Credit Analysis of Carbon Sink Ecological Compensation in P.R.C from the Perspective of Coase Theorem: An Empirical Analysis Based on Carbon Sink Financial Projects in X Village of Guangdong and Y Village of Zhejiang

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Abstract: The deterioration of the global environment and climate makes it historically important to achieve carbon peaking and carbon neutrality and plays an important role in promoting environmental protection. Among them, forestry carbon sink resources occupied an important role in China Certified Emission Reduction (CCER). While the development of carbon trading in China is still in its initial stage, the government is piloting it in some areas first, accumulating experience and gradually promoting it. This research analyzes the economic operation mechanism of the current carbon trading project such as the Green Carbon Credits, the management structure of CCER: How CCER can reduce the cost of emission reduction for enterprises and increase the flow of social wealth, how to make the development of forestry carbon sinks more widespread, and the potential directions for future development: how to make CCERs more widely available.
***Keywords*:** Carbon Neutrality, Carbon Sink, Coase Theorem, Payments for Ecological Services (PES), China Certified Emission Reductions (CCER)

In 2019, Xi Jinping, the 7th president of the People's Republic of China claims that P.R.C will reach the peak of carbon emissions in 2030 and eventually achieve the goal of carbon neutrality in 2060. Since 2020, the P.R.C government initiated different plans and projects attempting to lower the overall carbon emission in the atmosphere environment. Forest Carbon Sink is one of the major resources which are in a possession of high value of ecological compensations, especially from the aspect of reaching carbon neutrality. Based on the current research in regard to the topic of Coase Theorem and the payments for ecological compensation, the major research aspects are divided into the analysis of the relationships between transaction costs and the development of the carbon natural economy, the argument regarding the necessity and the effectiveness of authoritative intervention under the PES, the PES operational mechanisms, and the comparation among PES and other methodologies to achieve environmental externality regulations.

From the transaction cost perspective, some of the researchers claim that the cost within the process of natural resources transaction is an indispensable determinant factor in terms of payment efficiency and effectiveness. From both buyer and payer's common perspective, complicated purchasing procedures and related progress will harm the overall relationships of the general market of PES. As natural resources have been seen as special resources which cannot be valued by regular standards and common criteria, the existence of an intricate process of initiating the process of payments for ecological compensation would potentially disable the original purpose of the expected actions. Therefore, to establish and hold an effective market to promote carbon neutrality, there is an increasing demand that the overall transaction cost of carbon resources be reduced. In this way, individuals within the community will be more likely to demonstrate the willingness and the awareness to accept such PES commercial models and thus promote the actual implementation of the PES project. At this point, many researchers deem that the variation of transaction costs has a strong relationship with the feasibility of the PES program, and there are many recent types of research started to investigate more on the methodologies of how to lower the transaction cost to achieve positive externality utility maximization (Lai & Lorne, 2006). Also, a lot of researchers use Coase Theorem as solid evidence to rationale their justification in the process of illustrating the significance of transaction cost and its connection with the actual application (Aguilar-Gómez et al., 2020).

Apart from that, within the division of this research topic, the actual necessity and the effectiveness of the governmental regulations and interventions have been consistently argued for a comparatively long time. Also, there is a dispute regarding who should act as the buyers of the environmental sources. Based on the current research, there are mainly two types of buyers in the PES market including the factual users of the environmental sources or the third-party affiliation such as international agencies, NGOs, and the government. Some scholars believe that the "user-financed" mode PES program is

