Ecological Resource Rights Trading and Transformation Paths in the Northern Ecological Development Zone of Guangdong Province

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Abstract: The ecological region in northern Guangdong Province is an important part of the regional pattern of "one core, one belt and one area". It has obvious advantages in ecological resources, but its economy and society are relatively lagging behind. In order to achieve a higher level of regional coordination and promote common prosperity, this study discusses the transformation path of ecological resource rights and interests transactions. Research and calculate the trading potential of forest coverage indicators, pilot forestry carbon sink carbon inclusive projects and other methods, indicating that the transformation path includes forest coverage indicator trading and forestry carbon sink trading, etc., and proposes to build a forest coverage indicator trading platform and expand forestry carbon sequestration Suggestions such as the scope of carbon inclusive pilot projects.

Keywords: Rights and Interests of Ecological Resources; Transactions; Conversion Path

1. Introduction

In recent years, the Northern Ecological Development Zone of Guangdong Province has prioritized protecting and restoring the ecological environment and providing high-quality ecological products. The ecosystems of mountains, rivers, forests, farmlands, lakes, and grasslands have been well-preserved, and ecological resources have become increasingly abundant, strengthening the province's vital green barrier. The ecological resource rights trading and transformation path uses government control or quotas to confer scarcity on ecological resources, achieving efficient allocation of environmental rights and interests through market-based transactions and promoting the monetization of ecological resources. Specific practices include two pathways: forestry carbon sink trading and forest cover ratio trading [1,2].

2. Study Area

As the largest forest resource bank in Guangdong Province, the Northern Ecological Development Zone has a forest area of 4.418 million hectares and a forest volume of 270 million cubic meters, accounting for 41.9% and 43.9% of the province respectively. The forest coverage rate is 72.6%, which is much higher than the provincial average (58.7%). The air quality in areas such as Nanling National Forest Park, Wanlv Lake Scenic Area, Qingyuan Lianshan, and Yunfu Xinxing has remained excellent all year round and has been recognized as "China's Natural Oxygen Bar". In 2021, the average annual compliance rate of the air quality index (AQI) of the five cities in northern Guangdong was 96.4%, among which Meizhou, Shaoguan, Yunfu, and Heyuan ranked first, fifth, seventh, and eighth in the province respectively.

The forest ecosystems of the Northern Ecological Development Zone, typified by subtropical evergreen broad-leaved forests, nurture globally significant terrestrial biodiversity. For example, Nanling National Park boasts 5,098 wild higher plant species, accounting for 14.2% of the national total. Among these, 1,268 species are endemic to my country, representing 24.9% of the total. It also boasts 722 wild vertebrate species, representing 65.4% of the province and 16.8% of the national total. It is one of my country's priority areas for biodiversity conservation. Shaoguan is known as the "treasure trove" of Lingnan biodiversity, its superior ecological environment making it a habitat for numerous rare wildlife [3].

3. Ecological Resource Rights and Interests Trading and Conversion Paths in the Northern Ecological Development Zone

3.1 Forest Coverage Index Trading Pathway

3.1.1 Connotation and applicable areas of the conversion pathway

The forest coverage index trading path involves government-issued forest coverage targets, with regions rich in forest resources selling their surplus forest coverage indicators to regions struggling to meet them. The funds raised are used for forest resource conservation and economic development, stimulating enthusiasm for afforestation (*e.g.*, Figure 1) [4,5].

