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In April 2019, Chinese and international partners officially launched the BRI International Green Development Coalition (BRIGC) at the Second Belt and Road Forums for International Cooperation. BRIGC aims to establish a policy dialogue and communication platform, an environmental knowledge and information platform, and a green technology exchange and transfer platform, so as to advance global consensus, understanding, cooperation, and action of a green Belt and Road Initiative (BRI).

Environmental protection cooperation such as biodiversity protection has always been an important topic of the high-quality development of the Belt and Road Initiative (BRI). These selected 11 cases include the China Ecological Conservation Red-line policy, conservation corridors of the Greater Mekong Subregion, ecological restoration of the African Great Green Wall, blue carbon insurance and ecological compensation in coastal countries like the Philippines, deforestation-free supply chain in Gabon, organic agriculture in Laos, genetic resources sharing and women empowerment in China and other countries, climate change adaptation in the Loess Plateau Region of China, and ecological poverty reduction in the karst area of southwest China.

The report summarizes the rationale and lessons behind the practices in each case. This report puts forward policy suggestions that can be upscaled and used as reference according to the specific fields involved in each case, including inclusiveness of partnership, government support, cooperation mechanism, replicability and scalability. Through analysis, this report also evaluates the synergetic development of the BRI and global biodiversity conservation, and proposes suggestions for cooperation and a future outlook on how to strengthen the coordinated development between the two.

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Executive Summary

In September 2013, Chinese President Xi Jinping put forward the concept of “The Silk Road Economic Belt” for the first time, and emphasized that “in order to make countries have closer economic ties, deeper cooperation and broader development potential, we can jointly build ‘The Silk Road Economic Belt’ with innovative cooperation modes, and gradually form regional cooperation by taking a case or two as an example for the rest of the lot to follow, promoting work in all areas through drawing upon the experience gained on key points”. As of June 30, 2021, the Chinese government has signed more than 200 cooperation documents with more than 140 countries and 32 international organizations to jointly build “The Belt and Road”. BRI participating countries have extended from Asia and Europe to Africa, Oceania, South America and North America.

The BRI promotes investing in infrastructure construction such as roads and railways, which also brings challenges to the wildlife habitat, local biodiversity and even the whole ecosystem in the BRI participating countries. On the other side, the BRI also provides opportunities for global sustainable development. The experience and practice China has gained in ecological progress can provide solutions to similar problems for the BRI participating countries.

This report was organized by the secretariat of BRIGC, with support from the Biodiversity and Ecosystems Management Thematic Partnership which includes FECO, SEC, Institute of Geographic Sciences and Natural Resources Research of Chinese Academy of Sciences, UNEP-IEMP, WWF, Conservation International (CI) and the International Union for Conservation of Nature (IUCN). Additional support from Inner Mongolia Agricultural University, Chinese Academy of Forestry, and Chinese Academy of Tropical Agricultural Sciences.

This report, through data analysis and research, demonstrates BRI related opportunity for biodiversity conservation, and showcased the implementation level experiences by cases analysis. In the case selected process, some key global report was reviewed, including the Global Biodiversity Outlook, Nature based Solutions contributions platform, Position Paper of the People’s Republic of China for the United Nations Summit on Biodiversity, Database of International Poverty Reduction Center in China. Cases from development agenda that has biodiversity co-benefits were selected, including these from perspectives like agriculture, forestry, gender equality, climate adaptation, national planning, supply-chain management, poverty reduction, eco-compensation, ecological restoration, and protected area management.

These selected 11 cases include the China Ecological Conservation Red-line policy, conservation corridors of the Greater Mekong Subregion, ecological restoration of the African Great Green Wall, blue carbon insurance and ecological compensation in coastal countries like the Philippines, deforestation-free supply chain in Gabon, organic agriculture in Laos, genetic resources sharing and women empowerment in China



and other countries, climate change adaptation in the Loess Plateau Region of China, and ecological poverty reduction in the karst area of southwest China.

In addition to the introduction of the cases, we also summarize the rationale and lessons behind the practices in each case. This report puts forward policy suggestions that can be upscaled and used as reference according to the specific fields involved in each case, including inclusiveness of partnership, government support, cooperation mechanism, replicability and scalability. Through analysis, this report also evaluates the synergetic development of the BRI and global biodiversity conservation and proposes suggestions for cooperation and a future outlook on how to strengthen the coordinated development between the two.



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Case 1. The most complete ecological spatial protection system: China's Ecological Conservation Redline

1 GENERAL INFO

LOCATION: China

IMPLEMENTATION PERIOD: Since 2011

KEY INITIATOR AND STAKEHOLDERS: the Ministry of Ecology and Environment of China, the Ministry of Natural Resources of China.

TECHNICAL SUPPORT FROM: Center for Satellite Application on Ecology and Environment, Nanjing Institute of Environmental Sciences, Chinese Research Academy of Environmental Sciences, Chinese Academy of Environmental Planning.

2 DESCRIPTIONS

2.1 Introduction

At present, human beings are experiencing an unprecedented global ecological crisis, and the decline of biodiversity and natural supply system is still worldwide continuing. The destruction and fragmentation of species habitat led by human activities aggravate the level of species endanger, resulting in the biodiversity decline sharply. The Fifth edition of Global Biodiversity Outlook comprehensively evaluated the progress in achieving the current Aichi biodiversity goals and considers that only 6 of the 20 goals have been "partially achieved" by the 2020 deadline. This has sent an alarm for human society, and there is an urgent need for global effective measures to save the earth's ecosystem and ensure human well-being.

In order to slow down the rate of extinction and biodiversity loss, establishing a conservation system is recognized globally as a relatively effective way. In 2010, at the 10th Conference of the Parties to the Convention on Biological Diversity, scientists proposed to protect at least 17% of land and inland waters, as well as at least 10% of coastal and marine areas. Conservation biologist Edward Wilson proposed in 2016 that in order to prevent the loss of biodiversity and the extinction of more species that human beings have never met, we need to protect half of the earth, that is, the "half earth" plan. Nevertheless, the area covered by the current protected area system on the earth is far smaller than the area that needs to be protected. Scientists and policy makers have reached a broad consensus on this point. In addition, as a comprehensive national policy framework, the existing protected area system not only needs to consider technical solutions, but also needs to consider the feasibility of economy, finance, and management. An excessively high proportion of protected areas faces the dilemma that it is difficult to implement. For this reason, only relying on the protected area system is difficult to achieve the scientifically proposed area targets that should be protected.

In this context, China has proposed and established an ecological conservation redline (ECR) system, providing an innovative ecological protection framework, to the management and control of important ecological spaces. Through ECR, the largest ecological protection benefits can be obtained with the smallest ecological protection area, thus the integrity of the habitat is maintained.



2.2 Case goals and characteristics

China's ECR has innovatively expanded the scope of protected areas (PA). It is not only limited to areas such as national parks, but also takes overall consideration of ecosystem functions, ecological environment fragility and biodiversity protection hotspots. The ECR emphasizes the integrity of the ecosystem, so as to achieve large-scale and integrated protection of species and habitats, and provide an innovative solution for global biodiversity conservation. ECR can not only protect important areas of biodiversity, but also includes areas with important ecological functions and ecologically fragile areas into the scope of protection, that is, protecting precious species resources and protecting human welfare from nature. Among them, areas with strong carbon sequestration capacity or potential for carbon sequestration are also included in the ECR to provide nature-based promotion for mitigating climate change.

Compared with the previously ecological protection projects, the ECR has distinctive features. First, transform from conservation of species resources to comprehensive management and control of ecological spaces. While paying attention to important ecosystems and biodiversity hotspots, the ECR also protects ecological barrier areas (such as the "Three North" shelter forests) and ecologically fragile areas (such as oasis-desert interlaced zone and river and lakeside areas) for ensuring human settlements. Second, coordinate ecological protection and social and economic development, and emphasize scientific pattern. The delimitation of the ECR aims to build a national ecological security pattern, comprehensively considers the needs of ecological protection and the spatial allocation of economic and social development, attaches importance to the connectivity and integrity of the ecosystem with top-level design. Third, launch effective protection and control. The delimitation and management of China's ECR is led by the government. In terms of planning, the ECR delimitation can use appropriate administrative means to guarantee the planning objectives; in terms of operation, there are sufficient resources and strong policies to ensure the maintenance of the designated area; in terms of management, prevention development and construction activities to control the impact on the ECR area.

2.3 Specific interventions and activities

2.3.1 Establish an ecological spatial protection model

The ECR areas are delimited based on scientific assessment methods. The identification of areas and habitats to be protected is based on a technical assessment of the benefits of nature and humans. These benefits are divided according to three criteria: protecting biodiversity, providing ecosystem services (such as providing fresh water, clean soil, and a suitable environment), and reducing disaster risks (such as preventing coastal erosion, floods, landslides, sandstorms). Although China has established various types of protected areas before, covering about 18% of the country's land area, there are still many valuable ecosystems, animals and plants that have not been effectively protected. The ECR accurately includes the habitats of all rare and endangered animals and plants into the protection scope. Adopting a "top-down" design approach, the system allows decision-makers to consider the overall situation and implement systematic management of the ECR. This brings great benefits to maintaining the integrity and connectivity of the habitat. In the specific delineation process, the connection with the "three zones and three lines" of China's land and a spatial planning (namely town space, agriculture space, ecological space, and ecological conservation redline, basic farmland boundary and urban development boundary) was considered to integrate important ecological



functions. Sensitive areas of terrestrial and marine ecological environment and vulnerable areas are all designated as ECRs. The corresponding management requirements and protection measures are formulated.

2.3.2 The top-level design of ECR at the national level

As an important task of the reform of China's ecological civilization system and an important task to be completed in the "13th Five-Year Plan", China's ECR has made rapid progress in theory, practice and effectiveness. In January 2017, the Central Office and the State Council issued the "Several Opinions on Delineating and Strictly Observing the Red Line of Ecological Protection". This is the first national reform policy document specially formulated by the Chinese government for the ECR. It is the top-level design of the ECR, which clarifies the establishment of the ECR system, and determines the work objectives and main measures of the ECR at each stage. The protection model of the ECR can be summarized by three "ones", which is to draw "one line", form "one map", and establish "one set of management and control system". To draw "one line" is to evaluate the functions of the ecosystem, to involve forests, grasslands, wetlands, and oceans with special and important ecological functions into the ECR, so as to control important ecological spaces. The formation of "one map" is based on the delimited ECR of each province, to coordinate the land and sea to avoid regional separation, to ensure the integrity of the ECRs, and to form a national "one map". The establishment of "one set of management and control system" is to follow the requirements of "no reduction in functions, no reduction in area, and no change in nature" to establish a whole-process control system that runs through "strict prevention beforehand, management during the incident, reward after the fact".



Figure 1-1 The "Several Opinions on Delineating and Strictly Managing the Ecological Conservation Redline" issued by Chinese government

2.3.3 Delimit the ECR

According to the "Several Opinions on Delimitation and Strict Management of Ecological Conservation Redline", the ecological environment department took the lead in formulating the "Ecological Conservation



Redline Delimitation Guidelines”, which clarified the technical process and methods of ecological conservation redline (ECR) delimitation, which consisted of indicators selection, scientific evaluation, implementation and comprehensive mapping. The indicator selection involves two aspects of the ecosystem function and ecological environment sensitivity. The indicators of ecosystem function include water conservation, soil conservation, sand fixation and biodiversity maintenance. The indicators of ecological environment sensitivity include soil erosion, land desertification, rocky desertification, and salinization. The scientific evaluation is applied based on resource and environmental carrying capacity and land and space development suitability, selecting appropriate models to quantitatively evaluate the above indicators, identifying areas with extremely important ecological functions as well as sensitive ecological environment, in order to identify the basis for the ECR delimitation. The implementation refers to coordinating the initial scope of the ECR with the current land use and future development plans and handling the relationship between protection and development. The comprehensive mapping is based on high-precision remote sensing images and land use data. The assessment results are corrected and perfected through spatial analysis to form an ECR delimitation with clear boundaries and ecological integrity. All provinces (autonomous regions and municipalities) across China carefully organized the ECR delimitation in accordance with the requirements of the “Ecological Conservation Redline Delimitation Guidelines”. Through the scientific evaluation, in February 2018, the State Council approved the 15 provinces, including Beijing-Tianjin-Hebei, Yangtze River Economic Belt provinces and Ningxia Hui Autonomous Region to complete their ECRs. As of 2020, China has initially formed the whole map of ECR at a national scale.

For example, the Qinghai Province in the Qinghai-Tibet Plateau has allocated about 42% of its land area to the ECR based on the delimitation technology systems. The ECR constitutes an ecological protection network of “one barrier, one belt and three districts”¹, covering 100% of glaciers and permanent snow, 88.51% of lakes, 64.47% of marsh grasslands, 61.42% of wetlands, 60.17% of inland areas and 53.87% of the river water surface, protecting glaciers, snow mountains, river headwaters, forest shrubs, grassland vegetation and desert vegetation in the province. For provinces with rich biodiversity, the delimitation of ECR also improves the effectiveness of biodiversity conservation. For example, Sichuan Province is one of the provinces with the richest biodiversity in China. Based on the ECR delimitation technology system, 31.03% of the province’s area has been designated as the ECR, building a “four axis², nine core” ecological conservation Network, including Daba Mountain, Jinsha River, Ruogai Wetland and other key areas into ecological protection. 49.59% of the biodiversity conservation priority areas in Sichuan Province have been included in the ECR, covering important habitats for more than 8,000 rare wild animals and plants such as giant pandas, Sichuan

¹ “one barrier, one belt and three districts”: “One barrier” is the ecological barrier of the grassland and meadow wetland in the source of the Three Rivers; the “One Belt” is the ecological zone of Qilian Mountain glacier and water conservation; the “Three Districts” are the Qinghai Lake Grassland Wetland Ecological Function Zone, the Qaidam Desert Wetland Ecological Function Zone, and the East Hilly Biodiversity Functional Area

² Four axes: the redline area for soil conservation in the dry and hot valley of the lower reaches of the Jinsha River, the redline area for biodiversity conservation in Daba Mountain-water conservation red line area, the redline area for biodiversity conservation in southern Sichuan, and the redline area for urban drinking water sources in the basin-soil conservation red line area. Jiuhe: Yalong River Source water conservation redline area, Dadu River Source water conservation redline area, Yellow River Source water conservation redline area-Biodiversity conservation redline area, Shaluli Mountain biodiversity conservation redline area, Daxue Mountain biodiversity conservation-soil conservation redline area, Minshan biodiversity conservation-water conservation redline area, Qionglai Mountain biodiversity conservation redline area, Liangshan-Xiangling biodiversity conservation-soil conservation redline area, Jinping Mountain water conservation-soil conservation redline area.



golden monkeys, and yews, enabling more than 95% of the province's species resources to be effectively protected. For another example, starting from the dense water network and many lakes of the province, Jiangsu Province aims to build an ecological security pattern, conducts scientific assessments of the ecological environment, and identifies important areas for ecosystem services, ecological environment sensitivity and biodiversity to build the ECR. The ECR in Jiangsu Province are mainly distributed in important water conservation areas such as the Yangtze River, the Beijing-Hangzhou Grand Canal, and Taihu Lake, Hongze Lake wetland, coastal wetland and other biodiversity-rich areas, and Yilining town hills, Huaibei hills and other water conservation areas Important areas for soil and water conservation.



Figure 1-2 China's ECR surveying and demarcating practice (Source: SEC)

2.3.4 Establishing ECR supervision methods and measures

The Chinese government has established a whole-process supervision system for the ECR of "strict prevention beforehand, management during the incident, reward after the fact" to ensure that the ECR is realistic, defensible, and sustainable. The first is to incorporate the ECR into the national land and space planning and the government's comprehensive decision-making, establish the priority of the ECR in the development and protection of land and space, and prohibit new industrialization and urbanization construction projects. The second is to establish and improve the ECR monitoring network, accelerate the



construction of the national ECR supervision platform, and realize normalized supervision. The third is to strengthen law enforcement supervision, establish a normal law enforcement mechanism, enforce law regularly, punish violations of laws and regulations in accordance with the law, and ensure that all cases must be investigated and violations must be investigated. The fourth is to carry out evaluation and assessment, whose results serve as an important reference for the comprehensive evaluation, accountability, and outgoing audit of party and government leaders and leading cadres. The fifth is to establish a reward mechanism, and give preferential rewards in terms of ecological protection compensation and policy support for good protection effects.

Each province proposes practical methods and measures in terms of ECR supervision. In 2014, the Jiangsu Provincial government issued the "Interim Measures for the Supervision, Management and Assessment of Ecological Conservation Redline in Jiangsu Province" and "Rules for the Supervision, Management and Evaluation of Ecological Conservation Redline Areas in Jiangsu Province (Provisional)", which proposed principles of combination of daily supervision and annual evaluation, combination of qualitative assessment and quantitative assessment, combination of self-assessment and superior assessment. In June 2018, the Jiangsu Provincial Government issued the "Ecological Conservation Redline Plan of Jiangsu Province", which included the completion of the ECR targets, the implementation of control measures, the protection and restoration status, and the effectiveness of ecological protection into the assessment system. In 2016, Hainan Province issued the "Regulations on the Management of Ecological Conservation Redline", stating that those who violate the regulations and develop and construct disorderly constructions that constitute a crime will be held criminally responsible in accordance with the law. The regulations can build a solid legal line of defense for Hainan's ecological security. In 2019, the Ningxia Hui Autonomous Region promulgated the "Regulations on the Management of Ecological Conservation Redline", covering the delimitation and adjustment of ECRs, activity control mechanisms, restoration compensation mechanisms, control and punishment measures. The biggest highlight is in the legislation following the principle of "sticking to the bottom line and strict protection", which ensures strict protection of the ECR from four aspects: strict prevention at the source, strict control of the process, strict investigation throughout the process, and severe penalty of consequences.



Figure 1-3 Ministry of Ecology and Environment of China has issued a series of technical specifications for the ECR supervision

The national ECR supervision platform is currently under construction and adopts advanced satellite remote sensing technology to provide support for the timely detection of ecological damage. The platform has realized the acquisition, processing, storage and release of data from more than 10 high-scoring remote sensing satellites across China, laying a data foundation for supervision. An ecological interference risk assessment model has been established to identify areas with different risk levels in the ecological space. Artificial intelligence technology is integrated to form automatic change detection capabilities for ecological damage based on remote sensing image services. Technical specifications are proposed to establish a national, provincial, municipal, and county level ECR supervision account database. Consultations are conducted based on the “one whole map” of the ECR, which judge the type and degree of ecological damages found in daily monitoring, and dispatch on-site inspection according to the satellite remote sensing, drone aerial photography, ground observations and other data.

2.4 Project achievements

2.4.1 Proposing and creating a new ecological space protection model

Delimiting ECR is a major decision of the Chinese government. Compared with existing protected areas at home and abroad, the ECR system is based on ecological service supply, disaster mitigation control, and biodiversity conservation. It integrates existing types of protected areas and supplements the regions where the function of ecological services is extremely important or the ecological environment is extremely sensitive and fragile, so the composition is more comprehensive, the distribution pattern is more scientific, the regional functions are more prominent, and the control constraints are more rigid. It is a major improvement and innovation in the construction of the protected areas system. In June 2018, the Central



Committee of the CPC issued “Opinions on strengthening ecological environment protection and resolutely winning in pollution prevention and control”, and further proposed the goal that the area of ECR should account for 25% of China's total land area. Based on the important status of the ECR in the national ecological security strategy, the delimitation and strict adherence of the ECR has been incorporated into the "Environmental Protection Law of the People's Republic of China" and the "National Security Law of the People's Republic of China", and this ecological space protection model is upgraded to the legislative height. This provides a practical protection model for the promotion of global biodiversity conservation.

2.4.2 Establishing a scientific and operational ECR delimitation technology system

This is the first time that the ECR has been delimited in the world, and there is no existing method to support it. To this end, we have established a set of technical methods for delimiting ECR after repeated research to ensure national and regional ecological security. First, an ECR delimitation system was established, that is, what to protect. After careful research, an ecological protection system with important ecological function areas, ecologically fragile areas, and important areas of species resources and landscapes as the main body was established. The second is to establish a large-scale ECR delimitation method and technology based on scientific evaluation and spatial analysis. The third is to use a combination of "top-down" and "bottom-up" methods in practice, and the national level is responsible for the ECR top-level design including the establishment of a method system, formulation of technical plans, and unified delimitation procedures. The locality is responsible for the specific delimitation work to ensure that the ECR is accurately drawn, well delimited, operable and feasible.

2.4.3 Completing a map of China's ECR

In 2018, the State Council approved the ECR delimitation plan for 15 provinces in the Beijing-Tianjin-Hebei 3 provinces (cities), the Yangtze River Economic Belt 11 provinces (cities), and the Ningxia Hui Autonomous Region. The total area of ECR accounted for about 25% of the total land area of the 15 provinces. It is mainly the areas with extremely important ecological functions and extremely sensitive and fragile ecological environments, which basically cover various protected areas such as national and provincial nature reserves, forest parks, geological parks, world cultural and natural heritage, wetland parks, etc. In October 2018, the ECR delimitation plan for the remaining 16 provinces was basically formed. On the whole, the national ECR protection network has been basically completed, covering about 30% of the country's land area, and all ecologically important areas, extremely sensitive and fragile ecological environments, key protected wildlife habitats and important ecosystems are included in the scope of protection, laying a solid foundation for maintaining national and regional ecological security. Currently, the Ministry of Ecology and Environment, in collaboration with the Ministry of Natural Resources, is promoting the ECR assessment and optimization in all provinces (autonomous regions and municipalities) across the country combining the latest results of the third national land survey and the integration and optimization results of nature reserves.

2.4.4 Innovating and enriching the nature-based solution model

The ECR system proposed by China prioritizes the protection of areas with the most important ecological functions and the most sensitive ecological environment in the country, improves the solid-state capacity of the ecosystem, and provides a guarantee for mitigating climate change and maintaining biodiversity. This approach is highly compatible with the internationally accepted NBS approach. By strictly observing the ECR, the integrity, stability, and resilience of the ecosystem can be maintained and improved, and the green



barrier against climate change can be built by relying on natural forces, climate change can be adapted and slowed, and the impact of climate disaster risks can be reduced. This will promote the formation of synergy between the protection and restoration of the ecosystem and the response to climate change, and promote the harmonious coexistence of man and nature at a high level.

2.4.5 Forming an ECR management system

As an important part of the ecological civilization system, the ECR is also included in China's land and space planning reform ("Provincial Space Planning Pilot Program"), national park system ("General Program for Establishing National Park System"), and ecological protection compensation ("Opinions on Improving the Compensation Mechanism for Ecological Protection"), the nature reserve system and other major institutional reforms. Through coordination and connection with related system reforms, system synergy is formed. Integrating the ECR system into the key links and major processes of China's ecological civilization construction and economic and social development can not only promote the reform process of the ecological civilization system, but also improve the ecological civilization system. In addition, China has started to work out the management measures for ECR, trying to establish the management system for ECR in terms of the rule of law, fiscal and tax policies, standard formulation, and law enforcement, thus, to strengthen ECR management.

2.4.6 Building national ECR supervision platform

The Satellite Environment Application Center of China's Ministry of Ecology and Environment began to undertake the construction of the "National ECR Supervision Platform" in 2018. Through the integrated use of satellite remote sensing, cloud computing, geographic information systems and other technologies, the platform are building a "sky-space-land integration" ECR supervision technology system, to timely monitor and assessment human interference activities, ecosystem conditions, ecology environmental risks, and ecosystem assets in the national ECR areas. The specific construction content includes four parts: business application system, monitoring support system, standard specification system and red line supervision database. The ECR supervision business system is the core of the ECR supervision platform. It mainly uses multi-source, multi-temporal remote sensing data products and other auxiliary supporting data to monitor human interference activities, ecosystem conditions, and ecological asset conditions within the ECR, and make further evaluation and early warning, etc. All these measures are essential service of the ECR supervision work.

2.4.7 Developing an internationally oriented ECR delimitation toolkit

The practice of delimiting ECR is an important component of nature-based solutions, which has been highly recognized by the international community. It provides China's experience for improving the protected area systems proposed by the World Conservation Union (IUCN), and also provides China's scheme for fulfilling the two major conventions on Biodiversity and on Climate Change. In order to better publicize the practical experience of China's ECR, the Chinese ECR technical team and IUCN jointly developed the international version of the "ECR Delimitation Toolkit" (hereinafter referred to as the "Toolkit"), which is published as the IUCN Things. The "Toolkit" proposes an international approach to the delimitation of ECR, and it also promotes the concept, methods and tools of ECR in the global and regional ecological environmental protection planning, natural protection actions and natural resource management decision-making processes, and promote the scientific and simplified evaluation of ecosystem service functions. Government



agencies, planning departments, regional organizations, enterprises and environmentalists can use the toolkit to carry out ecological protection planning at the regional and national levels.

