

The Study on the Ecological Governance Method and Green Enclave Economy Operating in Rocky Desertification Region of Northwest Guangxi

Yongling Ye¹, Jiao Fan², Songqin Ye^{3,*}

¹*Business School, Hechi University, Hechi, Guangxi, China*

²*Chongqing Vocational College of Applied Technology, Chongqing, China*

³*Financial College, Jiangxi Normal University, Nanchang, Jiangxi, China*

**Corresponding Author.*

Abstract: The karst landscapes of Northwest Guangxi are characterized by three-dimensional ecological syndromes of desertification: vertical underground leakage, horizontal surface loss, and evaporation of light and heat from the sky, making them a veritable kingdom of "karst + desertification". The study of ecological management methods and green enclave economy operation in the rocky desertification area of Northwest Guangxi will help to form a causal chain between rocky desertification and poverty in the rocky desertification area, so as to realize the successful synergistic evolution of GDP and GEP. This paper adopts the ecological value-oriented green photovoltaic and ecological agroforestry, culture and tourism and other diversified industrial integration and comprehensive governance methods in the rocky desertification area of Northwest Guangxi, and the 1+1>2 new wooden barrel corresponding to the consortium and outsourcing operation mode of the virtual enterprise development of the green enclave economy. Eventually, it has achieved the outstanding achievements that the average annual reduction rate of rocky desertification, the greening coverage rate of villages, the forest coverage rate, the growth rate of per capita disposable income, and other indicators of double carbon and enrichment of "rocky nooks and crannies" have ranked in the forefront of Guangxi and the whole country, and it is a successful sample of rocky desertification area to interrupt the chain of causality between rocky desertification and poverty, and to realize synergistic evolution of GDP and GEP.

Keywords: Rocky Desertification Region of Northwest Guangxi; Rocky Desertification; Karst; Green Enclave Economy

1. Introduction

South Stone (rocky desertification) and North Sand (desertification) evolve inversely with the dual-carbon goal. In particular, the population density of the South Stone area is high (the South Stone area is 1.5 times the national average population density and more than 15 times the population density of the North Sand area), which evolves in the reverse direction of the goal of enrichment. Ecological management of rocky desertification is not only a scientific (ecological harmony between man and nature) issue, but also a livelihood (economic harmony between man and man) issue. Northwest Guizhou is a typical Karst (Karst, also known as karst, is the rocky desertification geological "gene") landscape, karst area accounted for 49.7%, rocky desertification area accounted for 15.4%. [1] The ecological management of rocky desertification is not only a scientific (ecological harmony with nature) issue, but also a livelihood (economic harmony with people) issue. Northwest Gui desertification area (hereinafter referred to as the desertification area) is a real "karst + rocky desertification" kingdom, which poses a great challenge to the goal of double carbon and wealth. The crux of desertification in Northwest Gui lies in the fragility of karst landscape and irrational anthropogenic reclamation, which requires scientific methods for development and protection. This paper provides suggestions for the management of rocky desertification in Northwest Guizhou,

aiming to help Northwest Guizhou realize a win-win situation in terms of ecology and economy through measures such as greening management and advantageous resource development.

2. Current Situation and Thoughts on Rocky Desertification Management in Northwest Guizhou

2.1 Current Situation of the Environment and People's Livelihoods in the Rocky Desertification Areas of Northwest Guizhou

According to the meteorological and geographic zoning and the 13th Five-Year Plan for the Comprehensive Management Project of Rocky Desertification in Karst Areas, Northwest Gui is defined as Baise City and Hechi City of Guangxi, in which 10 out of 11 counties (cities and districts) in Hechi City and all of 12 counties (cities and districts) in Baise City belong to Dian-Gui-Qian Rocky Desertification Area counties; and Northwest Gui is defined as the soil erosion area of the Pearl River First Level Basin and the Hongshui River Sub-basin of the Xijiang Second Level Basin, as the Hongshui River sub-basin of the Pearl River primary basin and the Xijiang River secondary basin.