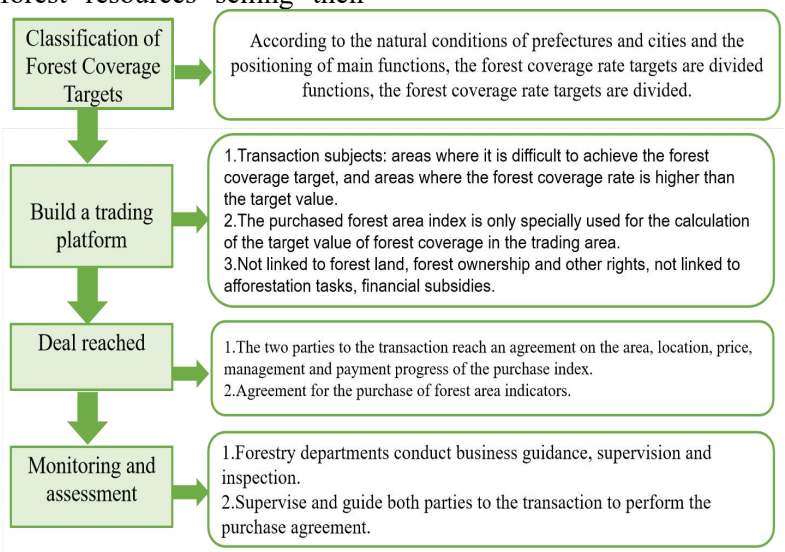

Figure 1. Schematic Diagram of Forest Coverage Index Trading

For example, Chongqing City, to increase its forest coverage, has implemented inter-district and inter-county forest coverage index trading by setting forest coverage targets, establishing a trading platform, negotiating forest area index prices and management funds, and signing purchase agreements (*e.g.*, Column 1).

Column 1: Typical Case Studies of Forest Coverage Index Trading
Chongqing, a key ecological barrier in the upper reaches of the Yangtze River, pioneered forest cover index trading nationwide. With the city's forest coverage reaching approximately 55% by 2022 as a binding target, each district and county will be assessed uniformly, clarifying the primary responsibilities of their governments. Furthermore, taking into account the differences in natural conditions, development priorities, and ecological space for production and living among districts and counties, particularly the limited land and green space in some districts and counties, counties experiencing difficulties in meeting their forest coverage targets will be permitted to purchase forest area quotas from districts and counties with higher forest coverage rates. These quotas will be used to calculate their forest coverage targets, fostering a virtuous cycle of regional ecological protection and economic and social development. The "Chongqing Municipal Work Plan for Implementing Horizontal Ecological Compensation to Increase Forest Coverage (Trial)" issued in 2018 defines forest coverage targets, establishes a trading platform, negotiates and confirms forest area quota prices, and requires purchasers to pay forest management fees and sign purchase agreements. By the end of 2021, a total of 362,000 mu (approximately 166,000 mu) of forest area quotas had been traded, totaling approximately 900 million yuan. This helped increase the forest coverage rate from 45.4% in 2018 to 54.5%. By implementing forest coverage quota trading, Chongqing has fully mobilized the enthusiasm of district and county governments to protect and develop forest resources, achieving a win-win situation for regions benefiting from ecological services and key ecological function zones. The proceeds from the sale of forest area quotas in economically underdeveloped districts and counties not only support the development of specialized economic forests, increasing production and income, but also create conditions for establishing public welfare forest protection positions, promoting local employment for impoverished households.

The forest coverage quota trading approach is generally applicable to areas with abundant forest resources and high forest coverage [6,7]. The five cities in northern Guangdong have the potential to sell forest area quotas to low-coverage areas in the Pearl River Delta, making this approach suitable for exploration.

3.1.2 Practical exploration and existing problems

Based on the forest resource situation in our province and compared with advanced regions, there is still room for improvement in our province's forest coverage rate, but the policy measures to mobilize the enthusiasm of cities and counties for greening and afforestation are relatively limited, and no exploration has been carried out on forest coverage rate indicator trading [8,9].

3.1.2.1 The overall willingness to green the land in our province is not strong, and the growth rate of forest coverage rate is low

Our province's forest coverage rate has reached a relatively high level, and the forest area and forest stock have maintained a continuous growth trend, but the growth rate is slow. From 2018 to 2021, our province's forest coverage rate increased from 58.56% to 58.74%, an increase of only 0.18 percentage points. According to the "14th Five-Year Plan for Forestry Protection and Development in Guangdong Province", by 2025, our province's forest coverage rate will increase to 58.9%. Although it has increased slightly, it is still significantly lower than national ecological civilization pilot areas such as Fujian (67%), Jiangxi (over 63.1%), Guizhou (64%) and Hainan (over 62%)[10].