3 CASE ANALYSIS

ECR is an important measure to improve the effectiveness of ecological protection and maintain national ecological security in China. At present, China's ECR has been basically delimited. About 30% of the land area has been included in the ECR protection. The protection of key ecological function areas, biodiversity protection priority areas and other key areas has been enhanced. More than 95% of the national key protected species and typical ecosystems have been protected, more than 50% of the ecological function unit has been protected, and the ecological value per ECR unit area is 1.4 times the national average level. ECR can build an ecological protection network at the national level, which lays a solid foundation for the protection of China's "three regions and four belts"³ national ecological barrier pattern.

The delimitation of ECR is completely based on scientific assessment. Delimitation of ECR is based on the actual situation of ecological environment in China, and combines quantitative and qualitative methods to scientifically evaluate ecosystem function, ecological environment vulnerability and biodiversity protection. The ecosystem function indexes were chosen such as water conservation, water and soil conservation, wind and sand fixation, biodiversity maintenance. The ecological environment vulnerability indexes were chosen such as soil erosion, rocky desertification and disaster sensitivity. Based on these indexes, important ecosystem service areas, sensitive ecological environment areas and biodiversity conservation hotspots were identified. Thus, ECR was delimited based on the evaluation results.

The Chinese government attaches great importance to the ECR, takes the lead in delimiting ECR and adopts a series of measures to ensure its implementation. In terms of planning, China's ECR is listed as an important part of national land spatial planning. In terms of operation, sufficient policies are provided to ensure the maintenance of the delimited ECR areas. In terms of management, China has made rigid control measures to prevent the encroachment and destruction of the delimited ECR area by human development activities. Government departments, relevant scholars, local communities, stakeholders and other parties have participated in the process of ECR delimitation, and achieved the overall consideration of all aspects of demands. Generally speaking, ECR in China can be summarized as a government-led, top-level design, assessment first and multi-party participation case, which provides a replicable and beneficial example for other regions to carry out ecological protection planning and ecological environment management.

4 CASE SUMMARY AND POLICY SUGGESTIONS

The delimitation of ECR is an important measure to promote the ecological civilization construction and land spatial development pattern in China, which is also an important innovation of China's ecological environment protection system. At present, China is the only country in the world to delimit ECR. China should show the world its innovation and breakthrough in the ecological environment protection, especially the BRI countries. Thus, we put forward the following suggestions to promote the ECR internationally:

³ "three regions and four belts": They are the Qinghai Tibet plateau ecological barrier area, the Yellow River key ecological area, the Yangtze River key ecological area, the northeast forest zone, the northern sand control zone, the southern hilly area and the coastal zone.



4.1 Integrating ECR to the nature-based solution to adapt to climate change

"Natural-based solution" is an effective approach against climate change. Delimiting ECR is not only conducive to enhancing the ecosystem stability and resilience, and adaptability to climate change, but also conducive to conserving and enhancing the carbon sequestration function of the ecosystem and mitigating climate change. During the Climate Action Summit of the 74th UN General Assembly in September 2019, the Chinese government has submitted a proposal to the assembly "delimiting ECR to mitigation and adaptation of climate change - action initiative for Nature-based Solutions". According to the proposal, the existing practice cases have proved that the purpose of "providing larger carbon sequestration services in a smaller area" can be achieved by determining the protection area with ECR.

We suggested that the Chinese government should further promote the implementation of the initiative. We will invite the parties of the UN Convention on Climate Change, the Convention on Biological Diversity, the Convention to Combat Desertification and other international organizations, non-governmental organizations and the private sector involved in biodiversity conservation. We will call on all parties to take active action to draw lessons from ECR practices and explore the provision and implementation of nature-based solutions as action initiatives for natural solutions to climate change. The above-mentioned measures can provide solutions for the practical realization of the "Convention on Climate Change" and "Convention on Biological Diversity", and make a positive contribution to the global response to climate change and the realization of goals of the post-2020 Convention on Biological Diversity.

4.2 Introduce important carbon sink ecological function areas to achieve Chinese carbon peak and carbon neutral goals

According to the ECR proposed by China, the important ecological function areas, such as water conservation, soil and water conservation, wind prevention and sand fixation, and the ecologically sensitive areas, such as soil erosion, land desertification and rocky desertification, have basically included as important ecological functions in ECR delimitation. However, due to the absence of taking the ecological function of carbon sequestration as a separate part in the delimitation method, some important carbon sink areas have not been identified. It can be included in the ECR. According to the assessment of the current ECR delimitation results, about 45% of the important carbon sequestration function areas have been included in the scope of protection, but this proportion of delimitation is low. In addition, marine and coastal carbon sequestration can also be improved by delimiting marine ECR such as mudflats, mangroves and offshore marine reserves.

The carbon sink acts as an essential approach to mitigate climate change and achieve natural response to climate change, from both international and domestic perspectives. China's ECR policy will be the first of its kind to scientifically protect nature. The original purpose of this policy is to protect areas with important ecological functions and fragility, restore wildlife populations, and protect human welfare from nature. Now we are exploring the potential of the ECR in improving carbon sequestration capacity and mitigating climate change. The ECR incorporates important carbon sink ecological function areas such as forests, grasslands, peatlands and permafrost lands into the scope of protection, which also contributes to climate action. We will further improve the results of the ECR delineation in accordance with the goals of carbon peaking and



carbon neutrality proposed by China and contribute to China's effective response to climate change and the implementation of the United Nations Framework Convention on Climate Change.

4.3 Integrating ECR into a “Green BRI” to prevent ecological damage caused by development activities from happening in the first place

Most BRI countries are developing countries, which are in a critical period of balancing development and ecological protection. Pre-planning of protecting important ecosystems is an important means to avoid ecological disruption, and the delineation of ECR can solve this problem while reducing the ecological footprint of BRI countries. Therefore, we recommend promoting the experience and practice of China's ECR to BRI countries, promoting BRI countries to develop ECR-based policy frameworks and submitting the policy frameworks as countries' national strategies under the CBD and UNFCCC.

Although countries can and should adopt protection measures that suit their own circumstances, they can still learn a lot from China's ECR system, especially the use of scientific means for spatial planning that considers the overall ecosystem functions. We believe that China will continue the innovation and learning in the process of implementing this policy and provide experience for other countries. The "Belt and Road" initiative is a viable and ready-made way for China to share its ECR experience. China can help BRI countries to carry out ecological conservation work in a similar way as ECR delimitation.



Case 2. Biodiversity Conservation Corridors in the Greater Mekong Sub-region (GMS): Connecting Transboundary Biodiversity Conservation Efforts in a Fast Developing Region

1 GENERAL INFO

LOCATION: Transboundary Biodiversity Landscapes in the 6 GMS countries, i.e. Cambodia, People's Republic of China (Guangxi Zhuang Autonomous Region and Yunnan Province), Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam

IMPLEMENTATION PERIOD: 2005 to present: Preparatory phase (2005-2006), Phase 1 (2006–2012), Phase 2 (2012–2018), Phase 3 (2018–2022)

KEY INITIATOR AND STAKEHOLDERS: It is an initiative under the Asian Development Bank (ADB) Core Environment Program (CEP), financed by ADB; the governments of Finland, the Netherlands, and Sweden; the Nordic Development Fund; the Global Environment Facility; and in-kind contributions by GMS countries. Partners include the environment ministries of the 6 GMS countries as well as non-government organizations (NGOs) such as Fauna & Flora International, World Wide Fund for Nature (WWF), and Wildlife Conservation Society (WCS).

2 DESCRIPTION

2.1 Introduction

As one of the richest biodiversity hotspots in the world, the GMS is home to a great number of endemic species, including 430 mammals, 800 reptiles and amphibians, 1,200 birds, 1,100 fish, and 20,000 plants. Moreover, new species are still continuously discovered in the region; 2,216 new species were identified from 1997 to 2014 (WWF 2015). As the high proportion of the world's threatened species live in the region, this means many of them are critically endangered, endangered or vulnerable.

At the same time, the GMS is also one of the world's fastest growing regions. During the past few decades, the region has witnessed rapid economic growth, resulting in increased prosperity. Unfortunately, much of the economic development has flourished at the expense of natural environment, including the rich and unique biodiversity, as a result of unsustainable use of natural resources.

The loss of biodiversity from terrestrial forested areas, inland waters and coastal zones are recognised by all the GMS countries as they give priority to the issues of biodiversity and habitats. Drivers of biodiversity loss include the Asia-wide demand for wildlife, timber, and non-timber forest products; loss or fragmentation of forests caused by highway construction; clearing of forests for mining and hydropower projects; as well as increased forest exploitation due to high poverty levels.

Motivated by concerns that continued rapid economic development, especially along the ADB GMS-supported road-based economic corridors, would further threaten the already stressed ecosystems and natural habitats, the Biodiversity Conservation Corridors Initiative began in 2005. According to the GMS Strategic Framework for the Biodiversity Conservation Corridors Initiative 2005–2014, the biodiversity conservation corridors (BCCs) is defined as "areas of suitable habitat that provide links between protected



areas". The biodiversity corridors often lie in juxtaposition to the GMS economic corridors, which were approved by the GMS countries in 1998 to help accelerate the GMS development as an effective means to link production, trade and infrastructure (ADB 2016). For this reason, there are both opportunities and challenges on the effective management – conserving the natural capital while also facilitating sustainable benefits from the ecosystem services to rural communities. It needs to ensure that “while the economic corridors enhance ‘physical connectivity,’ biodiversity conservation corridors support ‘ecosystem connectivity’ to accommodate movements of species between core areas. These corridors are embedded within wider conservation landscapes, which provide services based on ecosystem functions” (ADB 2011).

2.2 Objectives, uniqueness, driving forces

Since the GMS governments prioritise biodiversity conservation as a crucial action at the regional level, the efforts have been continued with slight evolvement. The initiative has been implemented so far under 4 successive phases with the main purpose presented below:

Preparatory phase (2005-2006):

Prepare a strategic biodiversity conservation corridors development framework (2005–2014) and action plan (2005–2008) to establish and maintain high-value BCCs in the GMS

Phase 1 (2006–2012):

Establish biodiversity corridor sites to undertake ecosystem restoration and poverty reduction measures

Phase 2 (2012–2018):

Improve management of transboundary biodiversity conservation landscapes and local livelihoods and with climate change considerations

Phase 3 (2018–2022):

Build on the landscapes and livelihoods work and prioritise the sustainable management of areas with high ecosystem service values, economic growth pressures, and potential

Since ‘Biodiversity Landscapes and Livelihoods’, which focuses on transboundary biodiversity conservation and local livelihoods, is a component under the overall ADB GMS CEP, the focus has followed the overall plan of the CEP, starting from piloting period, followed by scaling up interventions and finally consolidation of activities. The focus of each phase above has been adjusted in recognition of emerging environmental challenges and opportunities as well as alignment with GMS countries’ global, regional, and national priorities.

2.3 Interventions (tools and methods)

According to the GMS Strategic Framework for the Biodiversity Conservation Corridors Initiative 2005–2014, the key roles of the BCCs are: “(1) conserving habitat for species movement and for the maintenance of viable populations, (2) conserving and enhancing ecosystem services, and (3) promoting and enhancing local community welfare through the conservation and sustainable use of natural resources” (ADB 2018). Comparing to the economic corridors, the BCCs aim to “increase system connectivity, economies of scale, integration, and efficiency” (ADB 2018). Particularly, the BCCs are “intended to consolidate and expand the



development and economic benefits derived from natural systems in protected areas and across the landscapes linking them” (ADB 2018). This is done by (1) internalizing ecosystem services and biodiversity products in the development planning process, and (2) promoting the conservation, rehabilitation, and sustainable use of their natural resources.

During the Preparatory Phase, the initiative started with conducting the BCC needs assessment and BCC feasibility assessment. These assessment reports provided solid foundation to develop the GMS BCC development strategic framework (2005–2014) and action plan (2005–2008).

The BCC needs assessment was conducted through an analysis of at least five landscape-level ecoregion projects along with spatial data overlaid with the GMS road-based economic corridors. This assessment identified ecosystem fragmentation threats and locations, as well as priority areas and prevention and mitigation measures for biodiversity conservation and sustainable use within the GMS economic corridors. The BCC feasibility assessment was conducted through field visits and input from international and national consultants as well as representatives from line agencies, conservation and development partners. The assessment investigated the ecoregional determinants of the occurrence and importance of biodiversity values and associated ecosystem services. Both assessment reports were discussed at regional workshops with a wide range of stakeholders.

Based mainly on the assessment reports, the GMS BCC development strategic framework (2005–2014) and action plan (2005–2008) were developed. The strategic framework and action plan provided in detail what is to be undertaken in Phase 1 and what is expected over the next 10 years. Specifically, the strategic framework intended to (1) identify and prioritise terrestrial biodiversity conservation corridors of strategic importance; (2) review and analyse conservation and economic development policies to be harmonized among the GMS countries for effective and sustainable functioning of the biodiversity corridors; and (3) identify an enabling governance and management arrangement for implementation of the 2005–2008 action plan. The outputs of the action plan included: (1) analysis of threats to high-value terrestrial biodiversity conservation and protected areas, with specific reference to the GMS economic corridors; (2) assessment of conservation and development policy coherence for biodiversity corridor development; and (3) analysis of institutional and management options. The BCI Strategic Framework and Action Plan were finally presented at the GMS Environment Ministers’ Meeting (EMM) in Shanghai (May 2005) and at the Second GMS Summit in Kunming (July 2005). The summit endorsed the EMM recommendation for CEP implementation on BCCs (ADB 2018).

For Phase 1, the initiative generally focused on BCCs on the ground through piloting a biodiversity conservation landscape planning approach. It mainly established eight biodiversity corridor sites and undertook poverty reduction measures at the community level in these often marginalized areas. Moreover, it also sought additional financial support to scale up activities at selected sites.

This phase started with the identification of critically important biodiversity landscapes, which are considered the most important biodiversity conservation landscapes in the GMS that are vulnerable to increased development pressures and environmental degradation. Besides, they are globally and regionally high-value biodiversity landscapes/watersheds that need to be conserved to safeguard local livelihoods and investments in energy/hydropower, transport, water and sectors that enhance food security. With support from ADB and NGO partners, the national governments identified in total nine biodiversity landscapes. From these nine landscapes, eight pilot sites were established for BCCs. They were selected based on criteria



including locating within the GMS economic corridors or their zones of influence; being of a transboundary nature with international biodiversity importance and high poverty incidence; and having potential of reducing ecosystem fragmentation by linking two or more protected areas. These sites are (1) the Cardamom Mountains (Cambodia, Thailand); (2) the Eastern Plains of Monduliri (Cambodia); (3) Ngoc Linh—Xe Sap (Viet Nam); (4) Tenasserim between Western Forest Complex and Kaeng Krachan Complex (Thailand); (5) Xe Pian—Dong Hua Sao—Dong Ampham (Lao PDR); (6) Xishuangbanna (Yunnan, China); (7) Cao Bang (Viet Nam); and (8) Jingxi (Guangxi, China). At each of the sites, the focus was to establish or enhance the corridor connecting protected areas at the site as well as to develop its sustainable use. The site activities were implemented by the government agencies with support from academic and NGO partners (e.g. WWF, WCS, IUCN). These included: (1) instituting an enabling policy environment; (2) strengthening institutional set-ups and capacities; (3) promoting participatory methods on conservation practices; and (4) developing livelihoods opportunities to reduce dependence on forest resources (GMS EOC 2011).

Among all the sites, during the Phase 1 BCC projects in three countries were also created, i.e. in Cambodia, Lao PDR, and Viet Nam. These projects also served as a basis for transboundary biodiversity conservation landscapes developed under Phase 2. Each project mainly comprised the activities involving local livelihoods, forest/biodiversity and capacity improvements. These included (1) establishment of poverty reduction/livelihood improvement interventions, particularly the commune/village revolving funds; (2) land/forest use management harmonization; (3) designing and establishment of the biodiversity corridors including physical demarcation on the ground; (4) integration of the biodiversity corridors in provincial and national biodiversity and socio-economic development plans; (5) assessment of forest/ecosystem fragmentation drivers and pressures from relevant GMS economic corridor as well as national and provincial development plans and investments; (6) assessment of climate change resilience enhancement needs of local livelihoods and ecosystems; (7) assessment of ecosystem/forest based livelihoods improvement and employment needs and opportunities; and (8) capacity assessment of local communities, institutions and provincial administration in the three countries on biodiversity corridor for the follow-up project proposal preparation (ADB 2014, Mcleod 2018).

In addition, this phase also prepared for further financial support from different sources for the next phase. Particularly, the focus was on the Global Environment Facility (GEF).

Phase 2 shifted from pilot on-the-ground interventions to a broader transboundary landscape approach. Based on the priority BCCs identified during Phase 1, Phase 2 subsequently expanded this approach to transboundary biodiversity conservation landscapes and enhanced important transboundary activities in three bi- or multi-national corridors.

From the eight sites of BCCs identified under Phase 1, in order to enhance transboundary cooperation for improving habitat connectivity and ecosystem functions while developing sustainable livelihoods for local communities, Phase 2 extended them to seven transboundary biodiversity landscapes (TBLs). These are: (1) Cardamom and Elephant Mountains (Cambodia and Thailand); (2) Central Annamites (Lao PDR and Viet Nam); (3) Eastern Plains Dry Forest (Cambodia and Viet Nam); (4) Mekong Headwaters (Lao PDR, Myanmar, Thailand and Yunnan, China); (5) Sino–Viet Nam Karst (Cao Bang, Viet Nam and Guangxi, China); (6) Tenasserim Mountains (Myanmar and Thailand); and (7) Tri-Border Forest (Cambodia, Lao PDR and Viet Nam). The overall objective was to improve TBLs management to sustain the natural capital. The activities were composed of three groups: (1) development of TBLs management strategy (e.g. assessing/updating the



biodiversity and socio-economic profile, identifying conservation areas, developing the management strategy); (2) mainstreaming the TBLs management strategy into policy planning and development; and (3) establishing monitoring framework/mechanism (e.g. identifying indicators, setting up database, sharing knowledge at regional level) (Chan 2014, GMS EOC 2017).

Importantly, Phase 2 also promoted the effective management of biodiversity conservation and joint TBL management in three critical TBLs, i.e. the Eastern Forest Complex – Cardamom Mountains landscape (Thailand and Cambodia), Mekong Headwaters (Yunnan, China and Luang Namtha, Lao PDR), and the Sino–Viet Nam Karst landscape (Guangxi, China and Cao Bang, Viet Nam). With an overall aim to enhance the performance of investments in nearby economic corridors via maintaining and enhancing the flow of ecosystem goods and services, the activities focused on joint biodiversity conservation, ecological and habitat restoration, sustainable livelihoods for local communities, and integration of climate change considerations in BCC planning. At the three TBLs, memorandums of understanding were signed between government agencies to implement the mutually agreed activities. These included biodiversity and landscape assessments to further support the TBL strategy development; joint technical meetings and knowledge sharing events; joint patrolling for forest and biodiversity protection; establishment of systems to reward local people for forest stewardship; and integration of climate change considerations in the biodiversity management and design of BCCs. The TBL management strategies and action plans for these TBLs were also formulated to propose for future cooperation.

2.4 Key results and outcomes (especially about biodiversity conservation and sustainable use)

Since its inception, the ADB GMS CEP on biodiversity conservation corridors has brought together government agencies, conservation organizations and local communities to work together on integrated biodiversity conservation and livelihoods improvement. These corridors provide vital habitats for a large number of plant and animal species as well as ecosystem services that economic development activities both threaten and depend on.

The concept of BCCs was firmly introduced and subsequently reached consensus among the GMS country leaders to adopt this innovative approach in the long term. Before the CEP BCC initiative was launched, most government officials working outside the protected area would never have heard of the corridor approach. The BCC initiative has helped protect the GMS's valuable natural capital while placing local people at the center of forest protection measures. By ensuring that local communities are active partners and beneficiaries, the interventions have directly contributed to poverty reduction. One of the most valued interventions on this is the establishment of the Village Development Funds (VDFs) in pilot villages in biodiversity conservation corridors in order to help the poorest households have access to financial support in times of need, and to be able to seize livelihood opportunities in due time. The VDFs, along with other financial support for the community infrastructure improvement, has resulted in the BCC communities having better physical infrastructure (e.g. roads, healthcare, markets, other services) than other communities. Improvement of socioeconomic conditions of the BCC communities on their financial assets was a key component of the BCC activities at local level, along with capacity building on protected area and reforestation, among others (ADB 2018).

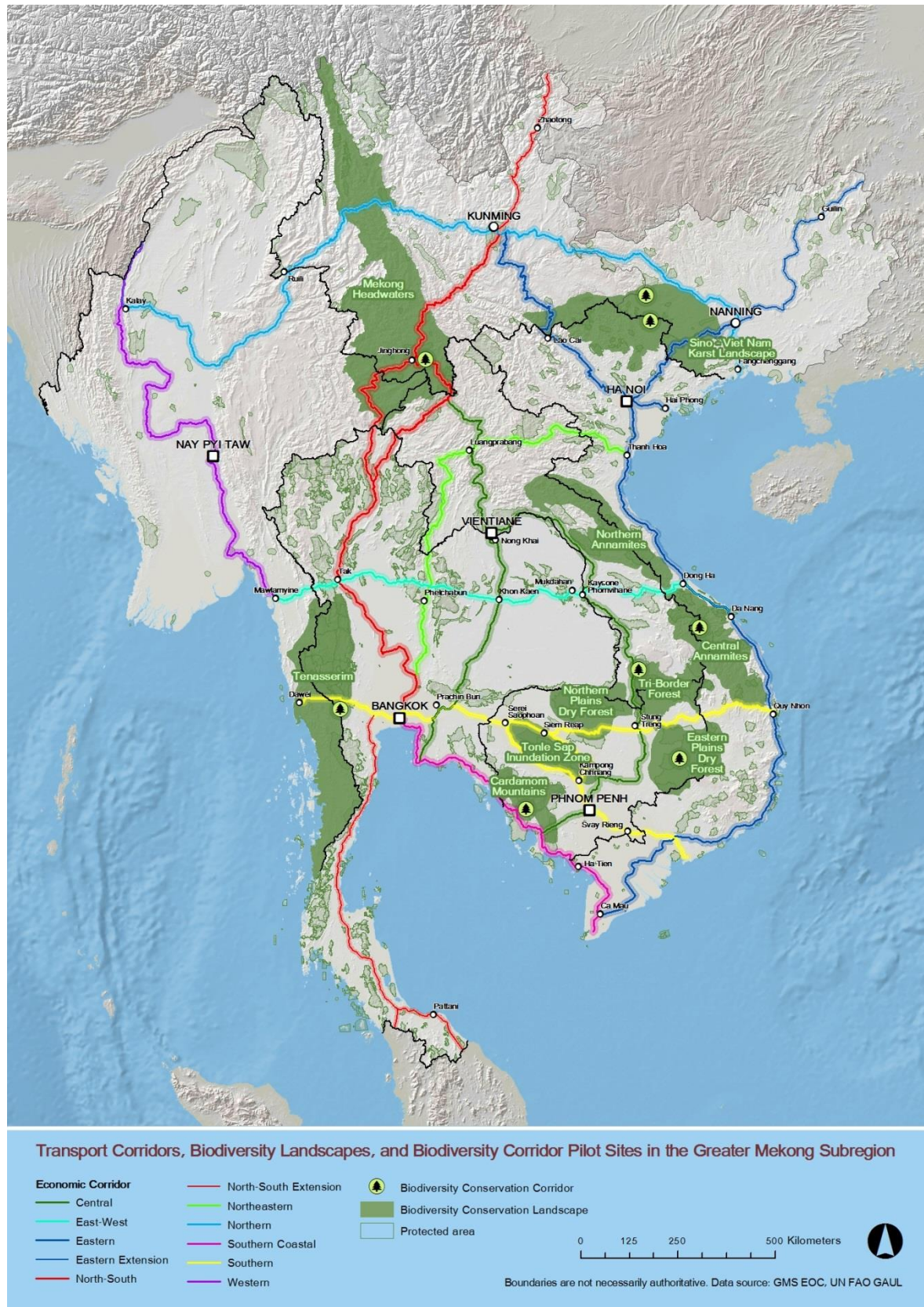


Figure 2-1: The GMS economic corridors, biodiversity landscapes and BCC pilot sites (Source: GMS EOC)



As of October 2018, the key results of the BCCs are summarised below (McLeod 2018):

- (1) The biodiversity corridor approach has been successfully introduced in the GMS. This has resulted in the better protection and management of more than 2.6 million hectares of the biodiversity corridors.
- (2) Poverty reduction interventions have benefited over 30,000 local people through infrastructure and development funds in villages and training programs.
- (3) Additional investments of \$98 million for forest and biodiversity conservation, including \$94 million under the ADB -supported Biodiversity Conservation Corridors Project, have been leveraged.
- (4) Biodiversity conservation and landscape management plans and policies have been developed or enhanced at national level to recognise biodiversity corridors. These include in: China's National Biodiversity Conservation Strategy and Action Plan (2011–2030); biodiversity strategies and action plans for Guangxi and Yunnan; Viet Nam's conservation policy approved in 2014; and Thailand's national biodiversity corridors master plan in 2012. These are in addition to the corridor-level management plans and policies that have been developed for the continuation and sustainability of the BCC interventions.
- (5) Biodiversity conservation collaboration between government agencies, conservation NGOs and local communities as well as between governments in the GMS has been strengthened.
- (6) Regional knowledge of biodiversity conservation and livelihood improvement in the GMS has been enhanced through various knowledge sharing mechanisms, including the GMS Information Portal (<http://portal.gms-eoc.org/>).