From the perspective of environmental science, comparing the results of China's four times of rocky desertification monitoring, in the 1990s, the average annual expansion rate of China's rocky desertification area was 1.9%; at the beginning of the 21st century, the average annual expansion rate of rocky desertification was 1.4%; from 2005 to 2011, the average annual shrinkage rate of rocky desertification was 1.3% (among which, the annual shrinkage rate of northwest Gui/Northwest Guangxi was 3.2%); and from 2012 to 2016, the average annual shrinkage rate of rocky desertification was 3.5% (of which the average annual shrinkage rate of Northwest Gui is 4.0%); from 2017 to 2023, the average annual shrinkage rate of rocky desertification is 7.7% (of which the average annual shrinkage rate of Northwest Gui is 7.8%).^[2] According to the authors' squatting research, Guangxi is the province (region) with the highest average annual shrinkage rate of rocky desertification among the eight provinces (regions) monitored in China, and Northwest Gui (Northwest Gui accounts for 60.7% of the rocky desertification

area in the whole region of Guangxi) is the slice of Guangxi with the highest average annual shrinkage rate of rocky desertification. Hydrological station observation shows that the national rocky desertification soil loss is reduced by 28.9% from 2017 to 2022, of which the sediment reduction in different secondary basins of the Pearl River Basin corresponding to Guangxi ranges from 25.6 to 71.0%, and the sediment reduction in Hongshui River sub-basin corresponding to Northwest Guangxi is 52.7%. The monitoring results show that the effectiveness of curbing rocky desertification and soil erosion in Northwest Guangxi is among the top in the country.^[3]

From the perspective of economy and people's livelihood, the growth rate of disposable income per capita of rural residents in the rocky desertification areas in Northwest Guizhou is higher than the national average. During the "13th Five-Year Plan" period, after deducting the price factor, the real average annual growth rate of the rocky desertification area is 10.1% (the national average growth rate is 6.0%); from 2021 to 2023, the real average annual growth rate of the rocky desertification area is 6.8% (the national average growth rate is 6.4%).^[4]

2.2 Symptoms of Rocky Desertification in Northwestern Guanxi and Ideas for Multi-dimensional Governance

2.2.1 Three-dimensional Syndrome of Rocky Desertification in Northwest Guizhou

The nature of karst landscape in Northwest Gui is a soluble rock area with shallow surface soil layer (it takes 10,000 years time unit to naturally form 1cm thick soil) and underground karst fissure, which tends to stony desertification due to water and soil erosion and difficult to produce vegetation. Vertical soil and water erosion from the scientific point of view is manifested as the vertical leakage of soil and water from the cracks of soluble rocks, horizontal soil and water erosion is manifested as the thin soil layer of karst is easily eroded horizontally by the rain into the river, and the evaporation of light and heat from the sky is manifested as the heating effect of the earth's surface, and the effect of the evaporating environment inhibits the growth of vegetation, among which the vertical soil and water erosion is the most

difficult to be solved by the rocky desertification nature, which is a "dead knot". Soil erosion from the perspective of people's livelihood is manifested as unreasonable reclamation, and man-made disturbance leads to soil loosening and accelerates vertical soil and water leakage (man-made leakage of 1cm-thick soil is only a ten-year time unit). When the karst soil layer, which has existed for ten thousand years, is "wrongly claimed from the land", the rock covered by the thin soil is exposed for a hundred years and rocky desertification is formed. Therefore, the crux of rocky desertification in Northwest Guizhou lies in the "rocky desertification gene" of karst landforms and the wrong claim to the karst fragile land. [5]

2.2.2 Ideas for Comprehensive Management of Rocky Desertification in Northwest Guizhou

Soil and water in the karst landscape of Northwest Guizhou are facing three-dimensional ecological problems of desertification: underground vertical leakage, horizontal loss on the ground, and evaporation of heat and light from the sky, and no one-dimensional management method can solve the three-dimensional ecological problems caused by "desertification genes" and "anthropogenic catalysts" in a three-dimensional way. Any one-dimensional management method cannot solve the three-dimensional ecological problems caused by "rocky desertification gene" and "man-made catalyst" in three dimensions. At the current stage of Industry 4.0 technology, from the scientific perspective, it is impossible to carry out ecological transformation of the karst landscape of 35,000km² area in Northwest Gui; from the perspective of people's livelihood, it is also impossible to ecologically immigrate the population of 3.495 million to the non-karst landscape. However, from the scientific perspective, it is possible to change from wrongly soliciting from the karst land of Northwest Guangxi (especially the rocky desertification area therein) to scientific utilization; from the livelihood perspective, it is possible to change from the pursuit of economic value by traditional agriculture to the innovative development of ecological value by eco-agriculture and non-agriculture (e.g., photovoltaic, culture and tourism, etc.). [6]