more effective as buyers have the related environmental information and thus can supervise and monitor the PES program's overall progress and circumstances. Also, it is easier for them to directly make related decisions about the real situation. “Government-financed” PES program, on the other hand, buyers are the third-party agencies that will not directly join and make substantial decisions regarding internal management of the PES. In this case, since the buyers normally do not have first-hand and updated information about the PES program, they do not have obvious incentives to track and monitor the status and its effectiveness, which may potentially result in an underproductive return in terms of the environmental compensation impact (Aguilar-Gómez et al., 2020; Engel et al., 2008)Nevertheless, some scholars also argue that the participation of the government or third-party involvement is an important determinant in the functionalities of reducing the PES transaction costs. As the green carbon industry requires a long-term high amount of investment and relatively high risks, the market environment of PES is still immature. Without assistance from the third-party agencies, the actual payment and transaction progress would be complicated for both direct buyers and payers to process, which not only lowers the motivation of PES but also may induce credit risks and other potential problems. Since most individuals do not have adequate information regarding the internal operation of the PES, the existence and operative subsidy provided by the authoritative organizations can empower individuals from the public sector to have more motivations and incentives to participate in such related projects. Also, to substantially apply the PES and produce a prospective impact, the government should take responsibility to establish comprehensive mechanisms for green carbon finance. Based on the Coase Theorem and the realistic circumstances, it is nearly impossible to control the transaction cost to zero or nonexistence, therefore, the consistent subsidy from the financial and policy-based are necessary for the development of PES (Tang Jijun, 2012). Meanwhile, researchers have also focused on the rationality of operational mechanisms such as performance measurements and payment flow methodologies.

Finding a sustainable method to neutralize the negative externalities caused by industrial production has been a consensus for many environmental researchers and scholars. There are several common techniques to control such harmful impacts including environmental taxes, command-and-control regulations, and integrated conservation & development projects. Based on current experience, scholars conclude that adaptation of different methodologies and plannings requires comprehensive consideration based on the country's economic development level, resource distribution, and economic development model (Engel et al., 2008)

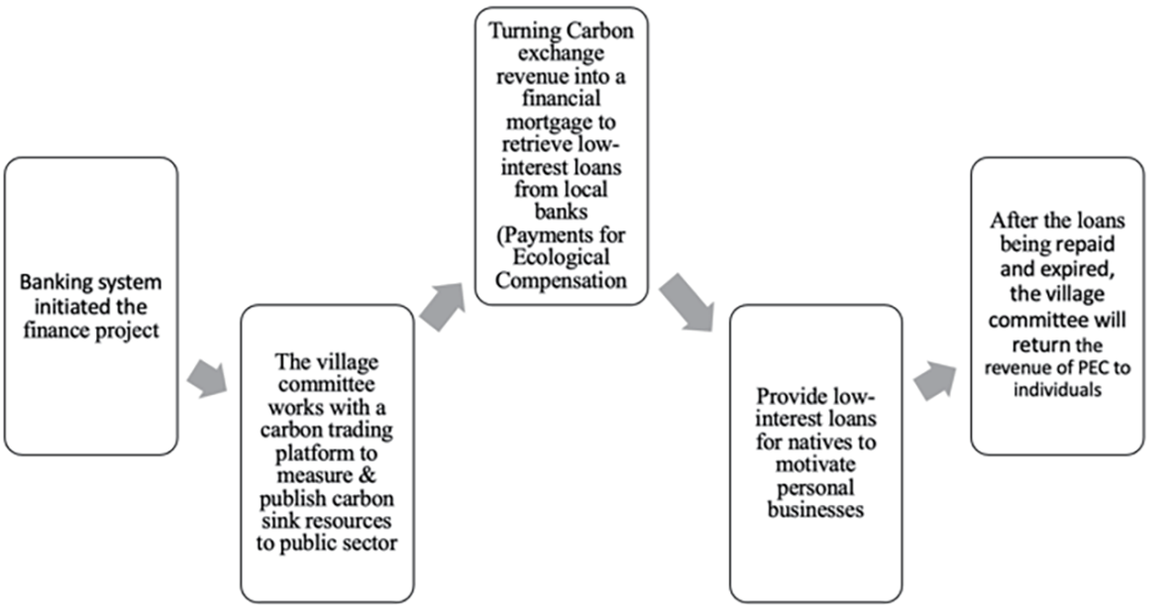
Instead of refocusing on the previous aspects mentioned above, this research will tightly focus on explaining the PES under the Coase theorem with the justification of the exemplifications from field research of Guangdong and Zhejiang of the People’s Republic of China (P.R.C).