Figure 2-2: A man in Guangxi, China, with his pig farm using a loan from village development fund (left); Project staff and villagers on patrol analyzing forest-monitoring information on a tablet in Viet Nam (right) (both photo credit: GMS EOC)

3 ANALYSIS

3.1 Political ownership, collaboration, approval, policy dimension

Biodiversity conservation corridor has been one of the key components under the ADB GMS CEP since the CEP's inception. In this way, the four phases mentioned in this case study refers to the overall CEP phases, each containing BCC as a flagship theme. The CEP institutional arrangement consists of the ADB, as the



executing agency, through its GMS Environment Operations Centre (EOC). The EOC implements the CEP in coordination with the GMS government agencies and other partners, including conservation NGOs.

The CEP national implementing agencies are the GMS Working Group on Environment (WGE) country institutions in each GMS country: Ministry of Environment for Cambodia; Ministry of Natural Resources and Environment Conservation for Myanmar; Ministry of Ecology and

Environment for China; and Ministry of Natural Resources and Environment (MONRE) for Lao PDR, Thailand, and Viet Nam. Besides these WGE focal agencies, implementing agencies include other national or subnational line agencies. Moreover, each country has established the national support unit (NSU), which is institutionalized under the WGE focal agencies at national and subnational levels (mostly the ministries of environment). The NSUs assist with implementation, coordination, and reporting for the CEP activities, and liaise between the EOC and the country focal points. The EOC serves as the technical secretariat to support the WGE and provides support to the NSUs.

The WGE consists of one nominated senior government official (focal point) from the environment ministries of each of the six GMS countries. It is responsible for overall coordination and supervision of the CEP activities within the country, as well as playing a significant role in facilitating cross-sector collaboration within the participating GMS countries. The WGE meets formally twice yearly, as well as participates in other GMS events and planning processes. An important aim of CEP is to build the capacity of the WGE to better enable the group to drive regional collaboration on environment and thus the WGE are regularly engaged in capacity building activities and knowledge exchange events.

High-level consensus and decision-making can be facilitated within the GMS framework through, first of all, the semiannual WGE meetings, where the key WGE guidance and agreement are obtained to further submit to the subsequent ministerial-level conference. Every 3 years, the environment ministers from the six GMS countries gather at the “Environment Ministers’ Meeting” (EEM) to review progress, achievements and set the agenda for environmental cooperation in the subregion. The first GMS EMM was held in Shanghai in 2005 and the most recent one was the EMM-5, held in Chiang Mai in 2018. A key objective of the EMM is to facilitate high-level multi-stakeholder dialogue to further strengthen the subregional cooperation on environment. Recommendations and decisions resulted from the EMM will then be presented at the meeting of the head of the state from the GMS countries. The GMS Summit, normally held every 3 years, is the highest forum, where the leaders from the six GMS countries can provide support at the highest political level to the GMS framework, its programs, projects, and activities as well as renew their commitment to subregional cooperation and its goals, among others. An example specifically related to the BCC which is mentioned earlier is that the BCI Strategic Framework and Action Plan were presented at the EMM-1 and endorsed at the Second GMS Summit (both in 2005) for the BCI implementation. Moreover, ultimately the implementing agencies of each country are responsible for mainstreaming environmental practices.

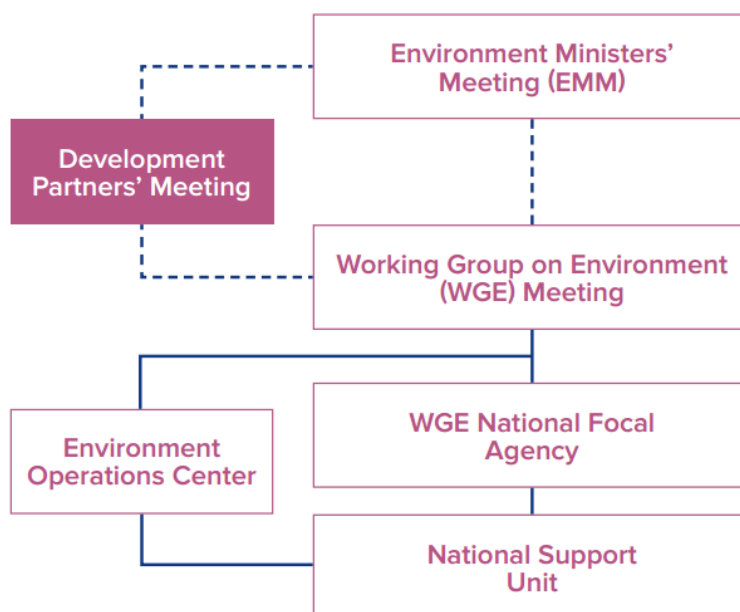


Figure 2-3: WGE organizational structure (source: GMS EOC)

Another important point to mention is that how the CEP can ensure strong country ownership. In this regard, the strategic alignment of the CEP necessitated a careful activity identification and prioritization process. To achieve this, the process used criteria based on the principles of national commitments, thematic alignment, scalability, replicability, impact, sustainability, and risk management (GMS EOC 2017). Examples of these selection criteria that are in relation to the national commitments include (1) Align with national policy directives and environmental strategies and be consistent with the country's national development plans, environmental strategies, and master plans; and (2) Contribute to international commitments of GMS countries, such as Sustainable Development Goals (SDGs), Nationally Determined Contributions under the Paris Agreement of UNFCCC, the Aichi Targets under the Convention on Biodiversity (CBD), etc. These criteria were used during country consultations for identifying the priorities in each country. Those national priorities were then evaluated to assess commonality and to determine their potential for “bundling” into broader activities, ideally with subregional and transboundary aspects. In this regard, the GMS countries have prioritised biodiversity conservation as both national and subregional significance, thus it has been a focus of the CEP from the beginning until the current phase.

3.2 Inclusiveness of partnership

Local community is placed at the heart of the BCC. This has reflected since the Preparatory Phase, as stated in the GMS Strategic Framework for the Biodiversity Conservation Corridors Initiative 2005–2014 that one of the key roles of the BCCs is to “promote and enhance local community welfare through the conservation and sustainable use of natural resources”. In order to ensure that the corridor management practices have local people at the center of forest protection measures, local communities living within the BCCs are direct beneficiaries and at the same time the main on-the-ground implementation of the forest restoration. The importance of local participation and gender is given priority since the CEP design stage. For example, one of



the CEP Phase 2 outcome indicators is “livelihoods of at least 60% of the participating households in the conservation landscapes are improved, with at least 35% of the beneficiaries being women” (ADB 2018).

All these have directly translated into the on-the-ground BCC implementation, as seen from the pilot activities. For example, the BCC projects in Cambodia, Lao PDR, and Viet Nam that started in Phase 1 focused on village/commune-based forest protection and restoration under the output “biodiversity corridors restored, protected and sustainably managed”, while the direct beneficiaries are “poor upland farmers, ethnic minority/indigenous peoples’ households, and women and children living in and dependent on the forest ecosystem in nationally acknowledged poor communes/villages in the three countries” (GMS EOC 2011). In this regard, the target communes/villages, particularly women, had participated in consultations on the intervention design and implementation throughout the project, where approximately 58 per cent of BCC beneficiaries in the three countries are indigenous peoples/ethnic minorities who are normally left behind in development initiatives. Under the project, biodiversity corridors or multiple-use areas would allow for current existing forest blocks as allocated by the three governments to remain protected under various levels of state protection. Connectivity between forest blocks would be restored as a result of broad community support obtained through proper consultation and participation modalities. This was accompanied by a series of awareness raising and capacity building activities to ensure the community support; small-scale infrastructure support (e.g. for potable water, waste management, road access); as well as a suite of livelihood improvement activities, including zoning for ethnic minorities’/indigenous peoples’ rights to access NTFPs; providing incentives, funding and technical assistance for income generation activities; establishing the commune/village development fund. Moreover, effective gender mainstreaming, led regionally by the Asian Institute of Technology, was ensured through various gender empowerment mechanisms to narrow gender disparities via, for instance, increasing access to economic and financial resources and opportunities; enhancing voices and rights; and improving access to educational, health and social services. A gender action plan was prepared to promote the empowerment of women for participation and decision-making throughout the corridor management and implementation activities.

For other groups of stakeholders, including NGOs, civil society, private sector and academic/research institutions, they have been engaged in the BCC pilot activities as well as the overall CEP mechanisms. At the pilot level, they can participate in the consultation of the project planning and implementation, as well as to take part in some of the interventions. For example, in Cambodia a local NGO partner “Cambodia Rural Development Team (CRDT)” supported the capacity building on agricultural livelihoods in some BCC villages. In Xishuangbanna (Yunnan, China), commercial insurance agreements to protect from damage caused by Asian elephants were signed in 2009 in an attempt to shift responsibility for compensating damage from wildlife from the government to a commercial company (GMS EOC 2011). As per other CEP mechanisms, there are formal meetings (e.g. the EMM) as well as thematic knowledge events organised as venues for government officials to meet business leaders, representatives of youth organizations, research institutions and development experts, among others, from the GMS. These include the topic of BCC.

3.3 Sustainability and Transferability

Certain level of sustainability on the BCC has already been demonstrated through policy and financial aspects. The biodiversity corridor management plan, which was initiated by the program, has been further raised up to the national-level biodiversity strategies and recognized in development planning policies, for



example in China, Viet Nam and Thailand, as presented earlier. Moreover, additional funding to support the continuation or expansion of the BCC activities has been sought as their own initiative (e.g. In Yunnan, China, the Investment Plan for Xishuangbanna Biodiversity Conservation 2015-2030 has been produced) or through request to the ADB (e.g. the governments of Cambodia, Lao PDR and Viet Nam requested the ADB to further design investment projects to scale up Phase 1 interventions, which resulted in the BCC projects in the three countries started in 2011). These sustainable results and impacts received from the GMS countries and development partners can primarily be attributed through firstly the design stage that aligns the topics with the national, sub-regional and international priorities, like the SDGs, UNFCCC and CBD that the GMS countries are required to meet their commitments and obligations. Secondly, capacity building has played a major role to provide the national stakeholders (e.g. the WGE and line agencies) with the skills to undertake activities on their own and assume greater ownership and resultant impacts. This also helps to facilitate cross-border interventions, knowledge sharing, and technical cooperation. Last but not least, due to the significant achievements, the BCC is now well recognized and embedded in the national-level biodiversity conservation as well as development planning policies (GMS EOC 2017). All these are important elements that the BRI and other transboundary cooperation schemes can learn from.

The success of the ADB GMS CEP BCCs could be replicated in the BRI as well as other cross-border infrastructure development initiatives. For the BRI Corridor “China-Indochina Peninsular”, which is also the location of the GMS plus mainland Malaysia, the BRI may directly build on the existing BCCs or expand the new ones to tailor to the BRI corridor routes. The BCC concept can also be replicated in other BRI corridors, especially the biologically rich ones. Fortunately, the Chinese Ministry of Ecology and Environment (MEE), which is the supervision body of the Belt and Road Initiative International Green Development Coalition (Green BRI), is also the focal ministry of the ADB GMS CEP. Therefore, internal discussion to exchange knowledge on the BCC can be a starting point. Since “biodiversity and ecosystem management” is one of the Green BRI’s thematic partnerships (Green BRI Center 2019), the existing resources (e.g. relevant database) under the ADB GMS CEP within the MEE can be useful to support the process of BRI biodiversity conservation as well.

4 KEY MESSAGES AND RECOMMENDATIONS

4.1 Key Messages

Biodiversity, as a significant part of the natural capital, also underpins economic development, such as for tourism, hydropower, agriculture, water management. Therefore, biodiversity conservation is essential for economic development in return. Moreover, the remote biodiversity-rich areas are sometimes the settlements of ethnic minority/indigenous groups who are often neglected in development projects. Thus, the BCC concept that aims at both biodiversity conservation and livelihood improvement of these marginalised groups will address the ‘leaving no one behind’ principle, the central commitment of the SDGs.

4.2 Recommendations

BRI is often referred to as the largest infrastructure development in the history of mankind. Since infrastructure development, particularly roads and railways, tend to affect the ecosystems in general and wildlife habitats and biodiversity in particular, it is crucial to consider biodiversity conservation since the beginning. In this regard, the BCC as part of the CEP, has always been in the strategic position of the ADB



GMS development framework. Therefore, the BRI, as well as other cross-border infrastructure development schemes, can follow the same direction by embedding the BCC or the ecological connectivity concept at the strategic development level. In fact, some scientific findings are already available to support this idea, especially the BCC at the transboundary scale, particularly for the BRI (Li Shuen Ng et al 2020). In this way, the economic development that the BRI promises to promote would also be more welcomed by conservationists and other concerned parties.

Under the ADB GMS CEP, China has played a leading role in South–South exchange and cooperation on the BCC, often with its own financial resources to share its experiences on transboundary conservation and find areas for collaboration. These included arranging study tours, initiating collaborative research and joint projects, and organizing regional knowledge events to share BCC-related good practices at transboundary scale. For the BRI, China is also in the best position to lead the South-South cooperation again. The topics and scope can be replicated from those under the ADB GMS CEP, but this time in a much wider scale.

Green finance policy should also be in place. For multilateral financial mechanisms, including the ADB, biodiversity conservation has already been included as part of their environmental safeguards. However, certain financial institutions under the BRI still lack this aspect, particularly at cross-border level, hence the necessity to catch up (Xia 2020). This requirement will also provide an assurance that the BRI project developers will be willing and able to bear the extra expenses to include measures like BCCs since the planning stage, in which the best option is potentially to avoid the biodiversity hotspots in the first place.

Scientific collaboration between researchers from China and other BRI countries can also provide essential information fundamental to further plan for biodiversity conservation along the BRI routes, as seen successful from the ADB GMS CEP experiences. Since other BRI countries may have limited technical capacity as well as funding support on biodiversity conservation, it is a proper opportunity for China to support both aspects in the form of mutual cooperation, in which can be built on from the academic institutions under the ADB GMS CEP. In fact, the Chinese government has already set up scholarships for talented students from BRI nations for their graduate studies at the Chinese Academy of Sciences (Xia 2020). On-the-ground data can then better support China's overseas investments to considerably reduce BRI's negative impacts on the biodiversity along its routes.



Case 3. Pan-African Great Green Wall Initiative--the case of Senegal

1 GENERAL INFO

LOCATION: Sahel region, Republic of Senegal

IMPLEMENTATION PERIOD: 2007-present

KEY INITIATOR AND STAKEHOLDERS: The Pan-African Great Green Wall Initiative involves numerous stakeholders, including 11 governments, African Union, international organizations such as UNCCD, FAO, WB, GEF, IUCN

2 DESCRIPTION

2.1 INTRODUCTION

Most countries in the Sahel region, at the south border of the Sahara Desert in Africa, face severe food and energy insecurity risks because of the perennial arid climate. Many studies have indicated that the Sahelian ecosystems are subjected to unprecedented stresses from human pressures, exacerbated by climate variability and climate change, threatening their current prospects for sustainable development. The arid and semi-arid land area accounts for two-thirds of the land area of most Sahel countries. The average population growth rate in this region is 3% (Youyuan, 2019). Rapid population growth has increased people's demand for food and energy from the degraded land. Meanwhile, these threats to the vulnerable environment in the region have seriously degraded natural resources, resulting in the decline of its agricultural productivity, value chain and various production systems, which has greatly affected the livelihoods and socio-economic emergence of local communities, and thus the sustainable development of the Sahel region (Diop, 2018).



(Figure 3-1. Schematic diagram of GGWI implementation countries Figure 2. GGWI related country implementation area, source: PA-GGW)

In 2007, the African Union Declaration 137 VIII approved the “Decision on the Implementation of the Green Wall for the Sahara Initiative” (AU2007)” (hereinafter referred to as GGWI). The Initiative plans to build a vegetation barrier with a width of 15km and a length of 7,775km from Senegal in western Africa to Djibouti in the east. It adopts sustainable integrated ecosystem management in the Sahel-Saharan region, so as to restore sustainable dryland, natural vegetation regeneration and enhance water resources management.

Meanwhile, the stable development of community economy can be realized, the livelihood level of local residents can be improved, and the impact of desertification on social development can be reduced (GGWR, 2020). In June 2010, the Pan-African Agency of the GGW was created to coordinate its implementation and support resources mobilization. Subsequently, the initiative was extended to 20 sub-Saharan African countries and regions (Figure 1). GGWI involves a large amount of investment from different stakeholders, including national governments, international organizations such as UNCCD, FAO, WB, GEF, IUCN, for the implementation of the GGW plan. Its objective evolves, and it is now “By 2030, the Great Green Wall aims to restore 100 million hectares of degraded land, sequester 250 million tons of carbon in the soil and create 10 million green jobs in rural areas.” (GGWR, 2020).

The Sahel-Saharan region shares similar environment with Xinjiang, China, as they host the world largest and second largest desert in the world respectively. China's combat desertification technology and experiences can be used for reference in the Sahel-Saharan region (Xinhua News Agency, 2017). In 2017, the Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences and the Secretariat of the African GGWI signed an MoU that China would participate in the Africa Great Green Wall programme. This had built the basis for Chinese ecological restoration technology transfer to Africa for a greener Belt and Road (Xinhua News Agency, 2017).

Among numerous countries implementing the Great Green Wall Initiative, Senegal has made some visible restoration impact on the ground. Through both biological and engineering measures to control water and soil, this programme helped conserve soil, combat desertification and rebuild ecological resilience, as well as promote local residents' participation and livelihood. Senegal's Great Green Wall is about 545 kilometers long and 15 kilometers wide, covering an area of 817,500 hectares (NAGGW, 2016). The Great Green Wall covers three administrative districts (Tambacounda, Matam and Louga), five tribes (Louga, Linguere, Ranerou, Kanel and Bakel) and sixteen towns in northern Senegal. Senegal's Great Green Wall Initiative is mainly implemented in Silvo pastoral area in Ferlo area, northern desert region (Diop et al., 2018).

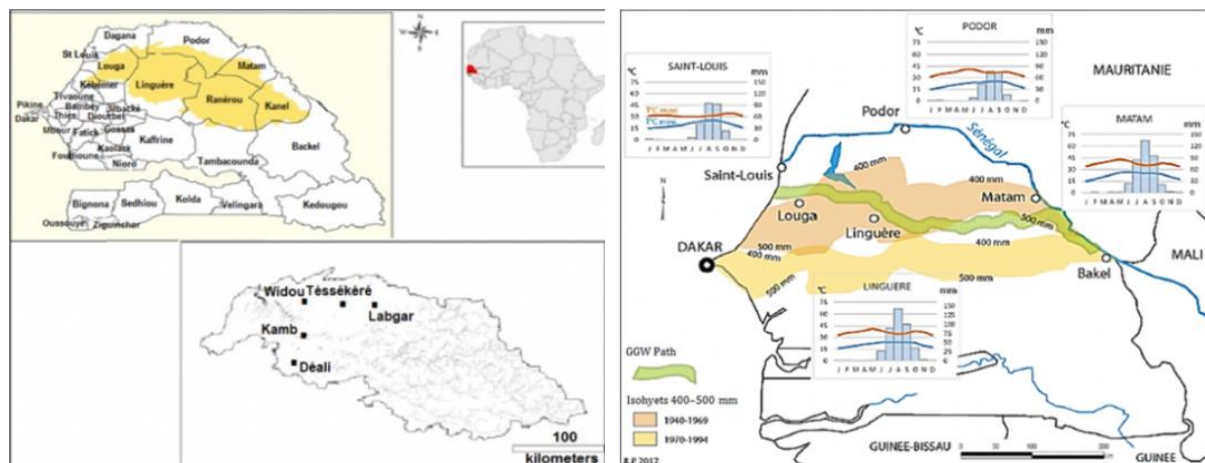


Fig. 3-2 Legend of project implementation in Ferlo area (left) and precipitation in Feolo area (right), Senegal; source, Ndiaye O and al., 2013; Peiry and Voldoire, 2019, in Ndiaye D. 2020)



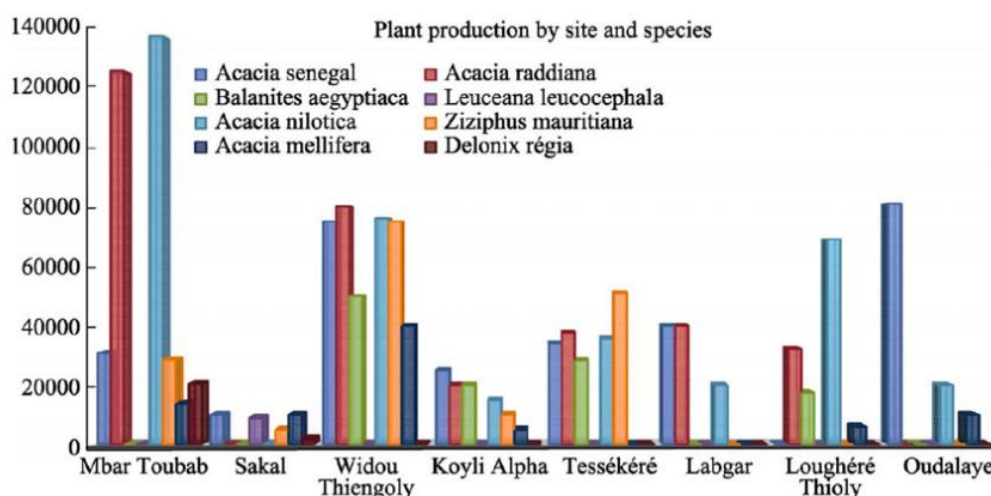
2.2 Intervention objectives of the case

The GGW initiative is to combat desert invasion through mature methods, enhance natural resources through integrated and sustainable management of land resources, protect biodiversity, improve production systems, and ensure local social and economic development through the establishment of various multi-platforms. The GGWI initiative not only protects and manages natural resources, but also strives to promote poverty eradication and achieve sustainable development. GGWI aims to sequester 250 million tons of carbon in 2030, restore 100 million hectares of degraded land and create 10 million jobs for people in the poorest areas of the world (GGWR, 2020).

2.3 Specific interventions and activities

In the implementation of GGW activities in Senegal, the following interventions and activities were adopted:

Species Selection for Restoration: In restoration species selection, several necessary conditions need to be met: i) resistance to water stress, adaptability and plasticity; ii) not be edible by local animals; iii) Have both forestry and economic value (Diop, 2018). After monitoring and studying 35 species in Ferlo, 22 of them regenerated well under extreme conditions. Based on preferred choices of local species, the main species produced have been *Acacia senegal*, *Acacia raddiana*, *Balanites aegyptiaca*, *Leuceana leucocephala*, *Acacia nilotica*, *Zizyphus mauritiana*, *Acacia mellifera*, *Delonix régia*



Reforestation: Nursery for seedling is the basis of GGW vegetation restoration plan, and such nursery ensures that: i) Plants with a good wood structure to resist adverse weather conditions; ii) Vegetation with well-developed roots can resist transportation and transplanting. Deep tillage is a treatment that uses a tractor to break the soil surface layer to a depth greater than 30 cm. This action not only facilitates the manual digging process, but also improves the soil conditions for plant growth (Diop, 2019). According to the different precipitation patterns in regions, the sowing time is usually around August before the rainy season. Innovative hydraulic engineering was adopted by the Great Green Wall to reduce surface water runoff and locally increase humidity for restoration and improves the water balance of crops and vegetation.



Setup firewalls: Ferlo region is a semi-arid region with pastoral areas with a risk of bush-fires after the rainy season, which makes necessary to establish a firewall to reduce the fire risk. By 2017, a total annual length of 1200 to 2000 km of firewalls (new and old) are regularly maintained every year.



Figure 3-3. Firewall construction to avoid bush fire; Photo by A.Guisse, May 2011

Build a multifunctional village garden: The establishment of multi-functional garden, or call it polyvalent village garden, is consistent with GGWI's goal for improve biodiversity, social and economic development, and promote the local community's livelihood and women's rights and interests. At present, such garden covers an area of 40 hectares, and nearly 900 women take turns to engage in various gardening and fruit planting in the garden. These non-timber forest products are directly related to the local community's livelihoods. Agricultural products can be beyond self-consumption, and continuously increase family income and promote sustainable income-generating activities. This activity mobilizes the enthusiasm of stakeholders, promotes community participation more in afforestation activities, and the income produced enables women to use revolving credit to engage in more other activities, such as small-scale agricultural trade (Diop, 2019). In the Sahel region, women are the main and direct users of natural resources such as land, meanwhile, they also bear the heavy responsibility of educating the next generation. Women are also the direct victims of desertification. Thus, it is important to empower women in sustainable forestry management and take part in multi-purpose and multi-functional gardens. Such benefit from gardens will also contribute to the early construction and subsequent maintenance of the Great Green Wall (Youyuan, 2019).