3.1.2.2 Some cities and prefectures have practical difficulties in completing the afforestation area indicators.

The Northern Ecological Development Zone and the Pearl River Delta differ significantly in their forest resource endowments, and the costs of increasing forest coverage through afforestation also differ. The Northern Ecological Development Zone has "space but not funds," while the Pearl River Delta has "funds but not space." There is an urgent need to strengthen regional cooperation and complementarity, achieving a win-win situation through forest coverage quota trading and other means. This approach would both increase forest coverage across the province and address the practical difficulties faced by different regions in afforestation [11].

3.2 Forestry Carbon Trading Pathways

3.2.1 Connotation and Applicable Areas of the Conversion Pathway.

The forestry carbon trading path involves enhancing the carbon sequestration function of forest ecosystems through afforestation, reforestation, forest management, and reduced deforestation activities. This path utilizes carbon sequestration technology development and market-based approaches to participate in carbon market transactions, thereby generating additional economic value from the forestry sector[12,13]. Building on traditional forestry development and management, the carbon credit certified emission reductions (CCERs) are determined based on the carbon sequestered by forestry carbon credit projects, and are then traded on the provincial carbon emission rights trading market. This approach will open up new income channels for forest farmers and increase their enthusiasm for forestry management activities (*e.g.*, Figure2) [14].

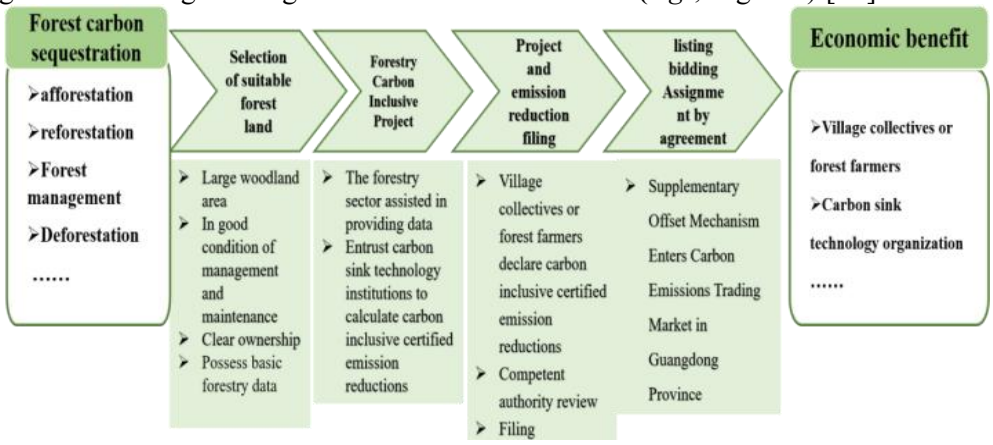

Figure 2. Schematic Diagram of Forestry Carbon Sink and Carbon Credit Project Transactions

For example, pilot forestry carbon credit trading programs have been launched in Guangxi, Inner Mongolia, Fujian, Shiyan, Hubei, and the Saihanba Forest Farm in Hebei. Sanming City in Fujian has innovatively developed forestry carbon tickets and "carbon sink + finance" products, and implemented judicial "carbon sink subscription orders" Conference Carbon Neutrality In 2016, our province launched pilot forestry carbon credit programs in six cities, including Shaoguan and Heyuan, generating significant economic benefits for forestland

operators in relatively impoverished areas (e.g., Column 2).