3. Sorting out Ecological Management Methods in the Rocky Desertification Area of Northwest Guangxi

Whether it is the environmental value from the perspective of science, the economic value from the perspective of people's livelihood, or the ecological value from the perspective of science and people's livelihood, the ecological management method of the rocky desertification area has been targeted, and the symptomatic management has achieved remarkable results.

3.1 Environmental Value-oriented Greening Governance in the Rocky Desertification Area of Northwest Gui

Predatory solicitation to karst fragile land with low ecological carrying capacity will result in the reverse evolution of vegetation coverage and rocky desertification; protective vegetation will form the positive evolution of vegetation coverage and rocky desertification. "Village greening coverage rate" and "forest coverage rate" are the main indicators of the effectiveness of ecological management of rocky desertification. Long-term implementation of ecological forest-grass hybrid afforestation such as "bamboo + Renzu bean", "Renzu bean + honeysuckle", mountain afforestation, returning farmland to forest project and the construction of thousand-mile green corridor of Hongshui River and green ecological barrier of rocky desertification area has made the forest accumulation and increment in rocky desertification area the first in the country. The volume and increase of forest accumulation in rocky desertification areas ranked first in the country. By the end of 2023, the greening coverage rate of villages in Guangxi was 41.1% (the greening coverage rate of villages in the whole country was 32.0% during the same period), among which, the greening coverage rate of villages in Hechi City in Northwest Gui was 47.6%, and the greening coverage rate of villages in Baise City was 46.0%, which ranked the first and the second in Guangxi, respectively. During the same period, the forest coverage rate in Guangxi was 62.6% (the national forest coverage rate was 24.0%), of which Hechi City had a forest coverage rate of 71.6% and Baise City had a forest coverage rate of 73.1%, ranking fifth and third in Guangxi. [7]

3.2 Economic Value-oriented Exploration of Advantageous Resources in the Rocky Desertification Area of Northwest Gui

Northwest Guilin has "eight mountains and one water and one field", and the karst landscape is a barren rocky mountain from the dimension of agricultural resources, and a natural scenic spot from the dimension of tourism resources. Karst landscape is suitable for developing eco-tourism and realizing non-agricultural ecological value. The development of karst landform geology, landscape, humanities and other composite resources, turning unfavorable factors into favorable factors, and realizing the maximization of non-agricultural ecological value.

Northwest Guangxi karst landscape after hundreds of millions of years of nature's ingenuity, the ghost of geological evolution, almost a collection of "stone, peaks, forests, mountains, valleys, lakes, waterfalls, springs, pools, rivers," and other elements of natural landscape resources. On the basis of natural landscape such as karst skylights, sinkholes, caves, dark rivers, etc., supplemented by elements of human resources such as health, longevity, etc., the karst landscape resources are marketed as economic benefits, people's livelihoods, and promote the integration of ecological resources development.^[8]

"The natural landscape of "Three Chinese Caves" and the longevity culture of "Shouyuan Cave" are integrated into one; Baise Buliuli River Immortal Bridge Scenic Spot (3A level scenic spot) is a collection of karst natural bridges, strange mountains and mountains, as well as the natural environment and recreation elements, such as oxygen ion. Karst Born Bridge, strange mountains, beautiful water, caves in one of the rafting and sightseeing scenic spot, the "world's largest span of Born Bridge", "Kingdom of Plants", "Bird Paradise" and other elements of natural landscape and "the first rafting in West Gui". It perfectly combines the natural landscape elements such as "the largest natural bridge in the world", "plant kingdom" and "bird paradise" with the humanistic landscape elements such as "the first rafting in western Gui" and "paradise journey".^[9]

3.3 Ecological Value-oriented Eco-agriculture in the Rocky Desertification

Area of Northwestern Gui

In the causal chain of rocky desertification and poverty, rocky desertification is the first cause, and Northwest Guizhou adheres to the comprehensive treatment of rocky desertification in terms of science and people's livelihood, and gives priority to science. That is to say, ecological value (ecological value = environmental value + economic value) oriented to realize green well-being in rocky desertification area, first green management of human-land conflicts, and then "green dividend" to promote well-being. As a result of long-term scientific evidence and practice test, the development of ecological agriculture in northwest Guilin, such as ecological mulberry, walnut, etc., is the ecological effectiveness of rocky desertification management, a one-dimensional approach. The traditional planting of corn and sweet potatoes requires annual plowing, and man-made disturbances aggravate soil erosion and rocky desertification deterioration.

