th National Forest Inventory, it is unlikely that private investors will use all the land available for afforestation to establish carbon forests, due to the high cost of afforestation and low growth rate of forests on poor sites.

4.2. The Future Demand and Supply for China Certified Emission Reduction Is Highly Uncertain

The demand and supply of the CCER is highly uncertain due to the fact that both the carbon market rules and forestry VER methodologies are determined by the policy-makers. Although the number of carbon forest projects validated in China's VER shows a sharply increasing trend, the demand for the CCER issued from these projects is uncertain. Under China's pilot Emission Trading Scheme (ETS), the use of CCER credits is supposed to be supplemental to emission reduction. The pilot ETSs set a limit to which individual installations can use CCER credits to comply with the ETS. The limit is 5% for Shanghai and Beijing, 8% for Chongqing, and 10% in Guangdong, Hubei, Tianjin, and Shenzhen, of allowances. In addition, some ETS also set restrictions on the project type and project locations. The limitation is a choice of policy-makers and it affects the demand for CCER negatively. Approximately 17 million allowances worth US $100 million had been traded in all seven pilot schemes combined by March 2015 [38]. CCERs traded on the Shanghai ETS have traded up to 19.4 million tons since it began listed trading in April 2015, with a total value of CNY 341 million and an average price of CNY 17.6/t CCER [39].

Currently, carbon forests following the forest management methodology have the largest area in all five kinds of carbon forest (see Table 3). They also have the greatest expanding potential. According to the 8th National Forest Inventory, there are currently 106 million ha of young- and middle-aged forests in China [40], which could be converted to carbon forests following the forest management methodology. However, how much of the existing forest will be converted to carbon forest is also a choice of policy-makers. By adjusting the requirements for complying with the forest management methodology, policy-makers can create adequate incentives for private investors to develop carbon forests based on the forest management methodology. Yet, there is no national target regarding carbon forest development based on the forest management methodology.

4.3. Potential Disputes between Carbon Forest Project Developers and Land Owners

Currently, most of the carbon forest have been established by forest agencies, local governments, and private enterprises on forest land owned by collectives consisting of rural households. A common arrangement is that the project developer bears the investment costs and shares the benefits of the project with the land owners. After the collective forest land tenure reform in the early 2000s, the use rights of collectively-owned forest land have been allocated to member households of the collectives. However, in most cases, the affected households (owners of use rights of the land) have not participated in the planning and design of carbon forest projects. As a result, many households are disgruntled with the plantation of carbon forests on their land.

According to our survey in Guangdong Province (The survey was conducted in 2015 through interviews of 154 households in three towns in Heping County, where carbon forest projects were implemented), many households were passively involved in carbon forest project—they were not informed that carbon forests would be planted on their land. Only 41 (27%) of the respondents knew what carbon forests are. A survey conducted in Guangdong Province in 2012 showed that over 80% of the households involved in carbon forest projects were not aware of carbon forests [41]. In most cases, the affected households did not have the opportunity to negotiate with project developers about the benefit-sharing arrangement before carbon forests were planted. Instead, the project developers decided, unilaterally which benefits will go to the involved households. The typical arrangement is that the timber produced in carbon forests belongs to the households, whereas the CCER credits belong to project developers. This arrangement led to widespread dissatisfaction among involved households

with the tree species planted in the carbon forests. In Guangdong Province, carbon forest project developers usually choose local broad-leaf tree species like *Schima* spp., *Castanopsis fissa*. However, only 22 (14%) of the respondents were satisfied with the tree species and were willing to participate in managing the carbon forest. A majority of the households prefer tree species which could bring higher economic returns in the short-term, such as *Cunninghamia lanceolata*, *Pinus massoniana*. The lack of active support and participation of households could lead to serious disputes about the management of carbon forests established on collectively-owned forest lands. The investigation by Qin et al. showed that households in some places had intentions to replace the local tree species with fast-growing tree species [12].

5. Summary and Conclusions

Forestry plays an important role in China's efforts on climate change mitigation. In addition to ambiguous plans to increase the total forest area and growing stock of timber, China has developed a whole set of policies to stimulate investment in carbon forest projects. The total area of validated carbon forest reached 3.5 million ha by the end of December 2016, of which 2.4 million ha have been developed within China's Voluntary Greenhouse Gas Emission Reduction Program. At present, the area of carbon forest in China is relatively small (less than 2% of the total forest area), and the estimated emission reduction generated from the existing carbon forest is negligible compared to the total GHG emission in China. The number of VER carbon forest projects is expected to increase rapidly in the coming years. However, the development of carbon forests relying on market mechanisms in the long-term is highly uncertain due to the increasing costs from AR projects, uncertainty in future CCERs demand and supply, and potential disputes with farmers who own the land use rights.