Column 2: Ypical Case Studies of Forestry Carbon Trading
Sanming City, Fujian Province, is a national pilot demonstration zone for comprehensive collective forestry reform. With a forest stock of 182 million cubic meters and a forest coverage rate of 78.7%, the city has formulated the "Sanming City Forestry Carbon Voucher Management Measures (Trial)" to address the difficulties in trading, monetizing, and applying forestry carbon sinks. The city has developed "carbon sink + finance" products, promoted judicial "carbon sink subscription orders" and "conference carbon neutrality" initiatives, and innovated forestry carbon sink methodologies, industry frameworks, and inherent application scenarios. Sanming City has established the province's first dedicated carbon sink fund and forestry carbon neutrality fund, as well as the province's first carbon sink service agency. It has also completed the nation's first carbon sink transactions under the Voluntary Carbon Emission Reduction Standard (VCS) project and the province's first carbon sink transaction under the Fujian Forestry Carbon Offset Ratio (FFCER) project. As of 2021, Sanming City has implemented 12 forestry carbon sink projects covering 1.18 million mu (approximately 1.1 million hectares), with four projects successfully transacted for a total of 19.12 million yuan. Shaoguan City, Guangdong Province, launched a pilot program for forestry carbon credits, exploring the development of a diversified incentive mechanism for forestry carbon credits, guided by the government, supported by technical support from third-party institutions, driven by the market, and fostering public participation. By integrating the provincial-level forestry carbon credit platform with the carbon emissions trading platform, certified emission reductions from forestry carbon credits can be offset against the carbon emission quotas of provincially controlled enterprises. From June 2017 to May 2021, provincially designated impoverished villages and enterprises in Shaoguan City developed forestry carbon credits projects, totaling 1.244 million tons of certified emission reductions. The unit price increased from 11 yuan per ton in 2017 to 41.1 yuan per ton in 2021, generating 30.752 million yuan in trading revenue, accounting for two-thirds of the province's total.

The forestry carbon sink carbon credit trading path is generally applicable to cities and counties with rich forest resources, good management and protection conditions, clear forest rights ownership, and good forestry development conditions. For example, Ruyuan County, Lianping County, Lianshan County, Xinxing County and other places in the northern ecological development zone are suitable for further in-depth practice of this path.

3.2.2 Practical Exploration and Existing Problems

In order to explore the organic combination of forestry carbon sink projects and low-carbon poverty reduction, Guangdong Province has carried out pilot projects for forestry carbon sink carbon credit projects in Shaoguan, Heyuan and other cities, but the scale of transactions is still relatively small. As of August 2021, the province's cumulative forestry carbon sink transaction volume was 4.205 million tons, with a transaction amount of 83.612 million yuan.

3.2.2.1 The pilot conditions are demanding and the scale of the carbon credit market is limited

The owners of registered national Certified Emission Reduction (CCER) carbon sink projects are generally large forestry farms, and the project forestland must be extensive. The pilot areas for carbon credit Certified Emission Reduction (PHCER) in our province are limited to ecological development areas identified in the main functional area planning of the pilot areas of the carbon credit system, provincially designated impoverished villages, key provincial revolutionary base areas, and ethnic minority areas, resulting in a relatively narrow scope for project development.

3.2.2.2 Insufficient efforts in variety development and limited forestry carbon sink varieties

Currently, there are only two types of forestry carbon sinks: CCER and PHCER. CCER has been suspended since 2017. PHCER in our province is mainly forestry carbon credit transactions, accounting for 95% of the cumulative transaction volume [15].

3.2.2.3 High development costs and low income for forest farmers. Existing forestry carbon sink development projects have long cycles, strict review processes, and relatively complex calculations

They mainly rely on third-party institutions (carbon sink development companies) for technical support, but the fees are high, forest farmers' income is low, and their enthusiasm is not high. According to Yunfu City, the current income of third-party institutions in carbon sink trading accounts for as much as 60-75%, which

greatly squeezes the income of forest farmers [16].

4. Discussion

4.1 Establish a Forest Coverage Index Trading Platform.

The provincial forestry department shall supervise the implementation of the transaction agreement and conduct index monitoring. Set a trading guide price, with the forest area index price not less than 1,000 yuan per mu and the forest management funds not less than 200 yuan per mu per year, and supervise that all the income from index trading is used for the protection and development of forest resources. According to estimates, the province's eligible cities and prefectures currently have about 9.75 million mu of forest area indicators available for sale, of which 8.47 million mu are in the five cities in northern Guangdong. Based on the calculation that the forest coverage rate of the eight cities in the Pearl River Delta (excluding Zhaoqing) increases by 1 percentage point, the forest area needs to be increased by about 600,000 mu, the index purchase cost needs to be paid by about 600 million yuan, and the annual forest management cost needs to be paid by about 120 million yuan (e.g., Table 1).