Mulberry tree is an indeterminate and developed root system with a life span of more than 100 years. Planting ecological mulberry trees in "rocky nooks and crannies" is conducive to plugging vertical rock crevices, maintaining horizontal soil and water, and is an ecological crop that is a "hero" of the Northwest Gui's anti-rock industry. Hechi City is the first city of sericulture production, ecological mulberry area of 1 million mu, Baise City, up to 700,000 mu. Northwest Gui two cities were awarded the title of "China's sericulture hometown", and the formation of the rocky desertification area "mulberry-sericulture-cocoon-silk-silk" "The whole industry chain is formed in the rocky desertification area.

Walnut sees seam root, drought and barren, life 80-150 years, a hundred years of peace, is a rocky desertification area both "green landscape" "money landscape" anti-rock pioneer tree. As the strategic reserve forest of Hechi City which hides wood in Rocky Mountains, walnut has been planted in an area of 3 million mu on a large scale, realizing the Pareto improvement of environmental and economic benefits in rocky desertification areas.^[10]

3.4 Ecological Value-oriented Ecological Industry Integration in Northwest Gui

Desertification Area

The ecological forest and grassland management method in the rocky desertification area focuses on the environmental value, the karst advantageous resource exploration focuses on the economic value, the ecological value of monoecological agriculture is low, and the ecological value of multiple ecological industry integration is synergistically multiplied. Industry 4.0 is the era of intelligent and cooperative innovation, which provides technical support for the karst landscape in Northwest Gui from the one-dimensional agriculture method to the diversified industry integration method, which is conducive to the integration and development of natural resources of Northwest Gui's karst with photovoltaic, agriculture and tourism and other ecological resources, and realizes the maximization of the diversified ecological value of rocky desertification area. Northwest Gui has strong solar radiation, high temperature evaporation of water, coupled with soil erosion in karst landscape, which seriously inhibits the growth of vegetation. Photovoltaic industry turns the disadvantage of sky light and heat evaporation into the benefit of solar radiation power generation and changes the depletion of karst traditional resources into unlimited photovoltaic resources, which is naturally suitable for rocky desertification management in the dimension of light and heat evaporation. Concentrated photovoltaic panels can not only efficiently block the evaporation of light and heat from rocky desertification areas, but also incidentally buffer the vertical leakage and horizontal loss of soil and water caused by rainwater washing in rocky desertification areas. However, photovoltaic industry only solves the problem of sky evaporation and surface washing in the rocky desertification area and plays little role in correcting the ecological bias of "rocky desertification gene" of vertical leakage and horizontal loss. The integration of green photovoltaic and ecological agriculture and forestry, culture and tourism multi-dimensional industries, and the joint efforts to correct the ecological bias of "rocky desertification genes" are conducive to the three-dimensional solution to the ecological knot of three-dimensional rocky desertification in Northwest Guilin. ^[11]

4. The Operation of Green Enclave Economy in Northwest Gui Desertification Area

In the rocky desertification area, there exists the short board of "rocky desertification gene", therefore, there exist two operation concepts of self-help and other-help to solve the short board, and the other-help to solve the short board is further divided into two operation modes of short-board alliance and short-board outsourcing. In order to fill more water in the barrel, the old barrel theory is to lengthen the short board, and the new barrel theory is to lengthen the long board (with the external long board assembled into a new barrel). Rocky desertification area innate short board is a three-dimensional ecological knot, rocky desertification and poverty as a result of each other, self-help to increase the length of the short board (to take the long and make up for the short) heart is not enough, limited effectiveness. Therefore, it is necessary for him to help correct the shortcomings (to make up for the shortcomings) and block the chain of cause and effect. Northwest Guanxi to play the local (fly into the place) karst landscape natural scenery, light energy, human resources and other long board, and foreign (fly out of the place) capital, technology, e-commerce platform, such as the long board of cooperation, the composition of the $1 + 1 > 2$ new barrel corresponding to the consortium, outsourcing mode of virtual enterprise (Virtual Enterprise, the enterprise value chain of the various aspects of the business is not completed within a business, but with external organizations allied, outsourcing cooperation to complete), then we will have to help the short board to correct the short board (raise the short board), blocking the chain of cause and effect, and outsourcing cooperation), it will be able to turn the unfavorable factors of the rocky desertification area into favorable factors and develop the green enclave economy of the rocky desertification area with ecological value orientation. ^[12]