1. General information of the field research

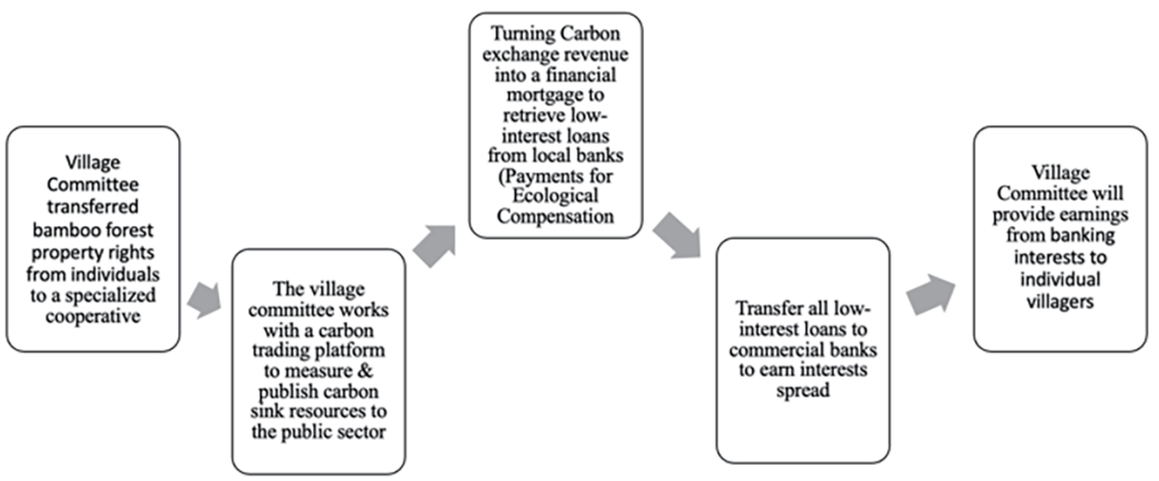
X village in Guangdong is a typical poverty-stricken village in China before the end of 2020. Y village in Zhejiang, by contrast, is one of the most well-developed and richest villages in P.R.C. Nevertheless, both X and Y villages are all in a possession of a prospective amount of carbon sink resources as X village has a lot of forestry resources and Y village has many bamboo forest resources.

In 2020, led by the People's Bank of China Zhaoqing Branch, X village initiated the carbon exchange program CCER (China Certified Emission Reductions) in Guangzhou. In this process, the volume of carbon sink will be measured, and trade those carbon sink resources on the exchange platforms. After the village committee received the exchange payment from the CCER exchange platforms in Guangzhou, they use that capital as a mortgage and retrieve a low-interest credit loan from a local rural commercial bank. Then the X village committee will use that low-interest loan as low-interest loans for business start-ups within the X village. In other words, any villagers who want to raise funds for establishing businesses that can promote the development of the village can request this green carbon loan. The repayment term is 3 years, and the interest rate is approximately 3%. After 2023, the original carbon exchange mortgage will release back to the X village committee, and they will return that income to all villagers.

In 2021, under instructions from the central government of P.R.C and financial support from the Bank of Liangshan, the Y village in Zhejiang initiated its green carbon financial program. The general process of the Y village green carbon project operations is similar to X village. The Y village committee transferred the majority of bamboo forest management rights to the bamboo carbon specialized cooperative, and it will take the major responsibility including collecting the carbon sink volume information and negotiating and establishing the carbon trading networks to complete the payments for ecological compensation. After the trading process, the village committee will transfer that capital to the Bank of Liangshan as a mortgage and retrieve the loan from the Bank. After the Y village committee gain a 30-year of a low-interest loan from the Liangshan Bank, they can either choose to transfer that capital to other commercial banks to earn the interest spread or make investments in other subjects. Eventually, the earnings from the interest spread will return to the villagers.