Figure 3-4. Nursery in northern Senegal; Source: FAO; A Guisse, 2009



2.4 Project Achievement (particularly biodiversity conservation and sustainable use)

The construction of the Pan-African Great Green Wall has brought a great many impacts on local communities while solving biodiversity loss, land degradation, desertification and climate change, including: i) meeting the demand for timber and non-timber products; ii) Improving household income by increasing sustainable income-generating activities and strengthening infrastructure conducive to social and economic development; iii) Increasing food reserves; iv) Improving women's rights.

By 2019, The Great Green Wall in Senegal has been built for 545km, afforestation of 72,452 hectares has involved 320,000 people in three major areas, producing more than 18 million seeds and vegetation, training more than 2,120 people, providing 1,800 jobs (GGWR, 2020). It also increased women's income and people's quality of life, built a number of multi-purpose gardens (fruit, vegetable, bee industry) and established rural enterprises and forest management institutions (Youyuan, 2019)

3 CASE ANALYSIS

3.1 Achieving co-benefits and balancing trade-offs

The Great Green Wall Initiative is a comprehensive management project, which not only consider biodiversity and ecosystem restoration, but also increase employment opportunities and improve social economical development. Since 2008, Senegal has planted and restored a large number of vegetation. Two criteria are followed in the selection of trees, one is drought tolerance, and the other is economic benefits, especially in food and medicine (Diop, 2019). The planting of these trees can be processed into products to promote the local economy. In the short term, these vegetation can keep land humidity and reduce land temperature during the day. With this restoration program, migratory birds, insects and animals have reappeared in this area. Local herdsmen said that with the woods, livestock can avoid the strong sunshine in the shade of trees, and the number of livestock has doubled. At present, 300,000 people in Senegal have benefited from this project.

Africa's "Great Green Wall" has both ecological purpose and a "green barrier" for African economy and society in a broad sense. The Great Green Wall also plays a vital role in improving local economy. Local residents, especially women's groups, actively participate in the construction of shelter forest, growing crops and carry out processing and re-trade, which not only improve their living standards, but also women's status. This also proves once again that the Great Green Wall Initiative is not only a afforestation program, but also about comprehensive governance.

3.2 Inclusiveness of participatory mechanisms

Attaching great importance to the role of community participation, the Great Green Wall Initiative encourages various methods and measures to restore natural forests and vegetation, support the establishment of public-private partnership and provide more rewards and incentive mechanisms, for instance, encouraging enterprises to join the "Great Green Wall" construction activities can not only effectively solve the problem of lack of technology and funds for community residents, but also increase job positions, technical level and family income for community residents. Allow managers in the private sector to adopt effective ways to deal with the threat of desertification, and train local residents to assume such



responsibilities, such as involving local farmers in the protection and management of natural forests, farmland and grassland; Involve enterprise managers in large-scale land consolidation and fertilization planning, especially in areas with serious land degradation; Let the community take part in the selection of tree species and plant species for shelter forest construction (Youyuan, 2019).

In Senegal since 2008, many schools, organizations and institutions have participated in the Great Green Wall. For instance, volunteer teams spontaneously organized by young people from Europe, America, Asia and other African countries have played a crucial role in the implementation of the Initiative (Diop, 2019). Several universities in Senegal have organized local students to take part in the implementation of GGWI, such as afforestation activities and providing medical services and training to women's groups and youth associations. Apart from the diversity of participants, the Senegalese military also actively supports GGWI activities (Diop, 2019) to ensure the successful implementation of planting and afforestation activities. The diversity of participants shows the people in the Sahel region's recognition of the GGW achievements.

3.3 Sustainability and replicability

The concept of dryland restoration is replicable. The global dry land coverage rate accounts for half of the earth's surface area (Huang et al., 2016), mainly located in Asia, Africa, South America etc. Desertification is affecting more than 110 countries and regions, 1.5 billion people, 3.6 billion hectares of arable land and pastures. The global desertification area is expanding at a rate of 50,000-70,000 square kilometers per year, resulting in direct economic losses of more than 2 billion US dollars (China Green Times, 2019). These fragile areas are extremely vulnerable to drought and climate change, and are also very sensitive to rapidly changing social impacts (Cervigni et al., 2016). The existence and impact of deserts in countries along "The Belt and Road" cannot be underestimated.

China has successfully built a green shelter forest in Taklimakan Desert, which has a remarkable effect on wind break and desertification control. It is because of successful experience and technology, the team from the Chinese Academy of Sciences transferred such technologies and schemes to Mauritania in 2012. The initiative of establishing a green barrier to prevent wind break and desertification control can be implemented in numerous countries threatened by desertification along "The Belt and Road". For example, the team from the Chinese Academy of Sciences established an nursery base in Nur Sultan, the capital of Kazakhstan, as well as a 300-acre demonstration base. The Chinese National Forestry and Grass Administration cooperated with Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) to jointly promote cooperation in desertification detection and control, and established technology demonstration centers in developing countries such as Egypt, and shared experiences with other countries through international cooperation (China Green Times, 2019). Measures such as species selection for "green barriers", improving soil conservation, wind break and sand fixation can not only combat desertification and restore local biodiversity, but also achieve sustainable development. In the meantime, residents are encouraged to actively participate in the construction of the "Great Green Wall". In the cooperation of desertification control among the member countries of the Pan-African Great Green Wall Initiative, the living standards of rural communities can be improved through the application of new technologies and change of farmers' land use behavior. This "Chinese model" can give some reference to countries facing the threat of desertification. It can be replicated and promoted, by adjusting measures to local conditions, and comprehensively taking into account the political, economic, social and cultural differences among countries



(Hu Jia, 2011). In this way, the international cooperation on desertification control under the Pan-African Great Green Wall Initiative is sustainable.



Figure 3-4. Xinjiang Taklimakan Desert Highway; Source Xinhua News Agency

4 CASE SUMMARY AND POLICY SUGGESTIONS

Case Summary

One of the main goal of GGWI is the sustainable development of the Sahel region and the integrated management of the exploitation of natural resources. With the advancement of the project, Senegal's GGW national strategic action plan has implemented many an activity related to afforestation, and carried out various social activities by planting economically valuable vegetation, so as to mobilize local people's enthusiasm to take part in. Since 2008, the establishment of multi-functional gardens and firewalls has brought a great many positive impacts on local people, which not only greatly increased employment opportunities, but also improved the overall social and economic level. The implementation of GGWI project in Senegal has achieved remarkable results, bringing opportunities and development potential to it. Specifically (GGWR, 2020):

1. A implementable scheme with political will, with strong support from local authorities and local people;
2. 72,452 hectares were afforested between 2008 and 2019, with an average survival rate of 70%;
3. 18 million seedlings were successfully planted, and a 132,050 km wind-break belt was built;
4. More than 119,000 hectares of land was restored;
5. More than 2,100 people have received relevant training;

The Pan-African Great Green Wall Initiative is not only to target at the problems of desertification and land degradation in the Sahara-Sahel region, but also to be a vital part of regional cooperation, South-South cooperation for "Belt and Road Initiative" (You Yuan et al., 2019). The GGW initiative can be used for reference and replicated. As FAO puts forward, GGWI is to promote sustainable arid and semi arid land management best practice, "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions." The GGWI



Initiative not only protects and manages natural resources, but also strives to promote poverty eradication and achieve sustainable development through rational management of natural resources and the ecosystem.

Policy recommendations:

According to the analysis of cases, from the perspective of policy, we should consider:

- (1) Further promote South-South cooperation, strengthen experience and technology exchange among China, African countries and other developing countries in desertification prevention and control and ecosystem restoration, so as to coordinate all resources to promote the GGWI and strive to achieve the its 2030 objectives of restoring restore 100 million hectares.
- (2) Governments of GGWI members should further develop appropriate land laws to ensure land use rights for the implementation of GGWI as planned, and carry out cross-sector coordination to ensure that multi-sectors coordination and participation in integrated land management. Relevant capacity building strengthens local resource management, planning and development capabilities;
- (3) Research institutions of GGWI members countries, it is encouraged to enhance its science for policy services on GGWI implementation. These include 1)science-based monitoring and evaluation the land degradation and restoration progress, 2) ensure concerns on biodiversity restoration and conservation was properly reflected in the GGWI. 3)calibrate ecosystem restoration-related technologies and provide capacity building for these practioners. The research community can play an important bridging role for government departments to promote local communities`s participation in the GGWI.



Case 4. Innovation for Coastal Ecosystem Protection - Blue Carbon and Green Insurance

1 GENERAL INFO

LOCATION: The Philippines and other coastal countries

IMPLEMENTATION PERIOD: 2020-Present

KEY INITIATOR AND STAKEHOLDERS: Conservation International (CI), Restoration Insurance Service Company (RISCO)

2 DESCRIPTION

2.1 Introduction

Marine ecological conservation is expected to be in the spotlight of the "Post-2020 Global Biodiversity Framework", which is expected to be adopted at the Fifteenth meeting of the Conference of the Parties (COP 15) to the United Nations Convention on Biological Diversity, to be held in Kunming, China, in 2021. The international community has set the goal of protecting 30% of the world's oceans by 2030. According to the Special Report on Oceans and the Frozen Circle in Climate Change published by the Intergovernmental Panel on Climate Change (IPCC) in September 2019, human activities have created a significant impact on marine ecology. It also found that significant reductions in greenhouse gas emissions, protection and restoration of ecosystems and sustainable use of natural resources would provide opportunities for the ocean conservation, support adaptation to future change, mitigate threats to the livelihoods and bring additional social benefits.

Conservation International (CI) has long been committed to marine ecological conservation, and leverage mangrove protection as a drive for coastal zone and coastal ecosystem conservation. Mangroves are one of the most important species on the planet. Globally, mangroves contribute \$82 billion a year to the economic value of preventing coastal flooding, locking up 10 times more carbon dioxide than terrestrial forest systems (P. Menéndez, 2020). However, nearly half of the mangroves on Earth have been lost in the last 50 years. For the protection of mangroves, CI has built a "green + grey" infrastructure in the coastal area, that is, adding nature-based solutions to the existing man-made facilities, which not only strengthens the fight against extreme disasters such as floods, storms and rapid sea level rise, but also provides freshwater and fishery resources for local communities. It can also absorb carbon dioxide in the air, which can be described as "three birds with one stone".

In 2013, one of the strongest typhoons ever recorded, Haiyan, hit the Philippines. According to the Philippines National Disaster Coordinating Council, at least 138 people were killed, 14 injured and 4 missing, with more than 4.28 million people affected nationwide. But the Philippine Red Cross says more than 1,200 deaths have been reported in two of the most affected areas. CI, in collaboration with local governments and communities in the central Philippines, piloted "green + grey" infrastructure in 2020 to enhance its resilience to climate change, such as the restoration of mangroves while building flood breakwaters.



2.2 Objectives, uniqueness, driving forces

CI, in this case, has attempted a distinctive innovation model of "blue carbon + green insurance" in the hope of achieving multiple benefits such as ecological conservation, climate change, economic development and community participation:

Goal 1: Protect and restore coastal ecosystems represented by mangroves

Goal 2: Carbon dioxide sequestration and adaptation to climate change to reduce the impact of disasters

Goal 3: Fully reflect the ecological value of mangroves in the form of insurance premiums and blue carbon sink revenues

Goal 4: Encourage local communities to participate in ecological conservation, create jobs and raise incomes

2.3 Interventions (tools and methods)

Innovative business models

Conservation International partnered with insurance companies to create the Restoration Insurance Service Company (RISCO). At RISCO, the ecological value of mangroves is integrated into insurance products in the form of service costs and carbon credits to support the restoration and conservation of mangrove ecosystems in local communities, giving priority to investing in coastal areas of developing countries where mangrove ecosystems are vulnerable to natural disasters. RISCO business starts from the Philippines, and intends to expand to Indonesia, Mexico, Brazil, Malaysia and other markets.

Source of income

1. Blue carbon revenues: mangrove blue carbon sink evaluation was done according to wetland restoration and conservation methodology of VERRA, an international voluntary carbon emission reduction standards agency. This allows to obtain economic revenues by selling blue carbon to the enterprises through compulsory and voluntary carbon emission market.
2. Insurance premium: as the protection and restoration of mangrove ecosystems contribute to the mitigation of natural disasters that corresponding to claims of insurance companies, RISCO will receive payment for ecological services by insurance companies every year.

Main interventions

1. Project site selection: RISCO will select the location of the project considering such factors as mangrove resources, insured or insurable assets and the risk of natural disasters.
2. Insurance companies/investors introduction: RISCO will take into account the actuarial modeling as well as the financial return of mangrove conservation and restoration, then develop related insurance and reinsurance products.
3. Mangrove ecosystem protection and restoration: Mangrove ecosystem protection and restoration and related monitoring will be carried out directly by RISCO or through local third parties.
4. Blue carbon sink development: RISCO will obtain legal property rights of blue carbon sink, develop project design documents (PDD), trade blue carbon sink and share carbon revenues with stakeholders.



Key stakeholders

The project involves a wide range of stakeholders, such as coastal communities and residents, coastal asset owners, insurance companies, blue carbon sink owners, blue carbon sink buyers and so on.

Development of blue carbon sinks

Blue carbon refers to the carbon stored in mangroves, tidal salt marshes and seagrass bed soils, aboveground living substances (leaves, branches, stem), underground living biomass (roots), and nonliving biomass such as litter and dead wood. Like the carbon stored in terrestrial ecosystems, blue carbon is fixed by plants in a relatively short period of time (years to decades). However, unlike terrestrial ecosystems, the carbon fixed in coastal ecosystems can be stored in a large range and for a long time, thus forming a huge carbon stock. Each year 1.9 per cent of the world's mangrove resources are lost, releasing 200 million tons of carbon dioxide, equivalent to 500 million barrels of oil, or 1.3 million vehicles of coal, 63 gas-fired power plants, and 50.5 million vehicles(Herr D,2015).

Because of the high carbon sequestration capacity and potential of mangroves, many international methodologies have been developed to verify blue carbon sinks generated from coastal ecological protection and restoration activities, such as Verified Carbon Standard (VCS) - developed by VERRA, an international voluntary carbon emission reduction standards agency. The VCS is the world's most widely used voluntary greenhouse gas emission standard, with more than 1600 VCS certified projects reducing carbon dioxide and other greenhouse gas emissions by 500 million tons by 2020(Verra,2020). The VCS certification of blue carbon sinks consists of five steps:

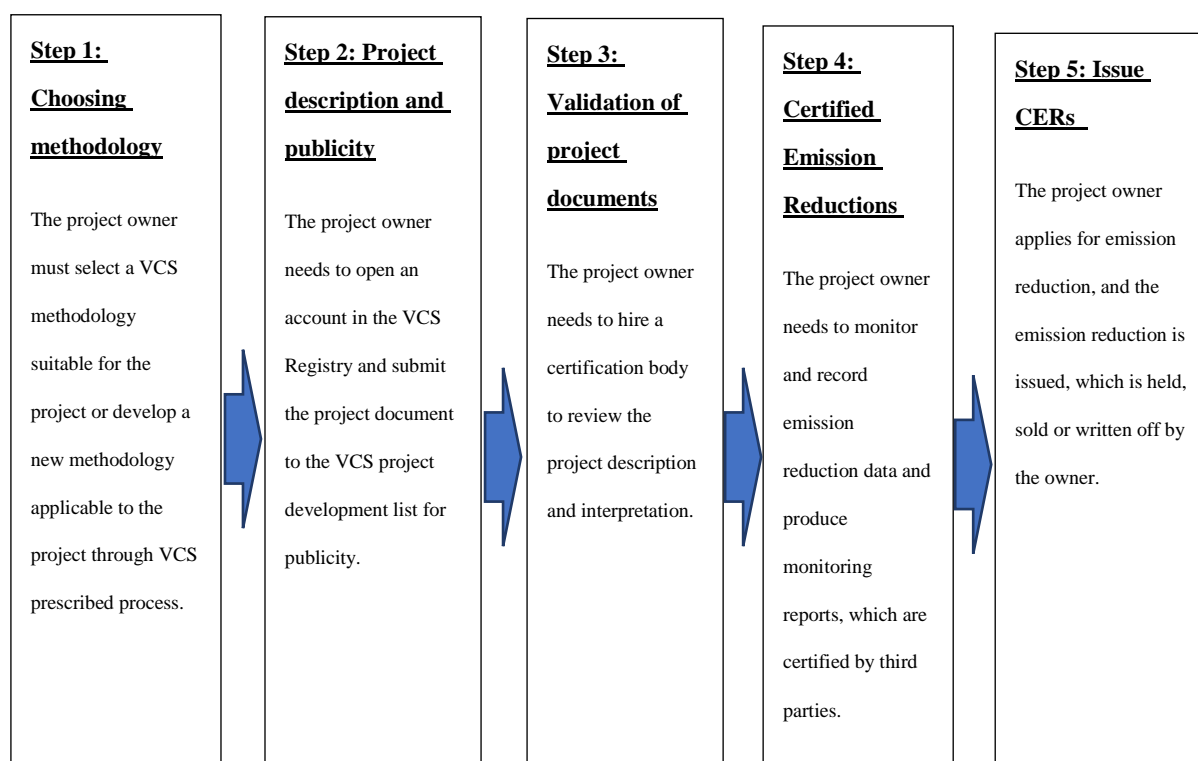
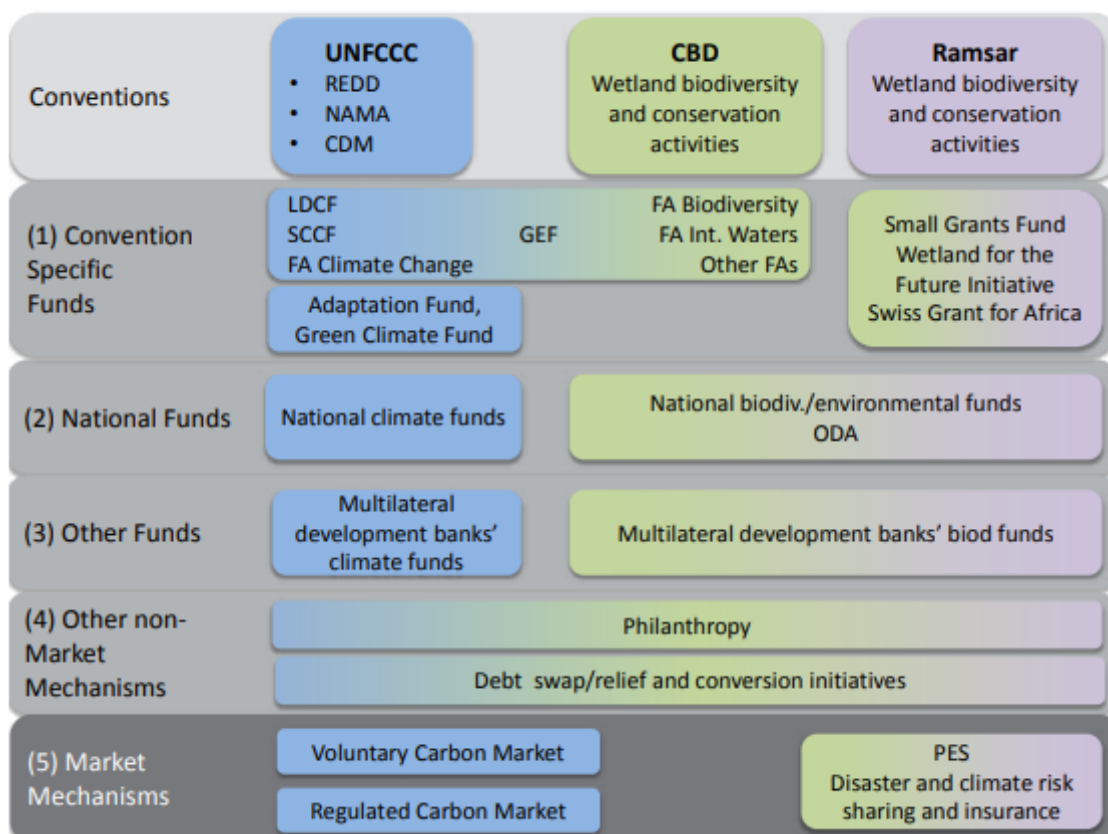


Figure 4-1. The five steps of Verified Carbon Standard certification of blue carbon sinks.

The funding sources of blue carbon projects include public financial instruments under the international conventions, or through market mechanisms, mainly carbon markets, and others.

Table 1. Overview of the main climate (blue) and biodiversity-related finance mechanisms relevant for coastal (wetland) carbon projects and programmes (Herr D,2015).



Companies invest in coastal ecosystem protection and restoration for carbon compliance, carbon neutrality and social responsibility, thus obtaining blue carbon sinks. For example, in 2020, Apple partnered with CI for a blue carbon project on the Gulf of Morrosquillo, Caribbean Coast of Colombia. The project protected 9600 hectares of mangroves and restored 1800 hectares. As certified by VCS, it will be capable of generating more than 1.4 trillion tonnes of CO₂ equivalent (Verified Carbon Units) over a 30-year project period. Since Colombia began collecting carbon taxes nationwide in 2016, local companies can offset carbon taxes by buying blue carbon from the project.

2.4 Key results and outcomes

Institutional innovation - the first professional company to integrate climate risk management with insurance

At present, there are two main challenges in the field of insurance to deal with climate change. One is that insurance companies fail to consider investment and efforts to prevent climate risk in the premium pricing. The other is the actuarial modeling mainly relies on historical data, but not fully considers potential climate change risks. RISCO is the first social enterprise to promote the insurance industry's systematic response to climate change, combining the contribution of mangrove ecosystem protection and restoration to climate mitigation and adaptation with innovative insurance business and premium pricing.

Model innovation - market mechanism promoting the value of ecological services

Scientific research has proved that mangrove ecosystem can effectively reduce wave height and storm intensity, and mangrove provides effective ecological services to prevent and resist natural disasters in

coastal areas. But for a long time, its ecological service value has not been fully reflected in economic activities, resulting in the insufficient investment for mangrove ecosystem conservation. In the long run, floods will affect the lives of 18 million people in the world's coastal areas, causing \$82 billion in economic losses each year. Given that the global insurance industry paid more than \$300 billion over the period 2000-2010 as a result of storms affecting coastal areas, RISCO worked with insurance companies and actuaries to calculate the costs and benefits of mangrove ecosystem conservation and restoration and embed relevant data in premium pricing models to reflect the value of mangrove ecological services through payment of insurance costs (RISCO,2019).

At the same time, the coastal blue carbon stored within mangroves, and the value of mangrove ecological services to cope with climate change are realized through the carbon emission trading mechanism.