So far, development of carbon forest has been regarded in China as an effective strategy to mitigate climate change. Despite the rapid increase of carbon forests in recent years, the sustainability and effectiveness of the strategy remains to be proved. The cost-effectiveness of carbon forest projects, rational targets of carbon forest development at regional and national levels, and the relationship between the VER mechanism and other strategies for enhancing forest resources in China are three key issues that need to be studied to ensure sound development of carbon forests.

Acknowledgments: This work was supported by the National Natural Science Fund of China (grant number 71473088).

Author Contributions: L.G. and P.G. designed the study; W.Z. and P.G. collected the data, analyzed and discussed the results; and W.Z. wrote the manuscript. All authors performed the final review of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

References

1. European Commission. Emission Database for Global Atmospheric Research (EDGAR). Available online: http://edgar.jrc.ec.europa.eu/overview.php (accessed on 30 October 2016).
2. National Development and Reform Commission of the People's Republic of China: China's Work Plan on Controlling Greenhouse Gas in the 12th Five-Year Plan. 2011. Available online: http://www.gov.cn/zwgk/2012-01/13/content_2043645.html (accessed on 7 November 2016).
3. The White House: U.S.-China Joint Announcement on Climate Change. 2014. Available online: https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change (accessed on 12 December 2016).
4. State Forestry Administration of the People's Republic of China: Action Plan for Addressing Climate Change. 2009. Available online: http://www.forestry.gov.cn/portal/xby/s/1300/content-127583.html (accessed on 3 May 2017).

5. National Development and Reform Commission of the People's Republic of China: China's Intended Nationally Determined Contributions: Enhanced Actions on Climate Change. 2015. Available online: http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China\T1\textquoterights%20INDC%20-%20on%2030%20June%202015.pdf (accessed on 14 December 2016).
6. State Forestry Administration of the People's Republic of China: State Forestry Administration Initiates Pilot Carbon Afforestation Projects in China. 2010. Available online: http://www.forestry.gov.cn/portal/yzlzl/s/1662/content-451638.html (accessed on 15 November 2016).
7. Wang, J.; Zhang, Y.; Shao, Q. Design of carbon forest in Xinjiang forest farms. *Mod. Agric. Sci. Technol.* **2011**, *12*, 220–225. (In Chinese)
8. Ye, R.; Chen, Y.; Zhang, S. Choice of tree species and afforestation method for carbon forest in Dongjiang river basin. *J. Green Sci. Technol.* **2012**, *11*, 59–60. (In Chinese)
9. Yang, H.; Zheng, H. Analysis of carbon forest management measures in Lianping City. *J. Green Sci. Technol.* **2014**, *2*, 139–140. (In Chinese)
10. Fang, X.; Gao, L. Construction of valuation index system for carbon forest in Guangdong Province. *Guangdong Agric. Sci.* **2015**, *42*, 157–162. (In Chinese)
11. Li, Q.; Lin, Z. Thoughts on carbon sequestration afforestation in Guangdong Province. *Cent. South For. Inventory Plan.* **2014**, *3*, 5–8, 11. (In Chinese)
12. Qin, J.; Gao, L.; Zhou, W. Management of risks related to carbon forest in Guangdong Province. *Guangdong Agric. Sci.* **2014**, *41*, 200–205. (In Chinese)
13. Xie, Y.; Gong, P.; Han, X.; Wen, Y. The effect of collective forestland tenure reform in China: Does land parcelization reduce forest management intensity? *J. For. Econ.* **2014**, *20*, 126–140. [CrossRef]
14. Tian, Q.; Ke, S.; Du, X.; Tian, G. Analysis of factors affecting the supply and demand of forest carbon sequestration. *Ecol. Econ.* **2013**, *2*, 168–172. (In Chinese)
15. Ning, K.; Shen, Y.; Zhu, Z. Rural households' cognition and willingness of participating in forest carbon projects: Survey of rural households in Zhejiang, Jiangxi and Fujian Provinces. *J. Beijing For. Univ.* **2014**, *13*, 63–69. (In Chinese)
16. Ming, H.; Qi, Y.; Li, Y.; Yu, W. Forest farmers' willingness to participate in CDM forest carbon projects. *J. Agrotech. Econ.* **2015**, *7*, 102–113. (In Chinese)
17. Xu, J. The 8th forest resources inventory in China: Results and analysis. *For. Econ.* **2014**, *3*, 6–8. (In Chinese)
18. State Forestry Administration: Analysis of Annual Statistic Reports of China's forestry in 2014. Available online: http://www.forestry.gov.cn/main/225/content-763186.html (accessed on 10 November 2016).
19. National Development and Reform Commission: Interim Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading. Available online: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2894.pdf (accessed on 18 November 2016).
20. China Certified Emission Reduction Exchange Info-Platform. List of registered methodology. Available online: http://cdm.ccchina.gov.cn/zylist.aspx?clmId=162 (accessed on 12 November 2016).
21. United Nations Framework Convention On Climate Change. CDM Project Cycle. Available online: https://cdm.unfccc.int/Projects/diagram.html (accessed on 12 November 2016).
22. United Nations Framework Convention On Climate Change. CDM Project Search. Available online: https://cdm.unfccc.int/Projects/projsearch.html (accessed on 12 December 2016).
23. State Forestry Administration of the People's Republic of China: The 2013 White Paper on Climate Change Mitigation Policies and Actions of the Forestry Sector in China. Available online: http://www.forestry.gov.cn/main/72/content-661422.html (accessed on 12 November 2016).
24. National Bureau of Statistics of the People's Republic of China. Available online: http://data.stats.gov.cn/index.htm (accessed on 15 December 2016).
25. Guangdong Forestry Bureau. Available online: http://www.gdf.gov.cn/index.php?controller=front&action=view&id=10084 (accessed on 18 December 2016).
26. Guangdong Forestry Bureau. Guangzhou, China. The Second Phase of the Carbon Forest Program: Construction Plan in Guangdong Province (2016–2020). 2015.
27. China Green Carbon Foundation, Introductions on China Green Carbon Foundation. Available online: http://www.thjj.org/about.html (accessed on 18 December 2016).
28. China Green Carbon Foundation Annual Reports (2010). Available online: http://www.thjj.org/sf_3BDCD35AACE1418398F80CF5E6DF3F82_227_thjj.html (accessed on 20 December 2016).