Guangdong X Village Green Carbon Project



Zhejiang Y Village Green Carbon Project

Figure 1. Operational Procedure Comparison of The Green Carbon Credit Program in X Village & Y

2. Case analysis under the aspect of Coase Theorem

The application of the Coase Theorem offers unique insights to analyze the operation of green carbon programs. This part of the research will analyze the cases from Guangdong and Zhejiang from the aspects of externality, property rights, ecological compensations, governmental interventions, and the minimization of transaction costs.

2.1 Externalities: rural carbon sink resources and industrial production carbon credits

Entering the 20th century, commercialization and industrialization empower human society and communities to achieve a leaping achievement. Meanwhile, the combustion of coal and fossil fuels produces a substantial number of negative impacts including carbon dioxides and other harmful emissions, a case in which factually and potentially harm the surrounding

communities and thus create negative externalities. specifically, the consequences of carbon emissions can result in air pollution, further induce health issues, destroy the ecosystem balance, and deduct sustainability in terms of development. Meanwhile, the rural carbon resources can absorb carbon dioxide from the atmosphere to compensate for the negative impact induced by industrialized productions, which provides positive externalities. In this process, industrial producers pay for their carbon emissions to exchange for the corresponding carbon sink resources, which accomplishes a form of payment for ecological compensation. Coase Theorem claims that when the property rights and parties can negotiate at a negligible cost, then the parties will be capable to negotiate an efficient solution to resolve the externality. In both cases of Guangdong and Zhejiang, the village committees are not directly made any transactions or sign agreements with industrial producers. Instead, they will upload their carbon sink information to third-party agency trading platforms. If industrial producers want to purchase a quota to compensate for their actual carbon emissions, they will complete the emission exchange with the agency instead of directly with the village committee or even the individuals. The agency will take the responsibility to supervise the environmental quality of the village forests and ensure the security of financial transactions or potential factors. With the implementation of the assigned agencies, the cost of negotiation can be potentially minimized which indicates the possibility of reaching the prospective externality.

2.2 Property rights: revenue distribution and resource affiliations

Achieving effective trading of carbon resources requires centralized resource distribution. In other words, individuals in the village cannot initiate any forms of carbon resource trading openly with buyers. Therefore, it is essential to have an interest group to lead the community. In the cases of Guangdong and Zhejiang, the village committees are taking the major responsibility to resolve the problem of forestry resource property rights. The Guangdong X village divides villagers into separate economic groups and each group possesses a specific amount of forestry land resources. In other words, the village committees own the rights to manage the forestry resources while individuals own 70% of the revenue earned from the carbon transactions, and the rest of 30% will stay at the village committee as an operation fee. In the Zhejiang Y village, by contrast, instead of managing the capital flow and the property rights of the bamboo forest via the local village committee, Y village decide to initiate and establish a new economic cooperative specialized in bamboo forest carbon exchange and transactions. The individual villagers will receive an annual packet of return including the revenue of selling bamboo and carbon trading investments. Since the 1990s, the Y village committee is responsible for persuading villagers to return the forestry bamboo resources back to the village collective. For now, most of the bamboo forest has returned to the village committee. Meanwhile, the specialized village cooperative will take charge of the financial management, regular bamboo maintenance, forestry supervision, and profits division. Nevertheless, the administrative niches of the specialized cooperative are from the village committee, which indicates that the Y village committee indirectly manipulates the procedures of the payments for ecological compensation. In the Y village, as the property rights of bamboo forests are clearly defined, the PES transaction cost has been further reduced which motivates both buyers and sellers to choose this path to minimize the negative externality induced by the industrial emissions.