Multiple benefits - multiple benefits achieved in the economic, social and ecological environment

- Provide ecological services for insurance companies so as to effectively reduce the insurance company's compensation rate;
- Stable funding for mangrove ecosystem conservation and restoration is provided through annual fees supported by insurance companies and revenue from carbon trading;
- Local communities have been given incentives to work actively on mangrove conservation and restoration by sharing insurance company annual fees and blue carbon sink revenues;
- The project will help the Philippines conserve and restore 4,000 hectares (approximately 9,884 acres) of mangroves with outstanding ecological benefits;
- The project has secured 600,000 tonnes of carbon in a decade, equivalent to a year-long reduction in emissions from 127,000 vehicles, and has had a significant impact on climate change

RISCO business model

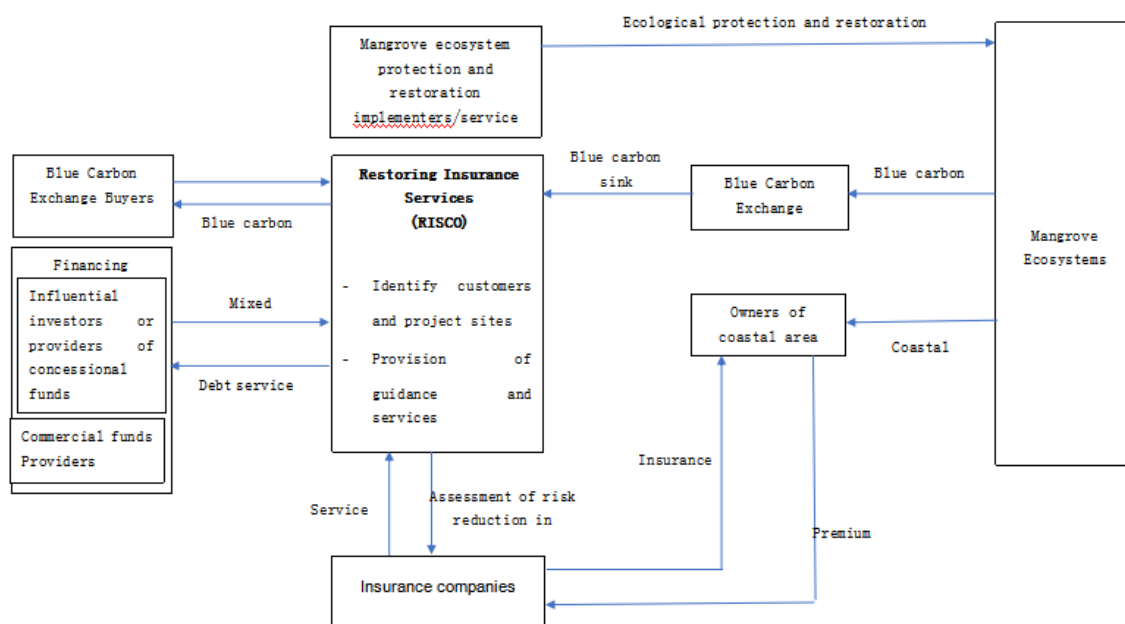


Figure 4-2 RISCO business model



3 ANALYSIS

3.1 Achieving multiple benefits and trade-offs - synergies in biodiversity conservation, climate change and economic and social development

The market mechanism fully embodied in this case realizes the multiple benefits of biodiversity conservation, climate change, economic and social development and so on, through strengthening the protection and restoration of coastal ecosystems and reducing the impact of natural disasters on local communities and economies. Biodiversity conservation helps to reduce the negative effects of climate change. Protecting or restoring coastal ecosystems, such as mangroves, can remove carbon dioxide in the atmosphere and store carbon, and can reduce extreme weather and natural disasters intensified by climate change, including floods and storm surges. Based on the value of ecological services provided by mangroves in disaster prevention and addressing climate change, insurance companies and carbon trading markets provide stable funding for the protection of mangrove ecosystems. Mangrove conservation and its investment provide jobs for local communities and enhance the well-being of the people. At the same time, in order to protect mangrove ecosystems, local development and productive projects and industries that have an impact on the ecological environment are also voluntarily abandoned.

3.2 Inclusion and participation - synergy among stakeholders to advance mangrove conservation

This case shows that the market-oriented protection of mangrove ecosystems involves a wide range of stakeholders. In this case, local communities and residents are the implementers and beneficiaries of mangrove conservation. Financial institutions are investors in the protection of mangrove forests. Enterprises are buyers of blue carbon sinks. CI is the project sponsor and the initiator of the latest concepts, best practices and scientific methods. RISCO is the special purpose agency (Special Purpose Vehicle, SPV) especially established for the implementation of the project, which is responsible for the operation and coordination of the project.

Therefore, promoting mangrove ecosystem protection through market instrument requires the participation of all stakeholders and their respective important roles. At the same time, it also needs to design effective mechanism to safeguard the interests of all parties, encourage all parties to actively contribute, reduce transaction costs, and improve the efficiency of project operation.

3.3 Sustainability and replicability - making full use of green financial products and model innovations

The introduction of market mechanism and innovation model to fully mobilize the enthusiasm of all stakeholders is the driving force for sustainably protecting the environment by all parties. In this case, insurance companies are fully aware that the protection and restoration of coastal ecosystems represented by mangroves can help reduce the risk of corporate compensation for natural disaster events and thus are willing to pay for ecological protection as a service. Combining ecological environment protection with the core business of enterprises and financial institutions and combining ecological environment benefits with economic financial returns is a very effective way to mobilize social capital to participate in ecological environment protection. It is worth learning and upscaling.

Mangrove conservation and restoration need to introduce market-oriented mechanism to encourage private sector investment, which should give full play to the important role of green finance. In this case, from the timeframe and risk preference of financial instruments, insurance products are very suitable to support



environmental protection projects. Since 2012, China has formulated and issued a series of policies to promote green credit, and in 2016 has established a green financial system to vigorously promote innovative financial instruments and models such as green credit, green bonds, green insurance and green funds to support biodiversity and ecosystem conservation and restoration. China's experience and practice in promoting green finance are also worthy of reference in ecological environment protection and climate change response.

The financial mechanisms under the UNFCCC, such as carbon trading, the clean development mechanism (CDM) and the REDD +, have been widely used globally. At the same time, the complementary use of green finance and carbon sink brings new impetus to ecological environment protection.

3.4 Conclusion

Mangroves are one of the coastal and marine ecosystems with the highest production capacity in tropical and subtropical coastal zones. They play an important role in purifying seawater, preventing wind and eliminating waves, maintaining biological diversity and storing carbon, among others. However, the problems of mangrove habitats shrinking, ecological degradation, biodiversity loss and alien species invasion are still prominent. The overall protection coordination of the coastal region is not enough, and the protection and regulatory capacity is still relatively weak. Therefore, mangrove ecosystem protection has attracted more and more attention. For example, in August 2020, the Ministry of Natural Resources of China and the State Forestry and Grassland Administration, China, jointly issued the "Mangrove Conservation and Restoration Special Action Plan (2020-2025)".

Policy and technical support for mangrove ecosystem protection is crucial. At the same time, as shown in this case, through innovative mechanisms such as green insurance and blue carbon, the market mechanism and social capital are introduced into mangrove protection, and the enthusiasm of all relevant stakeholders, such as government, enterprises, financial institutions, NGO and communities, is fully mobilized. Increasingly, it has become a new trend and new model of ecological protection. This model has 1) the multiple co-benefits of biodiversity conservation, climate change, economic and social development; 2) inclusive partnership by coordinating local communities and residents, financial institutions, enterprises, international organizations such as CI, insurance companies and other stakeholders to promote mangrove protection; 3) key driving force for environment protect by introducing market mechanisms and innovative models, as well as fully mobilize the enthusiasm of all stakeholders

4 POLICY RECOMMENDATIONS

Through the introduction and analysis of this case, we put forward the following policy recommendations:

4.1 Enhance mangrove ecological protection in countries along the "Belt and Road"

Enterprises and financial institutions in the countries along the "Belt and Road" should manage environmental and social risks related to coastal ecosystems during investment and project implementation. For example, China has strict and detailed regulations and requirements on "greenness" and environmental risk prevention in overseas operations and investment activities of financial institutions. These include Article 31 of the "Guiding Opinions on Building a Green Financial System of the Seven Ministries" from People's Bank of China etc; Article 21 of the "Guidelines on Green Credit" of the former China Banking Regulatory Commission; and Article 5 of the "Guiding Opinions on Regulating Banking Service for Enterprises



Going Out to Strengthen Risk Prevention and Control”. However, enterprises and investors are often not familiar with coastal ecosystems such as mangroves. Therefore, it is necessary to enhance relevant awareness and strengthen capacity building, and fully attach importance to the value of coastal ecosystems, such as mangroves, to local communities, as well as to effectively identify and resolve related risks.

At the same time, ecological protection projects are not for traditional investment of social capital because of low returns and high risks. However, the international community has set up a number of financial mechanisms for coastal ecosystem protection, including mangroves. Investors can make full use of these multilateral and bilateral financial opportunities, actively innovate more financial products; boldly apply public and private partnership (PPP), third-party market cooperation and other models; and carry out investment and financing activities for coastal ecosystem protection and restoration in relevant countries.

4.2 Put a value to mangrove ecosystem services in the form of blue carbon sinks

China's "Mangrove Conservation and Restoration Special Action Plan (2020-2025)" proposes "research and development of mangrove carbon sink project, explore the establishment of mangrove ecological product value realization". Promoting the development and trading of blue carbon is an effective way to realize the value of mangrove ecological products.

(i) Blue carbon sinks should produce ecological conservation benefits. Through the development of blue carbon project, it is necessary to promote the practice and norms of mangrove ecosystem protection and restoration in accordance with scientific knowledge.

(ii) Development or introduction of blue carbon methodologies. The blue carbon project should be standardized by introducing mature and recognized blue carbon sink methodology, or by developing blue carbon sink methodology following international norms.

(iii) Blue carbon should be actively traded as Chinese Certified Emission Reduction (CCER). Many countries have integrated blue carbon into their path to achieve targets set by their Nationally Determined Contributions (NDC) to address climate change. China should gradually incorporate blue carbon into the national certified voluntary emission reductions, together with forestry carbon sinks, renewable energy, methane and so on, to be offset by key emission sectors.

(iv) Strengthening research and pilot projects for the development and dissemination of mangrove blue carbon sinks. The mangrove blue carbon sink project has developed mature methodology and successful cases. China should strengthen relevant theoretical research, practical exploration and experience sharing, and carry out pilot demonstration in Guangdong, Fujian, Zhejiang, Guangxi, Hainan and other areas with rich mangrove resources.

4.3 Increasing investment in biodiversity and ecosystem conservation through a variety of means, including financial and fiscal support

Funding support for biodiversity and ecosystem conservation usually comes from private investment and public funds, such as fiscal funding, subsidies, tax breaks and payment for ecosystem services. For the increasing funding gap, countries attach great importance to leveraging private capital. The mechanism of green finance and carbon emission trading, as this case shows, facilitates the private capital investing into ecological conservation. Therefore, it is necessary to strengthen policy guidance and incentive support for financial means such as green credit, green insurance and green bonds to cover ecological protection



projects, and to create enabling conditions for private capital entry through tax concessions, risk sharing, guarantee and so on. At the same time, we should give full role to the market mechanism of carbon emission right trading, energy-consumption right trading and water right trading to realize the service value of ecosystem.

4.4 Promote enterprises to support ecosystems such as mangroves as an important way to achieve carbon neutralization

On September 22, 2020, President Xi Jinping of China announced at the general debate of the 75th session of the General Assembly that "China will increase its independent contribution, adopt more effective policies and measures, strive to peak carbon dioxide emissions by 2030, and strive to achieve carbon neutralization by 2060". And the leaders of the 27 EU countries agreed on more ambitious emission reduction targets at the Brussels summit on December 11, 2020, that by 2030 the EU's greenhouse gas emissions would be at least 55 per cent less than in 1990, by 2050 to achieve "carbon neutralization".

China's new "carbon peaks" and "carbon neutral" targets will inspire more countries and companies to take proactive climate action. Business sector and financial institutions can follow Apple Inc., as mentioned in the case, to achieve "carbon neutral" by buying blue carbon, while protecting marine ecosystems and supporting the economic development of local communities.



Case 5. From commitment to action: A Fifteen- Year Pathway on Sustainable Development of China's Responsible Forestry Investment in Gabon

1 GENERAL INFO

LOCATION: Gabon

IMPLEMENTATION TIME: 2005-2020

STAKEHOLDERS AND SPONSORS: World Wide Fund for Nature (WWF), China's National Forestry and Grassland Administration (NFGA), Chinese Academy of Forestry, China Forestry Investment Corporation in Gabon, Gabon's Ministry of Water and Forest

2 DISCRITION

2.1 Introduction

Since entering the 21st century, with the implementation of China's "going out" strategy, China's forestry foreign investment has continued to grow. Although its overall share in China's foreign investment is not high, but the impact is significant. As forestry is a resource-oriented, many of China's forestry overseas investment countries are located in the global biodiversity-rich areas, including the Congo Basin, South America and Mekong River Basin etc. In addition to being of great significance to the global biodiversity conservation, forestry is a labour-intensive industry and plays an essential role in promoting local social and economic development, especially for employment and income increase.

Gabon, located in Central Africa, is rich in natural resources within its vast territory. The country is working to build "Industrial Gabon", "Green Gabon" and "Service Gabon" and strives to become an emerging country by 2025. In recent years, Gabon's economic stability, large-scale economic construction and active infrastructure have made Gabon an excellent foreign investment destination. At the same time, Gabon has become an attractive land for forestry investment worldwide, especially by Chinese forestry enterprises, because its land area is 85% covered by tropical rainforests. At present, Gabon has become one of the important countries for Chinese forestry enterprises to invest overseas, and it is currently China's largest forestry investment country in the tropics. Since the 1890s, Chinese enterprises began to invest in forestry in Gabon, and have been growing steadily since then. So far, Chinese enterprises have about 50% of the local commercial timber forest business license, all are natural forests. As support, Chinese enterprises also actively participate in the construction of local infrastructure, roads in the forest, electricity, and other.

With the increase of Chinese enterprises' influence, legal compliance and sustainability have gradually become the focus. Reports of illegal logging of Chinese enterprises have occurred from time to time, which concerned the international community. In the context of the continued decline in global forest resources, especially in the tropics, there is an urgent need for action on protecting the valuable forest resources of the tropics through the promotion of responsible forest investment, sustainable forest management.

2.2 Objectives, uniqueness, driving forces

Chinese enterprises have quite a history in Gabon. In the past, reports of violations of local laws and regulations have occurred from time to time. This is directly related to the lack of attention paid by



enterprises to the requirements of rules and regulations and language and cultural obstacles, leading to a lack of understanding of local needs. Investors are mostly private capital, and the levels of enterprises varies due to the entry threshold of the forestry industry is easy. Many enterprises have short-sighted vision, without long-term investment plans. Gabon, for example, implements a system of sustainable business licenses for forestry enterprises, consisting of two types: a temporary permit (CPAET), and a long-term sustainable business license (CFAD). The enterprise's initial entry into the forestry logging industry will be granted with CPAET, the forestry managers with the CFAD support need to meet the CFAD requirements within three years. However, companies that comply with CFAD need to invest a lot of money and generally need to pass three years of business planning and a series of assessments to obtain. This process includes a complete biodiversity assessment, a forest resource assessment, a socio-economic impact assessment, and a comprehensive forest management plan. In the past, many companies that did not achieve CFAD during this period. By changing legal names to avoid their responsibilities and investments deliberately, there is no business planning and series of integrated assessments like CFAD to ensure responsible forest management in three years. This is an illegal act by changing the subject of registration to avoid the requirements of laws and regulations. In this context, transboundary and illegal logging by enterprises frequently occurred, causing damage to forest ecosystems and biodiversity, as well as negative social impacts. Besides, local forest governance contributes to the breeding ground for corporate non-compliance. It is essential to note that local corruption, which results in low criminal costs, contributes significantly to this trend.

The case mainly includes three parts. First, promote the responsible investment awareness and sustainable forest management level of Chinese forestry enterprises through tool development and capacity building; second, encourage enterprise behaviour change through the establishment of incentive mechanisms such as market and finance; third, solve the practical problems faced by enterprises in the process of investment through the establishment of multi-party dialogue and improve the investment environment; fourth, transfer Chinese forestry management experience through bilateral dialogue and cooperation to enhance local forestry governance. Finally, promote the local Chinese forestry investment enterprises to achieve sustainable forest management, and help wood-producing countries to improve the forest management system.

2.3 Interventions (tools and methods)

Research and tool development

At the beginning of 2005, WWF China together with other Chinese and foreign environmental protection organizations, supported the Chinese State Forestry Administration, visited Chinese enterprises on forestry investment in Africa and Asia, to conduct field research on the local impact of Chinese forestry overseas investment, and to obtain feedback from the host governments, private sector and enterprises. Based on several investigations, the State Forestry Administration has gradually developed a strategy to guide Chinese forestry overseas investment towards sustainable development. In 2007, the State Forestry Administration, together with the Ministry of Commerce, issued the Guide on Sustainable Overseas Forest Management and Utilization by Chinese Enterprises ("the Guide") to guide enterprises investing in plantations abroad to achieve economic and ecological win-win situations, protect local biodiversity and community interests. In 2009, the Chinese State Forestry Administration, together with the Chinese Ministry of Commerce, issued a Guide to the Sustainable Management and Utilization of Chinese Enterprises' Overseas Forests, which well responded to international concerns about the ecological and social impacts of Chinese enterprises'



overseas forestry investment. It became the first industry guide for Chinese overseas investment and broadened the government's guidance and overseas investment supervision.

The goal of the Guide is to promote it implement in core areas of China's forestry overseas investment, and guide Chinese companies, when investing in biodiversity hotspots, to comply with local laws and regulations and refer to domestic and foreign sustainable management technologies and measures to determine and protect high protection value areas, and avoid adverse effects on the environment during various operations and respect the rights and interests of local communities.

Tools promotion

Given the gap between the operating level of some Chinese forestry enterprises and the principles set out in the Guide, after the publication of the Guide, WWF China continued to support the Chinese State Forestry Administration by undertaking a series of activities over the past decade to promote the implementation of the Guide. WWF China and the Forest Products Trade Center of the Chinese Academy of Forestry Sciences signed a cooperation agreement on the "Initiative for the Sustainable Management and Utilization of Forests Outside China Enterprises" in June 2011. At the same time, long-term cooperation with other domestic and foreign environmental protection organizations has jointly launched the China-Africa Forest Governance Learning Platform (FGLP) and other mechanisms. Seminars and cooperative research are held jointly in key areas to provide enterprises with the latest forestry regulations and information of the investment destination country, forest management and import and export regulations, etc.

Through the survey of forestry training needs of Chinese overseas enterprises, it is found that some enterprises lack understanding of local investment environment and awareness of risk prevention and control, and a few enterprises lack legal knowledge, weak awareness of environmental protection, lack understanding of local culture and habits. Some forest management activities are not standardized. Especially in Gabon, some Chinese enterprises even use the policy of local forestry regulations on temporary licensing to avoid the forest management plan's requirement. These behaviours affect the international image of Chinese enterprises to some extent.

After the release of the Guide, WWF China began to promote it among Chinese forestry enterprises in Gabon. Under the Global Forest Trade Network (GFTN), China has also established various forms of cooperation with Chinese companies investing in Gabon to help the Chinese enterprises improve their management level. For example, In 2012 WWF organized two training sessions for the companies involved. There are four Chinese forestry companies invested in Gabon are officially contacted GFTN- China. One of the companies then began preparing for Forest Stewardship Council(FSC) certification of 320,000 hectares of forest land in Gabon. In June 2014, to enhance communication between Chinese enterprises and local governments, WWF established the Gabon-China Sustainable Forestry Round Table Forum with the Chinese Academy of Forestry Sciences, with the State Forestry Administration of China and the Government of Gabon invited.

To enhance the dissemination of the Guide, WWF China, together with its partners, has also conducted numerous training sessions on the Guide in China and abroad, along with disseminating information on the requirements of the Guide to enterprises and providing methods for its implementation based on research on the needs of enterprises. These covered major timber trading ports and areas where processing enterprises are concentrated, not only in Gabon, but also other important forestry investment sites such as



Russia, Cameroon and Mozambique. WWF also used the advantages of the global network to jointly work with other WWF offices in Russia, the Congo Basin, East Africa and Latin America to actively introduce the requirements of the Guide to local governments and to translate and print the Russian, Portuguese, English and French versions of the Guide, which made it widely welcomed and recognized in those targeted countries. At the same time, to support Chinese enterprises to familiarize themselves with the laws, regulations and customs of investment in destination countries, WWF China Forest Project also organized the translation of relevant rules and laws of countries such as Mozambique.

Exploring incentive mechanisms

During the process of promoting the Guide, WWF China and the Chinese State Forestry Administration actively explored incentive mechanisms for the implementation of the Guide, such as green finance, to promote the sustainability of enterprises' overseas investment by implementing the Guide, and to conserve global biodiversity while sustainably using them. At present, the definition of green forestry has been adopted by the Bank of China Regulatory Commission and will be used for relevant green investment decisions. FSC certification and other international concepts of sustainable forestry will also be incorporated into the regulations of wood processing industry parks and become a necessary standard to improve such industry parks' sustainability. It also coordinates two-way exchanges between government and business representatives of China and investment receipting countries, including helping the investment receipting country representatives to learn about forestry management and processing technology in China, and putting forward scientific suggestions for Chinese enterprises' overseas investment on tree species.

Establishment of a dialogue platform

Five years of joint efforts have contributed to the establishing the round table in Gabon, where the Chinese enterprises, the Chinese and Gabonese governments and WWF hold discussions on shared interests and issues. Due to cultural, language and other obstacles, it is difficult for both governments to communicate effectively with Chinese companies. After several seminars and training sessions, WWF recognized the need to establish a communication platform between local governments and Chinese companies. At the same time, WWF has translated local laws and regulations into Chinese and introduced the guidelines for overseas forest management of the State Forestry Administration of China to Chinese companies.

As trust was built and driven by WWF, in June 2014 Chinese companies and the Gabonese and Chinese governments agreed to establish a "Gabon-China Sustainable Forestry Dialogue Mechanism" to create an effective communication platform on China's responsible investment behaviour through round tables. The dialogue aims to support Chinese companies to implement sustainable operations in Gabon through effective communication. The State Forestry Administration of China has strongly supported the formation of this mechanism. As an essential participant in the round table, national forestry authorities from both countries were represented at the meetings.

On this basis, through the dialogue mechanism, the two governments continue to deepen exchanges. China's State Forestry and Grassland Administration signed a memorandum of cooperation in the field of forestry with the Government of Gabon to jointly promote the legal timber trade between China and Gabon.



2.4 Key results and outcomes

- i. **China's first industry guide for overseas investment, Guide on Sustainable Overseas Forest Management and Utilization by Chinese Enterprises, has been developed.** This is to guide enterprises investing in plantations abroad to achieve economic and ecological win-win situations, protect local biodiversity and community interests, by obey to local laws. The Guide responds to international concerns about Chinese enterprises' ecological and social impact on overseas forestry investment. It provided a new path for government to guide and supervise overseas investment.
- ii. **The "Initiative for the Sustainable Management and Utilization of Forests Outside China Enterprises" was signed by some important forestry overseas investment enterprises,** as organized by WWF China and the Forest Products Trade Center of the Chinese Academy of Forestry Sciences, in June 2011. These overseas investment enterprises committed themselves to learn and implement the guide in future business activities, to jointly promote sustainable overseas operations. The first batch of signed enterprises reached 10. Another twelve Chinese companies have made commitments to protect wildlife and improve the working environment and conditions of local employees in June 2014. All these companies have timber harvesting and processing operations, and manages 4 million hectares of forest lands in Gabon. In 2016, These enterprises are further committed to the Guide's requirements, constantly improve their forest management.
- iii. **According to the WWF survey, the area of certified long-term sustainable forest land running by Chinese forestry enterprises increased from 818,932 hectares in 2010 to 3,964,249 hectares in 2015, increased by 384 per cent.** By 2019, the figure had grown to 6,219,555 hectares, with all forestry enterprises investing in Gabon receiving the certificate, with significantly improved compliance and sustainability. Although there are still some reports of illegal procurement, the overall level is continually improving towards sustainable forest management. Gabon's commercial timber harvesting areas are mainly original natural forest areas, including many indigenous communities. The continuous improvement of Chinese enterprise management behaviour is of great positive significance for protecting biodiversity and sustainable utilization, local economy and employment rate.
- iv. The first Chinese forestry enterprise began to apply for the Forest Stewardship Council (FSC) certification in 2015, with a forest area of about 330,000 hectares. Since the Gabonese government recently announced the 2023 comprehensive FSC certification plan, most Chinese enterprises are actively exploring the certification and cooperating with WWF to organize relevant training. Although the process is somewhat delayed due to the COVID-19 pandemic, the overall development is positive.
- v. From 2010 onwards, China and Gabon's forestry departments have continuously strengthened dialogue and organized annual exchange visits to discuss the better promotion of responsible local investment by Chinese forestry enterprises. In 2015, a multi-party dialogue mechanism was established. In 2019, the two countries formally signed a Memorandum of Understanding on forestry, marking the beginning of a new milestone in the cooperation between the two nations.

3 ANALYSIS

Political ownership, collaboration, approval, policy dimension



This case study is strongly supported by the China's State Forestry Administration, now the State Forestry and Grassland Administration, due to several illegal logging problems caused by China's overseas forestry investment and trade at the beginning of this century. Through investigating forestry investment by Chinese enterprises in Africa and Asia, the local impact of Chinese forestry overseas investment and the feedback from the host government, different stakeholders was analyzed. Overseas investment in forestry is dominated by private enterprises, many of which have no registered entities in China, and there are regulatory and regulatory complexities by the government. Supported by these detailed investigations, the Chinese government was able to form Chinese forestry overseas investment guide based on international guidelines.

During 2007, the State Forestry Administration, together with the Ministry of Commerce, issued a Guide to the Sustainable Cultivation of Chinese Enterprises' Overseas Forests. In 2009, the State Forestry Administration, together with the Ministry of Commerce, issued a Guide to the Sustainable Management and Utilization of Chinese Enterprises' Overseas Forests (as the Guide in short). Guidelines are developed, taking into account local and international standards and indicators for sustainable forest management, such as the Forest Stewardship Council (FSC), while drawing on different stakeholders' voices. The guide also covers a more comprehensive range of environmental, economic and social aspects, particularly about local laws, protecting local biodiversity and community interests. The key principle is that the Chinese enterprises should pay attention to the safety of the environment and biodiversity, adopt scientific and reasonable harvesting methods and operational measures according to local conditions. Importantly, they should minimize the impact of forest harvesting on biodiversity-rich, ecologically fragile areas, wildlife habitats, natural landscapes, water and water quality of forest basins, soil ecological environment of forest land and regeneration of young seedlings, to ensure restoration of forest ecosystem functions. Appropriate measures should be taken to protect forests, especially high-value protected forests area. It also stresses that Chinese enterprises should take full account of residents' interests in carrying out forest management and utilization related activities and take appropriate measures to avoid directly or indirectly infringing, threatening and weakening the ownership or right to use legal resources of residents. These guidelines have historically pioneered sustainable investment outside China's forestry industry and constitute the necessary policy framework for overseas investment in forestry. Since then, several country manuals based on the guide have been developed, taking into account the need for a better interface between the guide and forestry practices in producing countries.