Relocation type ecological migration can only "give fish" to the livelihood of rocky desertification area, and transfer payment to make up for the shortfall can only "give fish" to the livelihood of rocky desertification area for a while, but the development of green enclave economy by virtual enterprise can "give fish" to the livelihood of rocky

desertification area, and virtual enterprise can "give fish" to the livelihood of rocky desertification area, and the development of green enclave economy by ecological value-oriented development. "A large area of rocky desertification area with green solid well-being.

Guangdong-Guangdong collaboration in northwest Gui mainly manifests itself in Shenzhen and Hechi City, Baise City, "the first rich to help the rich" development enclave economic cooperation. The author's long-term squatting research found that the development of green enclave economy practice in Northwest Gui desertification area is manifested in the operation of the new barrel virtual enterprise, specifically including the consortium and outsourcing two modes of operation.^[13]

4.1 The Consortium Model of Green Enclave Economy in Northwest Gui Desertification Area

From 2020-2023, Shenzhen Dapeng New Area will help Bama Yao Autonomous County in Hechi City (a key national rural revitalization support county, a rocky desertification mountainous area, with 30.0% of rocky mountains) to build and share the Shenzhen-Bama Special Pilot Zone of Great Health Cooperation. Initiated by Guangdong and Guizhou provincial governments, planned by Shenzhen and Hechi municipal governments, and organized and implemented by Dapeng New Area (enclave) and Bama County (enclave), the Shenzhen-Bama Pilot Zone is a successful model for the development of green enclave economy by virtual enterprises in the consortium mode under the new barrel cooperation in the rocky desertification area. Shenzhen (Dapeng) is the "fishing" party of the enclave economy consortium, and Bama is the "fishing" party of the consortium.

Shenzhen (Dapeng) gives full play to the advantages of capital (total investment of 33.9 billion yuan), technology (eco-agriculture and forestry, photovoltaic, rocky desertification ecological management and other technologies), platform (logistics 4.0, e-commerce 4.0, O2O services and other platforms) (the long board), and Bama gives full play to the karst landforms (natural landscapes, light and energy resources, and rocky desertification wasteland, which tends to

have zero opportunity cost, etc.), human resources (abundant, low-cost, hardworking), local special resources (longevity of life), and the special resources of the soil. Bama has the advantages of karst landscape (natural landscape, light energy resources, rocky desertification wasteland with zero opportunity cost, etc.), human resources (large number, low cost, hard work), local special resources (top of the longevity township, regional brand corresponding to the national geographic indications products such as Bama scented pig, Bama fire flax, Bama water, etc.), and so on (long board), and the new barrel is composed of 1+1>2 by "the first to be rich and the second to be rich. The new barrel is operated in practice in the form of "cooperative projects + cooperative bases + in-flight farmers", "out-flying companies + in-flying cooperatives + in-flying farmers" and other complexes and consortia.^[14]

4.2 Outsourcing Model of Green Enclave Economy in Northwest Guangxi Desertification Area

"Since the 14th Five-Year Plan, Longgang District of Shenzhen City has been helping Jingxi City of Baise City (a national key county for rural revitalization, with 94.64% of karst landscape area and 23.38% of rocky desertification area). Each of the 19 townships in Jingxi City has adopted the outsourcing mode of "outbound company + outbound market + inbound eco-industry + inbound farmers" to develop the green enclave economy of "10,000 enterprises helping 10,000 villages". Longgang-Jingxi industrial collaboration, industrial transfer and targeted help, adopting the outsourcing mode of virtual enterprise new barrel cooperation, construction of rocky desertification area green "enclave park". Longgang enterprises are the "fishery-granting" parties (contracting parties) of the enclave economic value chain outsourcing, and Jingxi villages and towns are the "fishery-receiving" parties (contracting parties) of the value chain outsourcing.