2.3 Governmental intervention: minimization of transaction costs

Governmental decisions & policy-based management determine the factual costs of PES and the motivations for the aspects of buyers and sellers. From the authoritative perspective, a central-focused organization is indispensable to controlling and maintaining the operational costs of the regulations, as separate interdepartmental cooperation would potentially be inefficient and create undesirable circumstances including miscommunication and invalid cooperation. An excessive amount of departmental management is presumably to result in fragmentation of functionalities, and eventually, no departments will be able to accomplish substantial supervision and implementation. In Guangdong X village, for instance, under the management of the X village committee, the village effectively prepared and collected the materials and the information to proceed with the PES market exchange and the intervention of the village committee provides adequate credit guarantee to convince the banking institutions and Emissions exchange platforms to establish trading connections. In this case, the X village committee, as a third-party agency, integrates all the relevant subjects of the interests to minimize the communication costs and thus lower the overall transaction cost. However, due to the absence of a dominant organization, the village committee has limited access to proceed with the PES program. During the interview, the head of the X village committee expressed his concern that since the central government in recent years did not provide them with adequate support and quota access, it is difficult for them to continue the PES and they must temporarily postpone, which cause the X village unable to proceed their PES program. In the Zhejiang Y village, the village committee is tightly connected with the upper-level governmental institutions, establishing a stable bonding between the Y village and the potential PES buyers. The upper-level authoritative institutions consistently provide Y village committees with vibrant instructions and support.

Table 1. General comparison of the green carbon credit program in X village & Y

	Guangdong X Village	Zhejiang Y Village
Participating Subjects	Villagers of X Village Local Investment Bank X Village Committee Zhaoqing Branch, The People's Bank of China	Villagers of Y Village Local Investment Bank Y Village Committee Y Village Bamboo Specialized Village Cooperative
Property rights division of carbon sink resources	Villagers and the Village Committee	Villagers and the Bamboo Specialized Village Cooperative
Carbon sink trading profit distribution	The direct revenue will be distributed to 30% for the village committee and 70% for the individual villages by 2023.	A certain part of the trading revenue will be used as the operational funding of the specialized cooperative. The individual villagers will receive an annual return including the profits produced by the bamboo and related investment incomes.
Forest Type	Wood Forest	Bamboo Forest
Major PEC Program Manager	X Village Committee	Bamboo Specialized Village Cooperative
Current Progress	Completed the first transaction in 2020; Providing financial loans to villagers for investments	Keep collaborating with the governmental institutions for preparing the essential materials of PEC
Villagers Understanding of PEC program	Individuals who intended to engage in entrepreneurship knew the PEC. Normal villagers demonstrated no signs of knowing or understanding the program.	Most of the villagers know the Bamboo Specialized Village Cooperative but do not know the progress of PEC
Villagers' attitude	Supportive	Supportive
Future of the PEC Program	Temporarily postponed due to the lack of payment quota	Positive potentialities with the development of new forms of green carbon related products and insurances

3. Graphing analysis: potential economics benefits & development feasibility

Carbon trading offers businesses an opportunity to reduce carbon emission reduction costs while maintaining or improving the reduction efficiency. For instance, before the China Certified Emission Reduction (CCER) trading, company A with high emission reduction costs, and company B with low reduction costs need to collectively spend much effort to reach the reduction goal. However, after the implementation of CCER trading, the company can choose not to reduce production emissions by themselves. Instead, they can pay the reduced cost to company B to make them reduce more carbon emissions. While the total amount of carbon emission reduction did not change, the overall costs of emission reduction have been bargained.

The combination of the applied concept of carbon neutrality, PES, and its derivative financial products enables the possibilities for green industrial expansion and additional carbon trading revenue growth, which may create a win-win situation. From the perspective of the natural resource of carbon sink, it offers a substantial amount of ecological compensation resources to offset the impact of industrial carbon emissions. If the forest is well protected and managed, the forest can consistently absorb a considerable scale of carbon dioxide to protect the forest environment. From the aspect of industrial producers, there are primarily three methods for them to control carbon emissions including reducing the scale of production, improving the production technical quality, or purchasing emission quota via PES. PES delivers a unique method to fulfill the emission governmental requirement while maintaining a comparative low expenditure. There is no need for them to renovate machines or reduce the scale of production. From the villagers' view, participating in the local PES allows them to gain returns at a minimum risk. Meanwhile, the village committee will take the responsibility to supervise and maintain the forest, which also benefits the villagers as they can save on the cost of maintenance. From the aspect of banking institutions, they can release more loans to the public sector stimulating the bank and economic development. At the same time, the enterprise and the business managers can borrow money at a comparatively low-interest rate to proceed with further developments. From the stance of the government, promoting carbon sink trading can lower the carbon emission level which helps the government to achieve carbon neutrality and carbon peaking goals.