In the process of implementation, in addition to the full support of the State Forestry and Grassland Administration, the Ministry of Commerce, the General Administration of Customs and the China Banking Regulatory Commission have given tremendous support to varying degrees. At the same time, through the Forum on China-Africa Cooperation (FOCAC), WWF regularly submits its research and case experience to the organizers and delegations of the meeting, to obtain a higher level of policy support.

Inclusiveness of partnership

Close cooperation between different stakeholders was established. These include the China's State Forestry Administration, the Chinese Academy of Forestry Sciences, WWF international and China office, and WWF Gabon and the African Regional Office. Participants representing diverse interests, including government agencies, businesses, and non-governmental organizations, were extensively invited to develop the Guide. The Global Environmental Institute (GEI), The Nature Conservancy (TNC), Forest Trends (FTs) and the



European Forest Institute (EFI) also contributed significantly to the content and release of the guide. In the course of the guide's advancement, one focus was invite local leading enterprises to participate and gradually land the Guide locally as a pilot, so as to lead other enterprises to participate in the implementation gradually. Through regular communication mechanism, China's national forestry departments, Gabonese water ministry and Chinese enterprises were involved in the dialogue.

Sustainability and transferability

At present, "Green Belt and Road" is a priority development project of WWF and forestry investment is an essential part of it. Since 2005, the implementation of the project has gone through 15 years. During the 15 years, the project has a few milestones, and established full cooperation with government, enterprises, NGOs, and the effort has been widely recognized. The next phase, particularly in terms of the policy dimension, it will focus on implementing the Memorandum of Understanding signed by the China and Gabon government, promoting bilateral working groups and enhancing in-depth cooperation. Apart from supporting business behaviour change and adapting to the Gabonese Government's 2022 comprehensive FSC strategy, it will build on China's experience in forest governance over the past 30 years, promote China's successful forestry model, help receipting countries to upgrade forest management, and ultimately build a model for South-South cooperation in forest and biodiversity conservation.

In terms of upscaling, this has important value in other China's key forestry investment countries, especially in the tropical region in the Congo Basin, Asia Pacific and other countries with relative poor forest governance. There is great potential to promote the Guide, establishing cooperation with leading enterprises, and promoting multi-party dialogue, strengthen incentive mechanisms such as green finance and market, meanwhile bilateral cooperation can be the primary component. All these can be promoted as a successful experience. Currently, WWF based in Gabon plans to do the same in countries around the Congo Basin, such as Congo, the Democratic Republic of the Congo and the Asia-Pacific region, such as Papua New Guinea, to promote sustainable Chinese investment on overseas forestry.

4 KEY MESSAGES AND RECOMMENDATIONS

4.1 Summary of key results and experiences

The main outcomes of the case include:

(1) Development of China's first industry guide for overseas investment

The Guide to the Sustainable Cultivation of Chinese Enterprises' Overseas Forests and the Guide to the Sustainable Management and Utilization of Chinese Enterprises' Overseas Forests have made the Chinese government forestry sector to guide enterprises overseas to change their investment behaviors.

(2) Promoting business commitment and action

In June 2011, ten foreign enterprises signed the Initiative for the Sustainable Management and Utilization of Forests outside China. In June 2014, twelve enterprises made commitments to protect wildlife and improve the working environment and conditions of local employees; and in 2016, they made further commitments to continuously improve their forest management under the Guide. The area of forest land owned by Chinese forestry enterprises that meets the long-term sustainable forest land license increased from



818,932 hectares in 2010 to 3,964,249 hectares in 2015 and 6,219,555 hectares in 2019. All forestry enterprises invested in Gabon have obtained this certificate.

(3) Bilateral dialogue and cooperation

These include the China-Gabon forestry sector dialogue, which began in 2010, the formal establishment of the multi-party dialogue mechanism in 2015, and the 2019 forestry related Memorandum of Understanding between the two governments.

(4) Good practices and models

These include development of the guide, cooperation mechanism with leading enterprises, multi-party dialogue, incentive model, bilateral cooperation between governments.

4.2 Recommendations for enhancing sustainable oversea forest investment

Firstly, it is imperative to thoroughly investigate and understand the investment situation and environmental governance in the countries for investment. It is necessary to analyze the root causes of the problems and find out the solutions through appropriate approaches. Administration and management in countries of investments are often fundamental to the challenges, and the emergence of the environmental issues is often closely linked to development problems. Therefore, the two directions should be fully emphasized when establishing project objectives.

Secondly, develop overall strategy and follow phased approach for implementation with continuous efforts. As mentioned above, over the past 15 years, project progression can be divided into three phases, each with a different focus. Through the critical breakthrough in each stage, the project finally achieved good results, although there were various difficulties encountered, e.g., a very tight funding situation in the initial period. At the same time, there are frequent changes in the countries' policies, especially the local elections and changes of government department heads, which will negatively affect the project's direction. However, the project's overall strategy has not changed, which is also a essential factor contributing to the success.

Thirdly, it is crucial to establish cooperation with multiple incentives to strengthen dialogue and collaboration with different stakeholders. In particular, NGOs can play an essential role as a necessary complement to government forces. In some countries where investments are made, NGOs are key in connecting communities and governments, as well as provide solutions to businesses problems.

Fourth, in promoting the change of enterprise behaviour, it is necessary to establish multiple incentive mechanisms. As shown in this case, incentive from policy, finance and market dimensions have been tested. A richer incentive mechanism is an essential cornerstone of enterprise behaviour change.



Case 6. Sustainable agricultural commodity supply chains and “Deforestation-Free”

1 GENERAL INFO

LOCATION: China, Indonesia, Malaysia, Brazil

IMPLEMENTATION PERIOD: 2017 to date

KEY STAKEHOLDERS: WWF, China Meat Association (CMA) and its joint 70 enterprises, China Food and Animal Import and Export Chamber (CFNA), Sustainable Palm Oil Round Table Initiative (RSPO) and other enterprises and social organizations.

2 DESCRIPTION

2.1 Introduction

China has been continuously strengthening its international trade after its accession to the World Trade Organization in 2001 and its announcement of the Belt and Road Initiative in 2013. For agricultural commodities such as palm oil, soybeans, and meat, China’s market potential and buying power have been growing steadily. In 2019, China has become the world’s second-largest importer and the third-largest consumer for palm oil, among which 98% comes from Indonesia and Malaysia. Indonesia and Malaysia, located along the Maritime Silk Road, both have a long history of commerce and trade with China, and enjoy a high level of biodiversity. Now, both countries are facing the threat of deforestation caused by the mass expansion of palm tree plantations.

In the meantime, China is the world’s largest importer of soybeans. In 2019, China has imported around 57.67 million tons of soybeans from Brazil, accounting for 65.2% of total Chinese soybeans imports. Besides, South America has become the major place of origin for China’s meat imports; China has become Brazil’s largest export destination for beef. The increasing global demand for soybeans and beef, along with intense competition for profit within the market, has become the driving force for South American countries to expand agricultural land at the expense of forest degradation. The Amazon rainforest has suffered degradation in 17% of its total area due to agricultural expansion. Meanwhile, the economic and trade relation between China and Brazil has been tightening. China’s actual investment spending in Brazil from 2003 to 2018 has soared to 69.2 billion US dollars, and Brazil expressed the intention to coordinate its Investment Partnership Program with the Belt and Road Initiative.

It is evident that unsustainable supply chains of agricultural commodity such as meat, soybeans, and palm oil have led to enormous forest degradation and related effects. When rainforests are replaced by single cash crop or livestock farms, flooding and soil erosion intensify, and the release of greenhouse gases leads to climate change. The total area of forests in Indonesia and Malaysia has decreased by 11.09 million hectares from 2000 to 2010. The smoky cloud caused by burning and logging in 2015 alone caused more than 100,000 deaths in Indonesia, Malaysia, and Singapore. Wild animals that have lost their habitat are forced to approach humans and livestock, bringing deadly viruses to local communities, for example, the new type of zoonotic malaria in Sabah was related to that.



Latin America is the most deforested region in the world. According to statistics from the Brazilian Forest Service, illegal logging has caused Brazil to lose rainforests at the size of two football fields every minute, and 7% of the logged forests are directly used for grazing. The Cerrado savanna contains about 5% of the world's species, whereas 46% of the area has been fully converted to soybean fields or artificial pastures. Only 19.3% of the savanna is still covered by natural vegetation. According to an assessment done by WWF in 2019, Cerrado had an average annual grassland reclamation of 680,000 hectares in the past four years, which is equivalent to losing an area of grassland as large as London every three months.

The reduction of forests is seriously threatening global biodiversity and ecosystem. A large number of wild animals are losing their habitats, for example, Sumatran tigers, rhinos, elephants, orangutans, jaguars, and anteaters. Hence, it is extremely urgent to curb deforestation. The protection of rainforests requires concerted efforts of the countries of origin, producers, and consumers. As a consumer country, China has played an active role in advancing sustainability of agricultural commodities' supply chains, increasing proportion of purchases of the "Deforestation-Free" products. This reflects the practice of a responsible world major economy, and is crucial for the realization of the "Green Belt and Road Initiative" and the UN's Sustainable Development Goals (SDGs).

So far, it is hard to reach complete traceability in the supply chain. So, it is difficult to directly map the effort of each stakeholder in the green transformation with the results of tropical rainforest and biodiversity conservation in the countries of origin. Even if some companies claim that their purchased products have achieved 100% sustainability certification, the risk of deforestation may still exist. Because it is hard to see clear actual results, participants often lack enthusiasm. Nor can one identify the responsible party for the damage of a particular piece of rainforest, and it is difficult to hold a specific company's production or business accountable. This has deepened the tragedy of the commons and encouraged many stakeholders to contravene the law following the majority's behaviors in the industry. Therefore, it is especially important to establish a public platform that involves multiple stakeholders and the entire supply chain. At the same time, inspired by sustainable forestry practices such as the China Paper Sustainable Alliance (CSPA) and the Forest Declaration initiated at the United Nations Climate Change Conference in 2015, the agriculture industries, primarily include oil, soybeans, and meat, are taking action to promote industry alliances.

In May 2017, Chinese government issued the "Guiding Opinions on Promoting the Construction of Green 'One Belt and One Road,'" emphasizing on "strengthen green supply chain management, promote green production, green procurement, and green consumption, strengthen international cooperation and demonstration of green supply chains, drive the upstream and downstream supply chain to adopt energy-efficient and environmentally friendly measures, and reduce the impact on the ecological environment by market means." Based on this guidance, all stakeholders have jointly established a green transformation platform for agricultural commodity supply chains, including these of palm oil and meat, to promote communication between the upstream and downstream of the industries, and encourage participants to make commitments to the green value chain. In 2017, the World Wide Fund for Nature (WWF) and China Meat Association (CMA) jointly launched the "Chinese Sustainable Meat Declaration" with 64 companies, which increased to 70 in 2020. In 2018, at the China Sustainable Palm Oil Supply Chain Forum and the Second RSPO China Forum, WWF joined hands with the China Chamber of Commerce for Food, Native Produce and Animal By-products (CFNA) and the Roundtable on Sustainable Palm Oil (RSPO) to co-launch the China Sustainable Palm Oil Alliance (CSPOA).



Figure 6-1 China Sustainable Palm Oil Initiative



Figure 6-2 The Chinese Sustainable Meat Declaration

2.2 Objectives, uniqueness, driving forces

In order to curb deforestation caused by commodity trade and to protect biodiversity and ecological security, we must tackle the problem from the supply chain overall. As an importer and consumer country of agricultural commodities, China hopes that, through the establishment of industry platforms and declarations, it can raise the awareness and capacities of practitioners and stakeholders of sustainable development. It aims to inspire upstream and downstream partners to coordinate actions and make public commitments in social, economic, environmental, and other aspects, promote the sustainable development



of the supply chain in an all-round way, and ultimately achieve the goal of “Deforestation-Free” and biodiversity conservation.

In the progress of practicing sustainable development of commodities such as palm oil, meat, and soybeans, it turns out that due to the limited amount of raw materials in one product, a single company often falls short in the power of leading a change in the entire supply chain. Even well-known multinational companies have to sacrifice part of their bargaining power to achieve green supply chains. At the Sustainable Palm Oil Supply Chain Forum in July 2016, WWF pointed out that no force alone can achieve the sustainable development of palm oil; significant impact can be realized only when stakeholders act together to form alliances and collegiality. It was the first time that the palm oil industry has publicly announced its plans to establish an industry alliance.

Members of other industries are also actively exploring potentials of sustainable development. In recent years, the meat industry has been affected by public events such as African swine fever and the COVID-19 pandemic. Environmental supervision and inspections have strengthened, and green development has become a rising trend. In October 2017, the China Meat Association, the World Wide Fund for Nature, and 64 leading companies in the Chinese meat industry jointly issued the “Chinese Sustainable Meat Declaration.” The “Chinese Meat Sustainable Development Project Plan,” launched simultaneously, stipulates the “Declaration” as a programmatic document and puts forward clearer, more specific, and more operable goals and tasks.

2.3 Interventions (tools and methods)

2.3.1 Promoting Communications Among Stakeholders: Local Field Survey and Annual Conference

In order to achieve the sustainable development goals of CSPOA and the “Declaration,” members have been conducting regular activities from multiple dimensions to advance the implementation of the plan.

In November 2019, WWF organized a field survey in the countries of origin, leading representatives of Chinese companies and industry associations to Sabah, Malaysia and Singapore to learn about palm oil production. The platform played a crucial role in enhancing communication and understanding between the demand side and the production side.

In July and August every year, CSPOA and the China Sustainable Palm Oil Supply Chain Forum convene an annual conference to review past work and develop future plans. The 2020 conference initiated the CSPOA work roadmap for the next five years. In addition to the forum, CSPOA organizes a conference call for its members at the beginning of each year and interviews absent members individually to ensure their participation.

Concerning the fact that stakeholders in the private sectors had limited knowledge about the issue of sustainable meat development, early activities after the “Declaration” mainly focused on knowledge enhancement. WWF, the Tropical Forest Alliance (TFA) and other organizations jointly organized two rounds of conference calls associated with the beef industry, and one conference call regarding the theme of green supply chains. WWF also organized small-scale discussions between companies in China and Brazil on how to implement the green meat supply chain. The participants include several well-known Brazilian beef companies, such as JBS and Marfrig, and domestic organizations represented by China Meat Association and its member companies.



2.3.2 Leading Practices: Industry Guidelines

On August 21, 2020, at the “Forest Dialogue” Sustainability Forum, China's first consumer-oriented guideline “How to Consume Forest-Friendly” was released, jointly compiled by WWF Beijing Office and China Chain-Store & Franchise Association (CCFA), supported technically by SynTao, and introduced in the “2020 Green Sustainable Consumption Week” charitable campaigns. This guide targets commodities associated with deforestation, aims to promote the issues of forest friendliness and biodiversity and to push companies to make changes through market demand.

On August 19, 2020, CSPOA released the “China Sustainable Palm Oil Sourcing Guideline (Draft for Comment)” at its annual conference. The “Guideline” analyzes the opportunities in the development of sustainable palm oil in China from three aspects: the role of palm oil in China's supply chains, the overview of sustainable palm oil supply chain, and business cases with practice guidelines, all of which provide compelling reasons for companies to purchase sustainable palm oil. Next, the Guidelines will solicit opinions in palm-oil-related industries and conduct pilot projects.

Currently, the WWF Beijing Office and the China Meat Association are jointly compiling the “Specification for meat industry green trade,” and will work to improve organizational standards based on the “Specification.” Future work will include guiding the production, trade, and processing practices of companies, and conducting group standard training and publicity work.

2.3.3 Raising the awareness in private sectors and local communities: Diverse Educational Campaigns

Launched in 2013, the Green Sustainable Consumption Week incorporated the topic of palm oil in 2016. Since then, WWF has been collaborating with RSPO and other organizations to conduct small-scale educational activities. In 2018, the week specifically focused on the topic of palm oil, with an online campaign named “Sustainable Palm Oil Doer” launched on Weibo. These efforts have turned into positive outcomes in raising the awareness of sustainable palm oil among Chinese communities and private sectors.



Figure 6-3 Creative concepts used in “Choose for Forest” Initiative to enhance awareness of sustainable consumption among enterprises and the public

On August 21, 2020, the “Forest Dialogue” Sustainability Forum put forward the “Choose for Forest” initiative. The purpose of the initiative is to promote the procurement and production of materials that are beneficial to the sustainable development of forests, tell more people about the stories around forest protection behind the products, encourage consumers to choose products with sustainable sources of raw materials (paper, wood, soybeans, meat, palm oil, etc.), and eliminate food waste to reduce the waste of natural resources.



2.3.4 Exploring Green Transformation: Tools Developed by Companies

In improving the traceability of supply chains, many companies have not only made sustainable commitments, but also developed a series of tools for education, supervision and certification, carrying out small-scale collaborative work to promote the transformation of green supply chains.

The public commitment of companies to accept public supervision is an important measure to facilitate sustainable supply chains. In 2013, Wilmar International, which controls 45% of the global palm oil trade, issued the world's first "No-deforestation, No-peat, and No-exploitation" (NDPE) policies. After that, more and more companies have made commitments to NDPE.

Companies also use supplier education to help upstream and downstream partners understand the impact of sustainable palm oil and corporate responsibilities. For example, Mars selects refinery suppliers with high standards. By the end of 2021, it plans to sign contracts only with suppliers that meet sustainable certification standards. This practice will significantly reduce the original approximately 1,500 suppliers in the supply chain to less than 100, and further reduce by half in 2022, thereby pushing indirect suppliers to achieve "Deforestation-Free."

In order to eliminate injustice in the sustainable supply chain, companies have developed tools for monitoring, such as the "Facts and Returns Framework" developed by Aarhus Karlshamn (AAK) and the "Palm Oil Alarm System" developed by L'Oréal. These tools help companies to supervise upstream and downstream supply chains by adding contravention cases to the database, investigating and verifying the cases, and formulating countermeasures.

In the process of exploring green supply chains, many companies have spontaneously established collaborative groups to explore market methods to improve agricultural commodity sustainability, such as the Palm Oil Innovation Group and the Sustainable Derivatives Action Alliance.

2.3.5 Formulating Policies: Green Finance

It was relatively late for topics around sustainable supply chains to emerge in the green finance field. While it is an international convention to start with financial institutions, as the project proceeded, it turned out that merely communicating with financial institutions was not enough. It is necessary to further cooperate with financial regulators that have stronger voices in the industry, drive more stakeholders to join, with bank supervision policies as the pivot.

China's green finance has made great progress this year. On July 21, 2020, the People's Bank of China issued the "Notice on the Green Financial Performance Evaluation of Banking Depository Financial Institutions (Draft for Comment)," upgrading green loans to green finance. Organizations such as the World Wide Fund for Nature provided many professional suggestions, and those related to the jurisdiction and forest certification of forest risky products were fully adopted.

Policies favorable to the implementation of green finance are also emerging. On May 29, 2020, the People's Bank of China, in conjunction with the National Development and Reform Commission, China Securities Regulatory Commission, and other departments, drafted and issued the "Notice on 'China Green Bond Endorsed Project Catalogue (2020 Version)' (Draft for Comment)." The document involves a variety of forest friendly certified products, including the RSPO sustainable palm oil certification criteria.



Companies that participate in the transformation of the green market will have priority in obtaining green financial support. On July 16, 2020, China Oil and Foodstuffs Corporation (COFCO) International announced that it has signed an agreement with a consortium of 20 banks to obtain a sustainable development loan of 2.3 billion dollars. As the largest sustainable development loan obtained by global commodity traders, the loan aims to help promote the “Deforestation-Free” project of soybeans in South America. COFCO International also announced that it has monitored all direct suppliers in 25 key cities in Cerrado region, and promised to achieve first-level traceability of all direct source from Brazilian soybean farms by 2023.

2.3.6 Promoting Sustainable Development of Supply Chains in Multiple Dimensions: Supervision and Intervention of Non-Governmental Organizations

The core members with leading positions in CSPOA have issued a series of industry guidance documents, calling on members to actively implement sustainable supply chain transformation commitments. The China Meat Association and the World Wide Fund for Nature are jointly preparing the “Specification for meat industry green trade.” The China Chamber of Commerce for Food, Native Produce and Animal By-products, and the World Wide Fund for Nature have issued the “China Sustainable Palm Oil Guideline” in 2020. The Tropical Forest Alliance (TFA) and its partners created the Forest-Positive Collective Action Agenda, calling on communities to take action to advance worldwide transitions to “Deforestation-Free” supply chains.

Some members published reports to enhance the understanding of deforestation risks by all parties. The Tropical Forest Alliance issued the “TFA 2020 Emerging Market Consumers and Deforestation Report.” The Carbon Disclosure Project (CDP) studied the progress of more than 100 companies in their commitments of sustainable palm oil, and released the “The Palm Book: Tracking progress on sustainable palm oil commitments in Indonesia.” It also assessed the quality of deforestation commitments in the report “From risk to reward: Accelerating corporate action in the palm oil sector.” In 2019, CDP released “The Neglected Risk report: Why deforestation risk should matter to Chinese financial institutions,” using soybeans as an example to explore the relationship between deforestation risks and Chinese financial institutions.

Supporting countries of origin to carry out local projects can also help in achieving sustainable supply chain management. Unilever supported WWF’s “Living Landscape Programme” to “produce, protect and restore,” helped small-scale growers in Sabah, Malaysia and a total of 60,000 hectares of palm tree plantations to obtain sustainable certification, thus achieved broader ecological goals such as “Deforestation-Free,” reduction of carbon emissions and protection of biodiversity.

WWF, together with the local Brazilian non-governmental organization TRASE, used satellite detection technology to develop a traceability system for soybean and meat supply chains. TRASE is committed to mapping the process trajectory of beef from the source to processing and to export, checking the public data of Brazilian production, and measuring the exposure of the local meat export market to environmental and social risks.

Promoting successful international experiences can also inspire Chinese companies. In 2011, WWF published a palm oil buyer scorecard to highlight the progress made by retailers and manufacturers in Europe, Australia, and Japan in sustainable palm oil. The scorecard details the list of companies that have made commitments and purchased sustainable palm oil, and includes the supply chain models they use. Similar scorecard is expected to be used in soybean field starting from 2020.



Some institutions use their advantages to conduct sustainability training for companies. Bureau Veritas Certification has developed a “sustainable development training solution” to train companies in terms of social responsibility, energy management, and resource management. The training aims to ensure that companies master the methods to sustainable development management, as well as the knowledge and tools to evaluate and improve its effectiveness.

Public educational activities can help to raise consumers’ awareness of sustainable consumption. On August 19, 2020, RSPO and Wild Bound jointly initiated the “Nature Creators” Chinese Youth Program. This program aims to improve the awareness of sustainable development and biodiversity among young people, thereby create positive influence on a larger social group and expand the sustainable market for palm oil and other commodities.

2.4 Key results and outcomes

The achievements made in agricultural commodity supply chains mainly manifest in the following aspects: organizing on-site inspections, convening conferences and forums to promote in-depth communications between upstream and downstream stakeholders of the industry, developing guidelines that target different roles in the palm oil and meat supply chains, building awareness and capacities of stakeholders in production, procurement, consumption and other aspects of sustainable development, assisting in the adjustment of green finance policies, thus comprehensively promoting the green transformation of supply chains.

It becomes gradually clear that the results achieved by consumer countries in sustainable supply chains are making a positive impact on biodiversity conservation in the countries of origin. In response to Malaysia’s deforestation caused by palm tree plantations, WWF helped Sabah to work on biodiversity conservation, and achieved the goals of reducing deforestation, reducing carbon emissions, and increasing income.

In 2012, the World Wide Fund for Nature helped Sabah in conducting a biodiversity survey and determined the routes of activities of elephants and other wild animals, hence established an ecological corridor for two fragmented forest habitats. By 2018, due to the reduction of conflicts between plantations and elephants and other animals, crop losses have dropped by nearly 100%. Not only elephants, but also orangutans, sambar deer and even Malay bears have appeared in the corridors.