Table 1. Calculation of the Trading Potential of Forest Cover Indicators in Various Cities in Guangdong Province

Potential sellers	Forest coverage (%)	Potential forest area for sale (10,000 mu)	Potential transaction value(100 million yuan)	Potential buyers	Forest coverage (%)	Increase in forest area for every 1% increase in coverage(10,000 mu)	Indicator purchase cost(100 million yuan)	Annual management cost(100 million yuan)
Shaoguan	74.43	260	26	Guangzhou	41.6	10.9	1.09	0.22
Heyuan	73.18	192	19.2	Shenzhen	39.78	3	0.3	0.06
Meizhou	74.48	226	22.6	Zhuhai	32.21	2.6	0.26	0.06
Qingyuan	69.63	132	13.2	Foshan	37.36	5.7	0.57	0.12
Yunfu	68.13	37	3.7	Huizhou	61.71	17	1.7	0.34
Zhaoqing	70.73	128	12.8	Dongguan	36.38	3.7	0.37	0.08
				Zhongshan	23.1	2.7	0.27	0.06
				Jiangmen	44.6	14.3	1.43	0.28
Total	——	975	97.5	Total	——	59.8	5.98	1.22

4.2 Reasonably Determine Forest Coverage Targets for Each City

Taking Fujian, Jiangxi, Zhejiang and other provinces as benchmarks, we will thoroughly implement a new round of Guangdong Greening Campaign. By 2035, the province's forest coverage rate is expected to increase to 60%, requiring an increase of approximately 3.4 million mu of forest area. Based on regional resource endowments and main functional positioning, determine forest coverage planning targets for each city, encourage each city to proactively strengthen ecological construction, and create demand for forest coverage index trading.

4.3 Formulate Forest Coverage Index Trading Rules. for Cities in the Core Area of the Pearl River Delta that Have Actual Difficulties in Achieving Forest Coverage Targets, Learn from Chongqing's Experience and Conduct Forest Coverage Index Trading

Cities with low forest coverage will voluntarily purchase forest area quotas from the five cities in northern Guangdong. The forest coverage rate of the seller after the sale should not be less than 65%. The price of forest area quotas will be determined by negotiation between the two parties. At the same time, the buyer will be required to bear the forest management expenses for no less than 15 years in principle.

4.4 Expand the Scope of the Forestry Carbon Sink Carbon Credit Pilot Program

Improve the forestry carbon sink carbon credit trading system and enrich the forestry carbon sink carbon credit methodology. Formulate a strict forestry carbon sink carbon credit project development and transaction management system, clarify the project development, transaction procedures and technical standards. Promote the forestry carbon sink carbon credit pilot program and expand the project development scope to the entire five cities in northern Guangdong in a timely manner.

4.5 Reduce Development Costs and Increase

Forest Farmers' Income

Drawing on Zhejiang's experience, the state-owned ecological resource asset management platform serves as the main body of ecological product providers, guardians, and traders, and undertakes the development and storage functions of forestry carbon sink carbon credit projects, reasonably sets forestry carbon sink storage protection prices, standardizes forestry carbon sink project development and trading procedures, controls project development costs, and guarantees forest farmers' income.

4.6 Increase the Forestry Carbon Credit Offset Quota in the Carbon Market

Appropriately increase the forestry carbon credit offset quota for carbon emissions, give priority to arranging the carbon credit certified emission reductions in the northern ecological development zone to enter the carbon emission rights trading market of our province, and use them to offset carbon emissions for emission-controlled enterprises and for non-emission-controlled enterprises and the public to achieve carbon neutrality. Encourage government agencies, enterprises, institutions, social groups, and individuals to subscribe to carbon emission reductions.

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