Apart from that, the existence of green carbon finance products opens a new channel for the villages to expand their revenues and thus improve their income level. Through mortgaging forestry resources and carbon trading funds, the bank

releases low-interest loans to villagers to retrieve benefits and encourage villagers to open start-up businesses to improve their income status. This process, meanwhile, drives and boosts the employment level of society. Establishing a reliable carbon sink resource exchange needs more new possible employees to push the development of the carbon neutrality industry. As the financial loan products increase investment capital flow into the village, it promotes local entrepreneurship, creating more occupation opportunities for individuals. The bank offers three types of loans in the Zhejiang Y village that cover storage and business investment. Also, the forestry property carbon exchange insurance can make sure individual villagers will not cause any financial risks or losses. With the central goal of carbon neutrality and the commitment to protect the environment, the significance of promoting PES is to effectually lower the current carbon emission level.

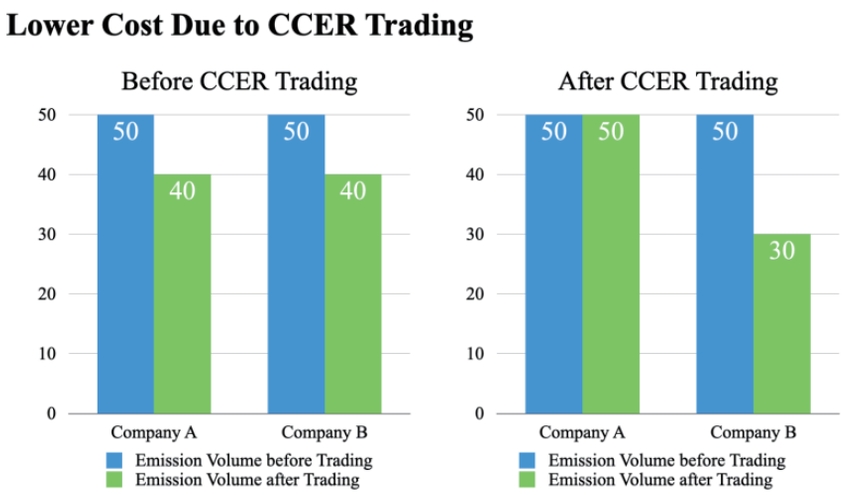


Figure 2. China certified emission reduction (CCER) cost model

4. Conclusion

Green carbon sink trading demonstrates a strong possibility in terms of the efficiency of payments for ecological compensation and the functionality of reaching carbon neutrality. Nevertheless, in the reality, the ineffectiveness of government participation disabled the maximization of the utilization of carbon trading.

(1) The operation of the green carbon exchange program is heavily dependent on authoritative instructions and financial incentives and support. While the property can be defined clearly, there is a space for the market to maximize the resources' utility. Besides, the forms of financial products are inadequate and are not able to fulfill the demands of individual customers.

(2) Since most of the population in the village are children and seniors, the willingness and the capability of innovations are comparatively low, which potentially cannot fulfill the requirement of current single financial loan products.

(3) Considering the risk of bank loans, some villagers are not willing to rent capital from the bank as they do not want to take the risks of bank loans.

In the contemporary world, lowering carbon dioxide emissions has been a consensus in the global community. The application of green carbon credits offers a unique opportunity for industrial producers to reduce emission reduction costs while fulfilling the central target of carbon peaking and neutrality. The effective operation of the entire mechanism and procedures is essential to achieve the maximization of mutual interests. With the instances from the X and Y village, the visible influences should make individuals realize the potentialities of the PES. Environmental protection cannot be achieved through paper talk, and it is time that the entire community should implement a genuine commitment to this blue planet.

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