Relying on the policy environment of Guangdong-Guizhou Collaboration Enclave Economy ("Enclave Park" value chain financial link support), Jingxi villages and towns put "one village, one policy, one town, one industry" corresponding to the green "Enclave Park". "The complete value chain of

R&D ("Shenzhen Products" technical standards), sales ("Shenzhen Products" O2O e-commerce platform) and branding ("Shenzhen Products" brand certification to expand the market) is outsourced to Longyi Village and Town. Certification to expand the market) is outsourced to Longgang enterprises to complete, and local farmers to complete the value chain land (including karst beauty), human resources, production (planting). More than twenty Longgang-Jingxi green "enclave park", essentially more than twenty value chain externalized cooperation composed of virtual enterprises, very strong cooperation with the new barrel competitive advantage, is conducive to the promotion of Jingxi villages and towns from the traditional agriculture in the cracks of the stone difficult to survive, turn to ecological industry to achieve the stone mountain wasteland transmutation of the mountains and green land.

5. Conclusions of the study

There are three-dimensional ecological cruxes of rocky desertification in the karst landscape of Northwest Guizhou, including underground vertical leakage, horizontal loss on the ground, and evaporation of light and heat from the sky. In view of the three-dimensional rocky desertification problems caused by "rocky desertification genes" and "anthropogenic catalysts", it is worthwhile to draw lessons from the ecological management idea that takes into account the science of rocky desertification and people's livelihoods. In view of the three-dimensional desertification problem caused by the "rocky desertification gene" and the "man-made catalyst", it is worthwhile to learn from the scientific, livelihood-considering and ecological value-oriented multi-dimensional ecological governance of rocky desertification area.

At the level of ecological governance methods of rocky desertification area: (1) environmental value-oriented greening governance of rocky desertification area, realizing the double-carbon target of greening coverage rate and forest coverage rate of villages in northwest Guianxi ranking in the forefront of Guangxi and the whole country; (2) economic value-oriented discovery of advantageous resources in rocky desertification area, through the development of resources such as geology, landscape and

humanities, and the promotion of the target of getting rich through the karst characteristic resources; (3) ecological value-oriented ecological agriculture in rocky desertification area, such as ecological mulberry, walnut and other eco-agriculture that see the seams and take root, is a one-dimensional method with remarkable ecological effectiveness in rocky desertification governance; (4) ecological value-oriented ecological industrial integration in rocky desertification area, such as green photovoltaic and ecological agriculture and forestry, cultural and tourism multi-dimensional industrial integration, is a multi-dimensional method to solve three-dimensional rocky desertification syndrome in three dimensions.

Ecological governance of rocky desertification area operation level: (1) rocky desertification area "Shamba Great Health Pilot Zone" green enclave economy consortium model, the essence of $1+1>2$ new barrel corresponding to the virtual enterprise consortium, the successful implementation of the rocky desertification area green enclave economy on the ground; (2) rocky desertification area Longgang - Jingxi (2) Longgang-Jingxi green enclave economy outsourcing model of "enclave park" in rocky desertification area is a model of operation of green enclave economy in rocky desertification area by utilizing its strengths and avoiding its weaknesses, and outsourcing the virtual enterprise to develop green enclave economy cooperatively.

Guangxi is the province with the highest annual average shrinkage rate of rocky desertification in China, and northwest Guangxi is the area with the highest annual average shrinkage rate of rocky desertification in Guangxi. Northwest Guangxi rocky desertification area stops the traditional claim to the fragile land of rocky desertification, blocks the causal chain between rocky desertification and poverty, and provides research inspirations for the realization of the goals of harmony between human and natural ecological status, synergistic evolution of GDP and GEP, dual-carbon and enrichment in the nationwide rocky desertification area (with an area of karst landscape of 1.2 million km^2 , an area of rocky desertification of 101 thousand km^2 , and 220 million people suffering from rocky desertification) with a view to the

realization of the goal of double-carbon and enrichment. It provides research inspiration for the realization of the goal.

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