At the same time, because small- and medium-sized growers, which comprise more than half of the total area, cannot afford expensive certification technology, the local government and NGOs are mobilizing stakeholders through landscape plans and special jurisdictional approaches. The goal is to have 100% of the state's palm oil production achieve RSPO sustainability certification by 2025. So far, 26% of Sabah’s total palm tree area has obtained RSPO certification. Unilever, Walmart and other companies have made commitments and are currently helping 60,000 hectares of land in Sabah to achieve sustainability certification.



Figure 6-4 Display of results of “Deforestation-Free” and biodiversity conservation in Sabah, Malaysia

3 ANALYSIS

3.1 Political Ownership, Collaboration, Approval, and Policy Dimension

Chinese policy research institutions have participated in project research on “Deforestation-Free” supply chains. The issues of sustainable development of palm oil and meat have all entered the Nature Based Solution (NBS) project library of the Ministry of Ecology and Environment. Based on the research results and policy recommendations of the 2016 “China’s Role in Greening Global Value Chains” special policy study, and taking China’s current environment and needs into account, the China Council for International Cooperation on Environment and Development (CCICED) established Special Policy Study on Global Green Value Chain in 2019. The study includes research on the trade and sustainable development of agricultural commodities such as oil, soybeans, and meat; the full report will be available by April 2021.

China’s national policy agencies have also engaged in cooperation and coordinated guidance in the field of green finance. On July 21, 2020, the People’s Bank of China issued the “Notice on the ‘Green Financial Performance Evaluation of Banking Depository Financial Institutions’ (Draft for Comment).” The program upgraded green loans to green finance, which is a major adjustment for financial management and regulatory agencies to adapt to the developing trend of green finance.

Political leaders expressed support for relevant issues at international conferences and other occasions. On November 6, 2019, President Xi Jinping of the People’s Republic of China and President Emmanuel Macron of the French Republic met in Beijing and signed the “Sino-French Beijing Initiative for Biodiversity Conservation and Climate Change,” making a commitment to reduce the forest footprint of both parties in agricultural fields. This initiative is closely related to the issue of sustainable development of soybean and meat.

On October 13, 2020, State Councilor and Minister of Foreign Affairs of the People’s Republic of China Wang Yi and Malaysian Foreign Minister Dato’ Seri Hishammuddin issued a joint press statement in which they



specifically emphasized the importance of sustainable palm oil trade. They agreed to advance corporation in the sustainable development of the palm industry, with compliance to the Malaysian sustainable palm oil certification and Chinese green food certification standards, so as to better prevent deforestation and protect biodiversity.

The progress made in forestry can also set an exemplar for the agriculture industry. On December 28, 2019, the 15th meeting of the Standing Committee of the 13th National People's Congress voted and passed the newly revised "Forestry Law of the People's Republic of China." In 2020, in China's position paper for the United Nations Summit on Biodiversity, China included commitments and practices of "Deforestation-Free" in the timber industry. With more than ten years of experience in sustainable development, the forestry industry is conducive to guiding the sustainable development of the agriculture industry.

3.2 Inclusiveness of Partnership

3.2.1 Engaging Multi-dimensional Stakeholders

The aforementioned two major industry cooperation and communication systems are inclusive at all levels. The initial stage of the platform focused on recruiting members. By increasing the awareness of sustainable development, corporate members were encouraged to join and make commitments. The first step in the preparation of the platform is to examine whether members meet the recruitment criteria, reach out and assess their awareness of the sustainable development of supply chains, and improve their understanding through repeated lobbying. Some companies did not have a deep understanding of sustainable supply chains; international companies generally have better knowledge than domestic companies. Nonetheless, they all have reached a certain level of consensus through the efforts in the past two years.

Although the sustainable supply chain platform is industry-oriented, its goal is to establish a multi-stakeholder communication platform, including production, processing, trade, manufacturing, financial investment, supervision, certification, and nature conservation organizations. The platform not only meets the needs of the industry's own interests, but also enables members in different fields of expertise to use their professional experience to promote the sustainable transformation of the supply chain from multiple angles.

3.2.2 Collaborating with Local Industry Associations, Increasing Momentum within Industries

The strategy for the establishment of the platform is to give priority to finding local associations for cooperation, such as the China Chamber of Commerce for Import and Export of Foodstuffs, Native Produce and Animal By Products in the palm oil and soybean fields, and the China Meat Association in the meat field. After gaining the understanding and support from local partners on the concept of sustainability, they must play their leading role in the industry to encourage major companies to actively participate in communication, and thus gain more recognition from stakeholders. This strategy can enhance the locality of the platform and enhance the sense of belonging and ownership of companies in the industry.

3.2.3 Combining Perspectives from Both Home and Abroad

The focus of international organizations such as WWF is on preventing deforestation and other internationally influential issues, while the focus of local industry associations and domestic companies is on the development prospects of their industries. Therefore, when the two parties cooperate, they can



integrate different perspectives from both home and abroad, increase the comprehensiveness of the industry declaration, and drive members to achieve their goals more effectively on the ground of consensus.

3.3 Sustainability and Transferability

3.3.1 Establishing the Platform: Building Capacity in the Initial Stage

After the establishment of the platform, a strong input work form based on due-date meetings was adopted in the initial stage. The expected design of the palm oil field is divided into five modules including policy influence and capacity building. In the field of the meat industry, platform-based activities are carried out from a range of perspectives such as policy, industry, enterprise, public, and finance. Members of the World Wide Fund for Nature and the Chinese Meat Association have jointly initiated many small meetings and activities to raise public awareness. The two organizations are also working together to develop the “Specification for meat industry green trade”, and will carry out pilot work in the future to put concepts into practice.

3.3.2 Participation in Private Sectors: Improving Awareness and Capacities

In the process of implementing the plan, many stakeholders in private sectors expressed a certain degree of concern. First of all, some companies did not have an adequate understanding of the concept of “Deforestation-Free” and sustainable supply chains, which caused obstacles to the implementation of the plan. Secondly, even though many have made promises and proposed positive visions, there are complex details to be managed in the actual practicing process. It requires a considerable amount of time to improve the awareness and ability of different departments within the company. Therefore, the actual process was slower than expected.

In addition, the model adopted by Chinese companies is different from the one of Western companies. In the common international model, companies first publish a long-term transformation plan, formulate more operable short-term plans under the long-term one, and announce the progress of the work at each due date. However, with regard to domestic sustainable development issues, companies are more inclined to hide their plans, and will only announce them in advance if it is certain that the plans will be realized. Otherwise, they will make the plans public only after any progress is made.

Companies are concerned about the uncertainty of the effectiveness of the plan. In order to overcome these suspicions, the established platform is not only open to its members, but also encourages non-members to participate. Under the consent of the members, certain implementation practices will also be open to non-members, so that they can have an understanding of the topics in advance and get ready for future participation.

3.3.3 Countries of Origin: Enhancing Communication and Understanding

The influence of supply chain issues is cross-national: the results of “Deforestation-Free” of palm oil manifest in Indonesia and Malaysia; the results of “Deforestation-Free” of meat manifest in South America— neither of which can be directly presented to domestic companies. Therefore, in order to help the companies to understand their potential contribution and responsibilities in the supply chains, it is crucial to demonstrate the relationship between sustainable supply chains, deforestation prevention and biodiversity conservation to them. This provides the basis for the successful implementation of the following plans.



WWF promotes communication between Chinese and foreign members on the platform through the network of offices in the countries of origin. WWF also leads stakeholders to visit Sabah in Malaysia to enhance mutual understanding, especially the demand side's understanding of the ecological environment and the significance of "Deforestation-Free." Although it is currently impossible to link the achievements of sustainable supply chains in China directly to specific areas of production, it is possible to estimate the impact through the efforts in the trade field, ensuring progress in the rainforest protection in the countries of origin.

3.3.4 International Experience: Tools for Reference, Exploring Localized Practices

The practice has proved that responsible value chains can effectively curb deforestation. At present, the international community is supporting "The Statement of Support for the Cerrado Manifesto (SOS)" that spans more than 135 companies and institutions across 6 industries to reduce the deforestation and land conversion caused by soybean planting in Cerrado, Brazil. In 2015, seven European countries signed "The Amsterdam Declarations". By 2019, 74% of European palm oil imported for food production needs has met the RSPO sustainability certification criteria. The amount of palm oil consumed in China is close to that of the European Union, but the market share of sustainability certified palm oil is just over 1%, which means there is still much room for improvement. Some international companies have formulated their own independent corporate roadmaps, work plans or policy visions. Relatively speaking, domestic companies are still lagging behind in terms of management of the sustainable development system and multi-dimensional perspectives. Drawing on international experience and exploring localized practices based on specific national and industry conditions will help to better achieve sustainable development goals.

At present, China's agricultural commodities have not yet formulated strict, clear goals on sustainable development. RSPO stated at the CSPOA launching ceremony that it hopes that 10% of China's total palm oil imported will be RSPO certified sustainable by 2020. Although this goal has not yet been achieved, an increasing number of companies have participated in the transformation of supply chains in recent years, reflecting the efforts made in the Chinese market. Goals that are overly ambitious can inflict pressure on stakeholders, and it needs more patience to foster consensus among all parties and lay a solid foundation for the ultimate realization of the goals.

4 KEY MESSAGES AND RECOMMENDATIONS

China's platform for sustainable agricultural commodity supply chains has accumulated certain experience and outcomes at different levels, including the establishment of an inclusive dialogue mechanism within the industry, covering the multi-dimensional upstream and downstream stakeholders of the supply chains, strengthening the communication and understanding between the consumer country and the countries of origin, promoting the joint participation of policy institutions in research, and adjusting policies to guide the industry to achieve sustainable development goals. However, as the platform is still in its exploratory stage, problems in many aspects remain. For example, the current certification system and prices are dominated by large companies and are not favorable to smallholders. High certification costs often exclude the smallholders from sustainable supply chains.

The development of sustainable agricultural commodity supply chains to prevent deforestation and protect biodiversity is in line with the requirements of the ecological civilization construction and the "Green Belt



and Road" initiative. It is also a crucial way to achieve the United Nations Sustainable Development Goals (SDGs). Based on the existing experience, we recommend that governments around the world send clear signals to the market to encourage the realization of green global value chains, jointly develop pilot projects for sustainable palm oil, soybeans, meat, and other commodities with countries of origins, and adopt green financial policy adjustments to lead companies to purchase sustainable palm oil, soybeans, and meat, and pass legislation to regulate corporate behaviors.

As an important participant in the Belt and Road Initiative, private-sector stakeholders should actively make public "Deforestation-Free" commitments, achieve clear traceability of supply chains, monitor risks, and ensure that commitments and actions cover the entire company and are applicable to all countries where the company operates. Private-sector stakeholders should also continue to increase the proportion of certified sustainable products, actively create demand for sustainable palm oil, soybeans, and meat through green market transformation, adjust the production and management investment plans for the countries of origin to ensure the sustainable supply of "Deforestation-Free" products, and support forest restoration, smallholder inclusion and biodiversity projects.

The strategy of NGOs should span the entire supply chain, fully utilize their professional and network advantages, and share the best practices in the green production of global agriculture and forestry commodities. NGOs should cooperate with manufacturers to ensure the adoption of better management tools, increase consumer demand for sustainable products, and achieve green market transformation. NGOs should support the producer and consumer countries to formulate relevant policies that guide the sustainable development of supply chains. They should promote the full use of degraded land for agricultural activities, and protect the natural forest resources and biodiversity from further damage. NGOs should also cooperate with financial institutions, encourage them to support the green transformation and sustainable development of enterprises. They should help foster the consensus of sustainable consumption across society through public campaigns and educational activities.



Case 7. Mainstreaming Biodiversity in Agricultural and Land Management Policy Framework of Lao PDR

1 GENERAL INFO

LOCATION: Lao PDR

IMPLEMENTATION PERIOD: April 2011 – December 2016

KEY INITIATOR AND STAKEHOLDERS:

“Mainstreaming Biodiversity in Lao PDR's Agricultural and Land Management Policies, Plans and Programmes” was a Global Environment Facility (GEF) funded full-sized project. GEF funding was US\$ 2.27 million, and with planned co-financing of US\$ 4.44 million the total project budget was US\$ 6.80 million.

The project executing agency was the United Nations Development Programme (UNDP) with the Department of Planning and Cooperation (DOPC) of the Ministry of Agriculture and Forestry (MAF) as the national executing partner. The United Nations Food and Agriculture Organization (FAO) was the primary partner for technical assistance. At provincial level (Luang Prabang and Xieng Khouang), the main stakeholders were Provincial Agriculture and Forestry Office (PAFO) and Provincial Natural Resources and Environment Office (PONRE). At the district level (Phonexay and Phoukout), the main stakeholders were District Administration Office, District Agriculture and Forestry Office (DAFO), District Natural Resources and Environment Office (DONRE), selected secondary schools, and Lao Women Union. Field activities were carried out within 7 villages evenly distributed across the 2 target districts. The villages were selected based on their status in relation to agrobiodiversity.

2 DESCRIPTION

2.1 Introduction

Introduction of agriculture into human civilization more than 10,000 years ago triggered a landmark transformation in our history - extensive human population growths and activities (Taiz 2013). Since then, in a more modern history, agriculture and food production have always been a top priority in the development agenda of the countries worldwide. With the world population expected to reach 10 billion by the year 2050, at least 50% more food will be needed to produce (Ranganathan et al 2018).

However, expansion of agriculture also needs to minimise its negative impacts to the environment. Food production is the biggest driver of biodiversity loss, land use change and deforestation, although it is tremendously dependent on the well-functioning of nature. For instance, 75% of all food crop types – including vegetables, fruits and some of the most important cash crops – require animal pollination, yet pollinators themselves are under threat (IPBES 2019). 70% of freshwater is used for agriculture (FAO 2017) and agriculture is also a key contributor to climate change (IPCC 2020). In recent decades, agrobiodiversity has been critically impacted by intensive farming, large-scale land use change and deforestation. Modern methods in the crop cultivation and animal husbandry have steadily decreased the biological diversity of crop varieties and livestock breeds. In connection with food security, it is crucial to prevent the further rapid loss of biodiversity of genes, varieties, breeds, species and entire ecosystems as the advancement of plant



and animal breeding profoundly depend on the availability of an extensive pool of genetic material. The source of this great biodiversity is largely found in wild varieties, on traditional farms or in the wilderness in the Global South.

Under the Belt and Road Initiative (BRI), China is strengthening agricultural cooperation with the countries involved, aiming to make a greater contribution to global agricultural development and economic growth (Xinhua 2018). The scale is sizeable; during 2014-2019 China's global investment in agriculture sector is almost US\$ 72 billion (AEI 2020). According to FAO, this could bring positive results to both China and those countries, where agriculture accounts for more than 25% of GDP and more than 40% employment that millions of farmers and fishers depend on (FAO 2017). However, although agriculture is important for generating and promoting sustainable livelihoods, it is essential, particularly for commercial large-scale agriculture, to ensure natural resources and biodiversity conservation, as well as rural development promotion, among others.

This case study presents an example of efforts to mainstream biodiversity in agriculture sector of Lao PDR, a country neighbouring to China that has attracted a large sum of investment in agriculture under the BRI. It shows how potentially a country can protect biodiversity in agriculture sector and hopefully can inspire other countries involved in agribusiness under the BRI.

Lao PDR, locating within the BRI's China – Indochina Peninsula Economic Corridor, has a population of about 6.8 million people, in which the agricultural sector accounts for around 70% of employment (UNDP 2015). The country has one of the highest levels of forest cover in Southeast Asia, i.e. 81% of total land area (FAO 2015). Thanks to its wide ranges of latitude and altitude, tropical climate and rich water resources, Lao PDR's tropical ecosystems host a large number of globally and locally significant species of plants, animals, fungi and other organisms. These ecosystems also include diverse agroecosystems - from the slash and burn agriculture in the uplands, long-established agroforests in the central, to paddy fields, household or community managed wetlands in the lower-lying lands of the Mekong Plain. The wealth of Lao PDR's agrobiodiversity is attributable to various factors: location between two major biogeographical zones – temperate in the north and tropical in the south, high ethnic diversity, and different climatic and altitudinal zones. The country's globally significant agrobiodiversity include cultivated local and indigenous varieties of rice (with over 3,000 local varieties and at least three species of wild rice), maize, sugar cane, bushy peas, livestock, and crop-associated biodiversity such as wild crop relatives, pollinators and other insects (UNDP 2018).

The Lao Government's overall development goals focus on poverty reduction, economic growth and social development. These cover not only advancement of infrastructure and investment in hydropower and mining, but also protection of the environment with acknowledgement of the significance of the sustainable use of the natural resources as well as the conservation of forests and biodiversity for future economic growth. However, despite a number of policies and laws relating to the conservation of biodiversity including agrobiodiversity developed, the policy and management mechanisms had been rather ad-hoc and greater attention was needed on the management of agroecosystems and agrobiodiversity. Moreover, incentives and capacities to mainstream biodiversity, especially agrobiodiversity, at community, district, province and national levels, were insufficient.



2.2 Objectives, uniqueness, driving forces: case study driving force from an economic-social perspective

The project sought to contribute to a long term solution by which “Lao PDR’s biodiversity, including agrobiodiversity, is maintained, protected and sustainably used as a key to poverty alleviation and adaptation to climate change impact” (UNDP 2010).

The project’s overall aim was to conserve biodiversity in agricultural landscapes of Lao PDR through mainstreaming biodiversity-focused measures in agriculture and land management policies. In so doing, the project addressed impacts of agriculture on biodiversity both in situ and ex situ, emphasising on species of global significance, at the wider landscape scale within agroecosystems.

Objective of the project was to provide farmers with the necessary incentives, capabilities as well as to support institutional framework to conserve agricultural biodiversity within farming systems of Lao PDR. The project comprised two overarching components, the first focusing on national policy while the second on village level actions. The outcomes/components and outputs were as follows (UNDP 2010):

Component 1. National policy and institutional frameworks for sustainable use, and in situ conservation of biodiversity in agroecosystems

This involved the mainstreaming of agrobiodiversity aspects into national legislation, as well as the development and promotion of policies that encourage and support the active conservation and sustainable use of agrobiodiversity in agricultural landscapes. Under this outcome, the four outputs focused on (1) Integrating agrobiodiversity into policies, (2) Promoting coordination on agrobiodiversity, (3) Enhancing institutional capacity for agrobiodiversity, and (4) Increasing understanding among key stakeholders of agrobiodiversity and its significance.

Component 2. Capacities and incentives to mainstream biodiversity, especially agrobiodiversity, at the provincial, district and community levels

This focused on the development of incentives and capacity for the community, district and provincial levels on conservation and sustainable use of agrobiodiversity. Its six outputs were concentrated around: (1) Strengthening the capacity of PAFO and DAFO on agrobiodiversity management and on extension packages and services, (2) Conducting Participatory Land Use Planning including the development and implementation of Participatory Natural Resources Management plans at village level to identify products for sustainable use and niche marketing, (3) Establishing in situ agrobiodiversity conservation areas to protect local biodiversity hotspots, (4) Promoting biodiversity-friendly farming approaches at two pilot sites, (5) Identifying and developing market incentives for agrobiodiversity for farmers and agribusiness, and (6) Linking the private and public sector through agrobiodiversity planning agreements.

2.3 Interventions (tools and methods)

The project worked strategically with central government, local authorities, agribusiness sector, NGOs, farmers, development partners, other projects, and the general public to make biodiversity a key consideration in routine day-to-day decision making. Particularly, the project closely collaborated with the Swiss Agency for Development and Cooperation (SDC)’s ‘The Agro-biodiversity Initiative’ (TABI), which operated in the same pilot provinces.

It is one of the Laos’s pioneering projects on integrating biodiversity conservation in land use policies. According to the project’s terminal evaluation report, a number of strategically important steps have been



initiated by the project in order to concretise actions for mainstreaming agrobiodiversity conservation in land use policies and plans. These included (UNDP 2018):

- Mainstreaming of biodiversity considerations into agricultural and land management plans, laws, strategies and guidelines
- Capacity building at the provincial, district and community levels for government staff and farmers through workshops, training sessions, study visits, field practices, etc.
- Establishment of linkages between different actors within the government to cooperate in complementary ways
- Creation of value-added biodiversity products for farmers' income improvements
- Dissemination of results through materials such as posters, booklets, videos
- Farmer field schools programme, study visits and seminars to inform, share experiences and network not only within Lao PDR but also in the region for South-South cooperation.

These actions are all significant steps for facilitating mainstreaming agrobiodiversity conservation in land use policies and plans. Below are highlights of key interventions:

In terms of policy mainstreaming, the project made contributions to the National Biodiversity Strategy and Action Plan (NBSAP) 2011-2020 (which was finalized in 2013), the National Agricultural Biodiversity Programme II (NABP II, finalized in 2014), Upland Development Strategy (2013), among others, through providing substantive comments, providing technical lead in drafting the document, supporting the funding for consultation process, etc. The overall aim was to include a section or objective on agrobiodiversity and its targets or indicators related to agrobiodiversity conservation to ensure future investment and action in support of agrobiodiversity in Lao PDR.

Another significant national-level project contribution was that the project was instrumental to the establishment of a national agriculture multi-stakeholder "Sub-sector Working Group on Agrobiodiversity". This is under the Sector Working Group on Agriculture and Rural Development, chaired by the Ministry of Agriculture and Forestry, aiming to support the implementation of the National Socio-Economic Development Plan (NSED) and the country's efforts on eradicating extreme poverty and hunger, as well as on ensuring environmental sustainability. The Sub-sector Working Group on Agrobiodiversity was established in 2013 to bring together technical experts from key institutions and organisations to discuss critical issues related to agrobiodiversity, and provide strategic guidance and policy advice for conserving agrobiodiversity (e.g. for the NABP and national targets related to agrobiodiversity).

At the pilot level, an important activity was the farmer field schools (FFS), where a series of hands-on training events were conducted for selected farmers within the pilot districts with an idea for the trained farmers to further share the knowledge and skills more widely in their communities. Experts from other countries, for example Thailand, conducted the training on both theoretical and practical aspects. These included topics of concept of agrobiodiversity and the application of biodiversity concept in farming system, cultivation and protection of native crop varieties, integrated pest management (IPM), organic vegetable home gardening, organic rice, home production of bio pesticides and fertilisers, inter-cropping techniques, rice-fish co-farming, among others. The FFS was also provided to extension officers and school students.



2.4 Key results and outcomes (especially about biodiversity conservation and sustainable use)

The project has resulted in a number of successes on agrobiodiversity conservation that span policy aspects, coordination mechanism, as well as provincial, district and farm-level capacity enhancement. Those key results are presented below (UNDP 2018):

- Sub-sector Working Group on Agrobiodiversity established
- 102,300 ha allocated for improved management of agrobiodiversity conservation
- 2 Provincial Biodiversity Strategy and Action Plan (PBSAP, for Xieng Khouang and Luang Prabang provinces)
- Oyster mushroom, wild tea and Melientha agriculture systems introduced and implemented as prioritized by the local government and local people at the pilot districts of the 2 provinces
- Promotion of agrobiodiversity crops, such as the indigenous sticky rice Khao Kai Noi, and
- facilitation of verification and certification issuance for the organic agricultural products
- Wild tea, mushrooms and medicinal plants survey of the new and known species, as well as technical guidelines for planting and cultivating these agrobiodiversity products
- 4 fish conservation zones in rivers and rice paddy fields identified and implemented for sustainable use and conservation of fish species, as well as included in the land use planning developed by the project
- 36 village-based Forest and Land Use Plans Allocation and Management, including the allocation of village conservation areas, approved by the district governors
- 740 rice farmers (37% females) and 361 vegetable farmers (81% females) graduated from the season-long (typically 1 time per week) farmer field schools (FFS) in 53 villages of the two target provinces
- 350 students from local schools and 14 extension staff also trained under the FFS on IPM, rice and vegetables production etc.
- Several publications and communication materials produced, e.g. success story, posters, technical reports

Some of the most successful results are highlighted below (UNDP 2018; UNDP 2016):

Support to policy mainstreaming and coordination

The project has provided substantial contributions to mainstreaming of biodiversity considerations into agricultural and land management legislation, as well as the development and promotion of policies that support sustainable use of agrobiodiversity in agricultural landscapes. These policies included the Upland Development Strategy, the second NBSAP (under the Convention on

Biological Diversity: CBD), the Aichi Targets in the 5th National Report to the CBD, NABP II, and Provincial Biodiversity Strategy and Action Plan (PBSAP). Moreover, the project also supported the establishment of the Sub-sector Working Group on Agrobiodiversity, as well as assisted this working group to develop national targets for agrobiodiversity related production and conservation. All these would be instrumental for further actions to conserve agrobiodiversity at national and provincial levels.



Integration of agrobiodiversity conservation in land use planning and in situ conservation

The project supported the TABI project in finalising and validating the Forest and Land Use Plans Allocation and Management (FALUPAM) of Phoukout District (Xieng Khouang province) and Phonexay District (Luang Prabang province). A total of 36 village FALUPAM, which included allocation of altogether 102,300 ha for improved management of agrobiodiversity conservation, have been approved by the district governors. Moreover, with proactive participation of the villagers, the project supported the two target districts on establishing conservation areas, for example fish conservation zones, wild tea conservation areas, and medical plant conservation areas. These in situ conservation areas help to protect and increase the agrobiodiversity for communities and are crucial for successful implementation of PBSAPs in the two target provinces.