29. China Green Carbon Foundation Annual Reports (2011). Available online: http://www.thjj.org/sf_76735104CB4845F99C0DC309C1969F62_227_thjj.html (accessed on 20 December 2016).
30. China Green Carbon Foundation Annual Reports (2012). Available online: http://www.thjj.org/sf_4C467C226D124C2DAE648E682937AA13_227_thjj.html (accessed on 20 December 2016).
31. China Green Carbon Foundation Annual Reports (2013). Available online: http://www.thjj.org/sf_0998BE7152BA4273A368E4C63CACB6ED_227_thjj.html (accessed on 20 December 2016).
32. China Green Carbon Foundation Annual Reports (2014). Available online: http://www.thjj.org/sf_01AE057AD8A048B8859DE711E15EB6FF_227_D3521F8F997.html (accessed on 20 December 2016).
33. A More Specific VER Project Cycle Description. Available online: https://www.thepmr.org/system/files/documents/China\T1\textquoterights%20domestic%20offset%20scheme%20-20140226_0.pdf (accessed on 12 November 2016).
34. China Certified Emission Reduction Exchange Info-Platform. Available online: http://cdm.ccchina.gov.cn/sdxm.aspx?clmId=163 (accessed on 27 December 2016).
35. National Development and Reform Commission of the People's Republic of China: Announcement about the Operation of the National GHG Voluntary Emission Reduction Transaction Registration System. 2015. Available online: http://www.ccchina.gov.cn/archiver/ccchinacn/UpFile/Files/Default/20150504174034137668.pdf (accessed on 10 November 2016).
36. China Certified Emission Reduction Exchange Info-Platform. Available online: http://cdm.ccchina.gov.cn/zyDetail.aspx?newsId=52887&TId=169 (accessed on 6 August 2017).
37. State Forestry Administration: Instructions on Improving Carbon Forest Project Trading. Available online: http://www.forestry.gov.cn/main/72/content-675073.html (accessed on 21 November 2016).
38. World Bank: Carbon Pricing Watch 2015. Available online: http://documents.worldbank.org/curated/en/2015/05/24528977/carbon-pricing-watch-2015-advance-brief-state-trends-carbon-pricing-2015-report-released-late-2015 (accessed on 20 October 2016).
39. Shanghai Environment and Energy Exchange. Trading Date by the End of 21 December 2016. Available online: http://www.cneeex.com/ (accessed on 21 December 2016).
40. State Forestry Administration: Main Results of the 8th National Forest Inventory in China. Available online: http://www.forestry.gov.cn/main/65/content-659670.html (accessed on 5 July 2017).
41. Fang, X.; Gao, L. Affecting factors and strategies for Guangdong carbon forest projects. *Jiangsu Agric. Sci.* **2012**, *40*, 6–8. (In Chinese)