Adding value to agrobiodiversity products

The project also promoted selected value-added agrobiodiversity products, such as oyster mushroom, wild tea and wild Melientha (vegetable), through technical knowledge, materials and equipment for production as well as packaging and labelling along with partnership establishment with local traders and marketing. Particularly, according to a project study (Pedersen et al 2016), a large number of the Phou San Wild Tea, which was largely cultivated inside forests of various densities in Xieng Khouang province, was sold as fresh tea or semi-dried tea mainly to Chinese traders. Besides, the project conducted studies that would not only contribute to sustainable harvest but also to promote economic values of the selected high-value wild species, e.g. wild mushrooms (in general), the wild mushroom “Xieng Khouang Matsutake”, and wild tea.



Figure 7-1: Wild tea planted inside Phou San forest (left, credit: Pedersen et al 2016) and wild Melientha (right, credit: Pha Khao Lao 2020)

Capacity development and awareness raising

A number of capacity building and awareness raising activities were organised at national, provincial, district and community levels for different types of stakeholders to promote the integration of sustainable use and conservation of agrobiodiversity. These were done in the forms of workshops, training sessions, on-the-job training, training of trainers (TOT), study visits, field demonstrations and FFS (particularly the IPM modules), among others, for government officials (at central, provincial and district levels – particularly agricultural extension officers and technical officers), community leaders, school teachers, farmers and school students. The TOT programme was provided not only within the project districts but also to all districts in Luang Prabang and Xieng Khouang provinces. The farmers who graduated from vegetable-based ecosystems module, as part of the FFS, later on transferred their new knowledge to 186 neighbouring villagers at the

‘Farmers Field Day’. Organic native rice with approved certification from the government can also be sold with higher price. Moreover, at Pha Tad Ke Botanical Garden in Luang Prabang, the project supported the establishment of four ethnobotanical plants for the public to learn.

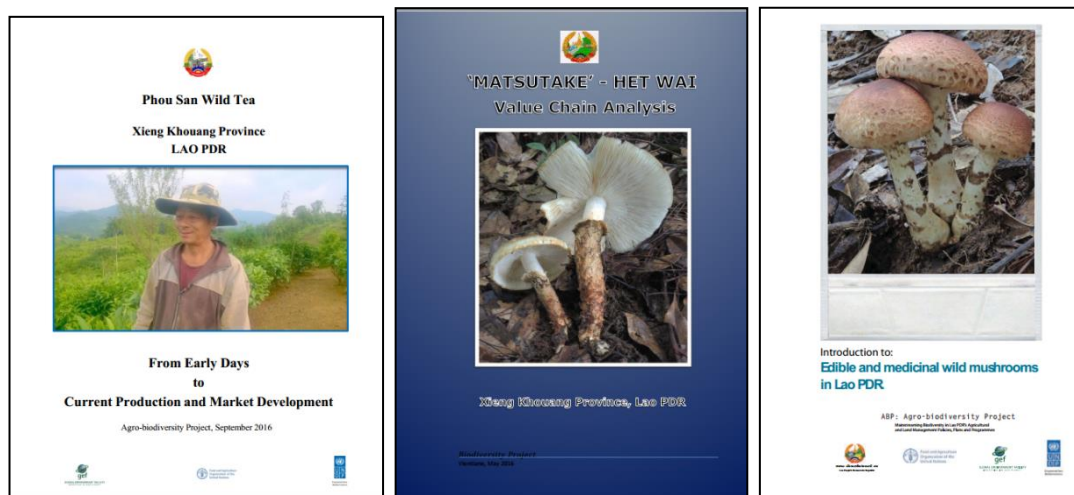


Figure 7-2: Examples of project publications

3 ANALYSIS

3.1 Political ownership, collaboration, approval, policy dimension

Through working closely with the government at different levels, particularly from the Ministry of Agriculture and Forestry (MAF) and Ministry of Natural Resources and Environment (MONRE), as well as with other agrobiodiversity-related initiatives in the country, the project obtained substantial support on policy aspects. A series of capacity development events for government staff directly enhanced their knowledge in relation to strategies and planning on agrobiodiversity conservation at national, provincial and district levels as well as on how to implement these actions with local communities on the ground. Importantly, the “Sub-sector Working Group on Agrobiodiversity” that the project contributed to the formation is a national body that provides policy advice for conserving agrobiodiversity. Besides, the project collaborated with other initiatives, especially TABI, to achieve the policy goals. Last but not least, the project steering committee (PSC) was chaired by Vice Minister of MAF. The PSC held annual meetings to discuss progress made on project implementation, to take related decisions and to review and approve the annual work plan. All these have contributed to the success of the project’s policy dimension, resulting in agrobiodiversity considerations mainstreamed in a number of national and provincial strategies and action plans.

3.2 Inclusiveness of partnership

According to the project’s terminal evaluation report (UNDP 2018), stakeholder participation process during the project preparation was solid and very relevant. Also, during the project implementation, the stakeholder participation as planned in the project design was achieved. During the project formulation stage, information was comprehensively collected from different ministries, UN agencies, development partners, other projects, NGOs, and individuals with relevant experiences and knowledge. A series of workshops were also held at national and sub-national levels to inform about ideas and to gather opinions. Decisions on how to design the project, the areas of focus and pilot sites were based on this process. During



the project implementation stage, the inclusive stakeholder participation strengthened both the horizontal links (between government agencies in the capital city as well as between provincial and district bodies) and the vertical links (within the ministries based in the capital city and their offices at provincial and district levels). The entry points for interactions included the concrete tasks related to agrobiodiversity conservation mainstreaming into various plans and strategies as well as several capacity building activities. For interventions at the pilot districts, the collaboration was mainly facilitated by the District Agriculture and Forestry Office (under MAF) at the pilot districts. The project team and local partners held quarterly meeting, which was important to monitor the project progress. Activities implemented at the pilot sites were identified through consultations with local government staff and communities. Also, at local level gender issue was particularly given attention, especially on beneficiaries at pilot districts. For example, the total number of FFS graduated farmers were 398 (43% females) and 613 (48% females) in Phonexay and Phoukout districts, respectively.

3.3 Sustainability and transferability

Several factors have contributed towards sustainability of the project interventions, according to the project's terminal evaluation report (UNDP 2018), particularly the formation of the Sub-sector Working Group on Agrobiodiversity and integration of agrobiodiversity into the broader development framework. Mainstreaming agrobiodiversity considerations into national policy is important to create a national-level and long-term impact. This was a major focus of the project since the beginning. To be realistic with the limited project duration and budget, the project took opportunity to provide inputs only to the relevant new policies being developed or those under revision – not the ones already ongoing, which would be too ambitious. The working group has continued, although without the project's secretarial assistance, which is crucial for agrobiodiversity coordination at national level. Also, FAO has taken further steps to formulate a project on underutilised crops and livestock related agrobiodiversity. The PBSAP for Xieng Khouang and Luang Prabang provinces for sustainable use and conservation of agrobiodiversity are in progress, led by MAF and MONRE. At local level, the in situ conservation interventions will continue to protect and increase the agrobiodiversity on site. Production of high-value agrobiodiversity products, such as oyster mushroom and wild tea, will continue and can be sustained if the farmers find it profitable with market access, however microfinance might be needed to support the farmers lacking own funds. In terms of replication, strategic partnership with other initiatives (in this case, TABI) and strong support from the government will be beneficial on agrobiodiversity mainstreaming into policy. Moreover, site selection for pilot interventions is another crucial factor. The inclusion of villages/districts where both poverty rate is high and agrobiodiversity resources are abundant can be an asset to learn from this project with appropriate adjustments to the country and local context.

4 KEY MESSAGES AND RECOMMENDATIONS

Key messages

This project was among the first in Lao PDR to address the integration of agrobiodiversity into agricultural and land management policy framework. Through combination of the protection of local species diversity and introduction of agricultural practices that help lift families out of poverty, along with actions at policy level and capacity building, the project outputs have been considered successful. Therefore, this project should be replicated in other regions where agrobiodiversity is an issue.



Economic dimension is also fundamental to address the agrobiodiversity issue as economic incentives and market forces are among the primary drivers of threats to agrobiodiversity. In this regard, the project improved the understanding of these aspects with a focus on crop and crop-associated biodiversity, including on wild tea. Lao tea yearly export, with the total value of USD 6 to 10 million, is approximately 1,200 tons - of which nearly all is to China, where there are growing demands for organic and wild tea (Pedersen et al 2016). This presents an evident opportunity for the BRI investment in agribusiness to promote agrobiodiversity conservation while supplying the agricultural products to China. Those products can include not only various sources of tea from different countries but also other important imported ones, e.g. soybean, cereal grains, bananas, rubber and edible vegetable oil. If it is not feasible to commercialise the wild and native species of these products, the BRI investment can still promote biodiversity-friendly way of production, e.g. rubber agroforestry and sustainable banana farming. In fact, this practice could go beyond the BRI up to the global trade of agricultural products.

Recommendations

Agrobiodiversity plays a crucial economic role in Lao PDR, where rural people rely on a large number of species for their diet. However, commercialisation of agriculture, including replacing traditional varieties with a few high-yielding varieties, mono-cropping, large-scale land conversion, and overuse of pesticides and fertilisers, has resulted in the reduction of the diversity of crop, livestock and wild species. Many local varieties of rice and other crops have been displaced by improved varieties with greater needs for agrochemicals. Wild relatives of rice and other terrestrial and aquatic species are at risk from changes in land use and agroecosystems. This unsustainable farming intensification and its negative results are actually common in many countries involved in the BRI. Therefore, it is essential to consider this issue, particularly in the countries with similar context that the majority of population depend on the biodiversity of their natural environment on a daily basis for food security, nutrition and livelihoods.

China has in recent years considerably increased the investment in agricultural technology advancement. Some of these technologies can enhance soil health, promote biodiversity, reduce wastage, promote nutrient recycling, promote diversification and integration, and build on local knowledge. This is a promising South-South cooperation opportunity for the Chinese agricultural businesses and research institutions to work with their counterparts in the BRI countries. International organisations can also be engaged in the process.



Case 8. Conservation and utilization of Agarwood resources in Hainan and its joint pilot in Southeast Asia

1 GENERAL INFO

LOCATION: Hainan province of China, Malaysia, Thailand and Cambodia

IMPLEMENTATION PERIOD: 2015-2020

KEY INITIATOR AND STAKEHOLDERS:

The project is funded by the Ministry of Agriculture and Rural Affairs of the People's Republic of China, the Provincial Government of Hainan Province, the Hainan Provincial Science and Technology Department, the Hainan Provincial Agriculture Department and the Hainan Provincial Forestry Bureau. It is initiated by the Chinese Academy of Tropical Agricultural Sciences, with technical support from the Institute of Medicinal Plants of the Chinese Academy of Medical Sciences (Hainan Branch), the Institute of Forestry Science of Hainan Province. It is participated by leading enterprises of Hainan, Universiti Putra Malaysia, Chiang Mai University of Thailand, Royal Agricultural University of Cambodia and a number of overseas enterprises.

2 DESCRIPTION

2.1 Introduction

Agarwood is a plant of Thymelaeaceae (*Aquilaria* Lam.) containing black resin. It is a world-famous spice and precious traditional medicinal material. Agarwood is a sacred object recognized by the five major religions in the world. It is known as "Diamond of the wood" and "the top-grade of all fragrances". It was one of the essential commodities of the Maritime Silk Road. Agarwood is mainly produced in Malaysia, India, the Philippines and countries in the Indo-China Peninsula. In China, Agarwood is produced primarily in Hainan, Guangdong and Guangxi provinces and is called domestic agarwood or earthen agarwood. The record of agarwood began in Tao Hongjing's "Famous Medical Records" in the Liang Dynasty. There are also records of agarwood in the Old Testament of the Bible. It has been used in the Middle East, China and Japan for at least 3,000 years. According to statistics, the current wild resources of agarwood species are mainly distributed in Asia. On the diversity of agarwood, there are 15 species in Southeast Asia and three species of *Aquilaria* in South Asia. The main species of *Aquilaria* in East Asia are *Aquilaria Sinensis* (Lour.) Spreng. and *A. yunnanensis* SC Huang.

Agarwood is an important Chinese traditional medicine, widely used for treating digestion, breathing, cardiovascular, rheumatoid and other diseases. Modern pharmacological studies show that agarwood is effective for treating diseases related to digestive system, respiratory system, cardiovascular system and central nervous system.

The demand for agarwood has also significantly increased, as people's living standard and health concern raises. Agarwood becomes one of the world's most expensive spices with a high economic value and a limited supply of products. For instance, Singapore spends more than \$1.2 billion a year to import agarwood. However, unregulated deforestation over a long period and at a big scale has led to agarwood scarcity in the wild. Therefore, agarwood plant resources have now become a precious plant resource that



countries of origin are competing to protect. Nowadays, all agarwood plants have been included in the "IUCN Red List of Threatened Plants" and "The Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES)" for protection. These days, most of the agarwood produced in the market is artificially created by the incense-making method. "The Flora of Hainan" records that *Aquilaria sinensis* is mainly distributed in Baoting, Lingshui, Sanya, Ledong, Dongfang, Wenchang and other places, and has its habitats in the mountains or hills of middle altitude. The main driving force of Hainan agarwood trees' endanger status are human-made destruction and low natural reproduction rate.

Cultivation is currently the most effective way to meet the demand for agarwood raw materials. At present, China, Malaysia, Thailand, Lao PDR and other countries are vigorously promoting the cultivation of agarwood trees. The total number of agarwood planting in China has reached 30-50 million, and 5-10 million trees are still being planted every year to maintain the momentum of rapid demand growth.

The selection and breeding of new varieties is the way out to adjust the planting structure and provide high-quality agarwood. Although agarwood trees cultivation has decades of history, issues exist in the systematic evaluation and selection of agarwood germplasm resources. The seeds used are from cultivated or wild-aged plants, without systematic screening. The germplasm is uneven, with genetic diversity and instability. The biological characteristics of cultivated white agarwood differs from the wild, with less fragrance production and unstable quality. With the continuous expansion of agarwood planting scale in China and abroad, the investigation of germplasm resources should be strengthened. Its adaptability, aroma quality and stress resistance should be screened comprehensively. It is important to select high-yield and high-quality tree species with excellent traits for promotion and planting, optimize the structure of agarwood tree planting, conduct systematic evaluation and research on the germplasm resources of agarwood original plants; and carry out the selection and breeding through different breeding techniques.

The breakthrough of artificial agarwood-inducing technology needs to address the bottleneck problem that can improve the agarwood industry. The main reasons that have restricted the industrialization of agarwood for a long time are mainly due to the long production cycle and slow results. Since the growth cycle of the agarwood tree is long, it takes several years for the tree to reach the pharmacopoeia requirements for artificial cutting, drilling, sawing, and other methods to form agarwood aroma. Planting, growing, and harvesting generally takes twenty to thirty years or even longer. Therefore, under the condition that agarwood's quality can be guaranteed, the problem of how to shorten cycle of harvesting needs to be solved urgently.

The establishment of standards as well as the inspection and testing institutions is an important guarantee for ensuring market order and safeguarding the interests of consumers. For a long period, the agarwood standards at national, regional, sector and enterprise levels have been missing which limited this industrial development. Product standards also need to be formulated and improved to promote industrial development. Due to the high value of agarwood, diverse production areas, unique fragrance, scarce resources, etc., problems like agarwood fraud have become serious. The identification agarwood authenticity is judged by experienced practitioners using fire, water test, nose smell, etc. It is subjective and of low credibility. Therefore, an authorized inspection and testing agency is necessary as a third-party agency to serve the industry.



2.2 Objectives, uniqueness, driving forces

The project has been strongly supported by the Ministry of Agriculture and Rural Affairs of China, the Chinese Academy of Medical Sciences, the Hainan Provincial Department of Science and Technology, etc., in cooperation with various agarwood associations and enterprises in Hainan Province, and the participation and support of Malaysian, Thai and Cambodian governments, scientific research institutions, and enterprises. The overall demand for agarwood in the world has increased, and prices have continued to rise. The core issues that restrict the industry's development are variety optimization, large-scale production, breakthroughs in agarwood-inducing technology, product development and service system development. The project's overall goal is to promote the healthy, rapid and systematic development of the world agarwood industry. The specific objectives are 1) Multi-party cooperation to explore an efficient industry chain development model, including agarwood investment, planting, processing, development, and services. 2) strong science and technology support for industry development, including select a batch of good varieties, build standards and products. 3) establish demonstration sites to stimulate the industry development in surrounding areas and countries. 4) strengthen international cooperation with participating countries.

2.3 Interventions (tools and methods)

Interventions can be divided into the following categories:

- (1) The Chinese government guides, supports, funds, and creates a favorable environment for the development of the agarwood industry. The funding provided includes the construction and operation of demonstration sites, selection and breeding of new varieties, research and development of agarwood-inducing technology, seedling propagation and promotion. A cooperation model of "scientific research institutes + industry associations + leading enterprises + cooperatives + farmers" was also created. The scientific research institutes carry out basic research, develop scientific and technological products, and build connection with BRI countries. The leading enterprises invest in planting, processing and product development. The cooperatives and farmers carry out planting, agarwood-inducing and rough processing.
- (2) Provide support for cooperatives and farmers' production activities. Following the subsidy policies, 500 yuan per mu for seedlings will be given, or seedlings will be sent to the field for free. The seedlings donated are generally 2-year-old agarwood trees with a high survival rate and rapid growth. According to the Forest ecological service compensation policy 50 yuan/mu during the project period is provided. At the same time, an ecological compensation mechanism to solve protection areas' livelihood and development issue is gradually established. Farmers surrounding the public forests can join the forest protection team, and thus increased employment and farmers' income.
- (3) Capacity building for sustainable development. The project provided training in cultivation method, water and fertilizer management, pest control, breeding and agarwood-inducing technology. It played the vital role for agarwood cooperatives by guiding planting, agarwood-inducing, essential oil extraction and rough processing, job creating, and marketing, Information-based supply platform. This effectively protect farmer's interests by supporting all support from planting, processing to marketing.
- (4) Enhance global influence. International events are held such as agarwood fairs, expos, and exhibitions. Participants exchanged knowledge on the latest developments in agarwood, and share displayed agarwood products. Tourism and trade also expand the international influence of Hainan Agarwood. Lots of events



were organized, including annual agarwood Expos (January 1st of each year) in Wenbifeng, Ding'an, the Fifth China (Hainan) International Agarwood Tourism Trade Fair in 2016; the Haikou International Agarwood Industry Development Conference in 2017 and 2018, the Haikou International Agarwood Industry Sustainable Development Conference in 2018, the 4th Haikou International Agarwood Industry Development Conference in 2019. Government officials and practitioners of agarwood producing countries were invited to participate.

With regard to the scientific and technological service guarantee system, the activities below were carried out:

- (1) Scientific research: Scientific research institutions (including in other participating countries), led by the Institute of Tropical Bioscience and Biotechnology (Chinese Academy of Tropical Agricultural Sciences) and the 'Hainan Branch' Institute of Medicinal Plant development (Chinese Academy of Medical Sciences), systematically summarized the chemical components and synthetic pathways of agarwood during the project period. They conducted in-depth research on the whole genome of *Aquilaria sinensis*, isolated and identified many compounds. Also, a series of fundamental studies on pharmacological activity and metabolomics have been carried out to provide scientific and technological support for the development and utilization of agarwood.
- (2) Standard formulation: To standardize the agarwood industry market, under the leadership of the state and government authorities at all levels, research institutions, enterprises, associations have formulated or participated in the formulation of national standards, national forestry industry standards, local standards in Hainan Province, and enterprise standards.
- (3) Establishment of inspection and testing departments: To regulate the market and safeguard the rights and interests of consumers, Hainan Province has established specific inspection and testing departments related to agarwood in recent years. Approved by Hainan Provincial Bureau of Quality and Technical Supervision, several agencies have been established to provide third-party testing services.
- (4) Guiding documents were formulated by the government: These include "The 13th Five-Year Plan (2016-2020) for Science and Technology Development in Hainan Province", "Opinions of the People's Government of Hainan Province on Accelerating the Transformation of Agricultural Development Modes and Enlarging and Strengthening High-Efficiency Agriculture with Tropical Characteristics (2016)", "Notice of the General Office of the People's Government of Hainan Province on Issuing the Implementation Opinions on the Protection and Development of Chinese Medicinal Materials in Hainan Province (Qiongfufu Office [2016] No. 224)", "Agarwood Industry Development Plan 2018-2025 in Hainan Province", "Healthcare Industry in Hainan Province Development Plan (2019-2025)", and "Hainan International Agarwood Expo Park Conceptual Planning Plan (2020)".
- (5) Breeding of new varieties: During the project period, the Chinese Academy of Tropical Agricultural Sciences made breakthrough progress by systematically breeding three fine varieties of *Aquilaria sinensis*, which solved the shortcomings of artificially cultivated agarwood trees such as low yield, low quality and poor fragrance. Hainan province takes this as an opportunity to establish a demonstration site for breeding and cultivation of improved varieties to promote the upgrading and adjustment of the planting industry structure.



(6) Breakthrough in agarwood-inducing technology: During the project period, scientific research institutes and civil organizations have applied for and approved some patents related to agarwood-inducing technology. The development of agarwood-inducing technology and demonstration sites have been recognized by the government, industry, and enterprises, and have been widely used.

(7) Knowledge generation: Since 2015, three high-tech monographs on agarwood have been published, which comprehensively guide *Aquilaria* plants breeding, planting, agarwood-inducing, investment and other aspects. They also were used for training and knowledge exchange with other countries.

(8) Research and development: Traditional agarwood products mainly include agarwood incense tablets, incense powder, ornaments, accessories, bracelets, incense, essential oils, etc. The scientific research institutions and industries involved in the project expanded the form of agarwood products, continuously reduce costs, and develop high-tech products that are accessible to local consumers.

2.4 Key results and outcomes

Cultivation: Taking this current policy as an opportunity, especially after the implementation of the "Greening the Hainan Island" and the "10,000 Mu of Agarwood cultivation Trees" project, the breeding and planting of agarwood trees in Hainan has developed rapidly. So far, according to the special survey data of the 4th General Survey of Traditional Chinese Medicine Resources in Hainan Province and the development of artificial agarwood trees planting in recent years, the area of agarwood trees planted on Hainan Island has reached 105,000 mu (7000ha). Calculated by an average of 200 trees per mu, there are a total of 21 million trees. Those over 20 cm high reach 35,000 mu and nearly 4 million trees. In 2014, Malaysia planted about 2,764 acres of agarwood trees, with 15.711 million trees, mainly distributed in Perak, Pahang and Sabah. During the project period, the number of agarwood trees increased to about 20 million, of which at least 3 million trees can be used for inducing. In 2016, Thailand planted 9.272 million trees, and now there are about 15 million trees. According to on-site investigations, by 2019 there were 5 million trees planted in Cambodia.

Research progress: So far, more than 160 monomer compounds have been isolated and extracted from agarwood. The chemical components of "Qi-nan" agarwood have been studied in depth. The breakthrough was published online in well-known international journal *Natural Product Reports* entitled "Natural products in agarwood and *Aquilaria* plants: chemistry, biological activities and biosynthesis". The research provides a scientific basis for further revealing the formation mechanism of agarwood and continuously improving artificial methods to increase the yield of agarwood. In 2020, the Chinese Academy of Tropical Agricultural Sciences released the detailed genome map, which will lay a good foundation for the conservation biology of wild *Aquilaria* species, the mechanism of agarwood, fragrance genes and the evolution of tree species. It will also provide possibilities for further genome-based molecular breeding of *Aquilaria* plants.

Breeding of new varieties: The improved varieties of *Aquilaria sinensis* "Reke 1" (the improved variety number: Qiong R-ETS-AS-010-2016), "Reke 2" (the improved variety number: Qiong R-ETS-AS-003-2017) and "Reke 3" (the improved variety number: Qiong R-EST-AS-002-2019) were systematically selected and bred. The selected varieties have their own characteristics, among which the biggest advantage of "Reke 1" lies in the agarwood inducing large piece of agarwood for making handicrafts. The biggest advantage of "Reke 2" is high quality, and easy to be induced in the young forest stage. "Reke 3" has a hard texture, good quality, and



good aroma. At present, "Reke 2" is the main varieties promoted in Hainan, Guangdong, Guangxi, Yunnan, Fujian and other provinces in China.

Agarwood inducing technology: There are mainly 6 national invention patents on agarwood-inducing technology being awarded. The advantages of these new technology are shortened production cycle, high output and low cost. The above-mentioned patented technology is widely used in the project area, accumulating yield at 1 million trees. If calculated at 1kg/plant, it will produce 1 million kg. Even at a lower price of 1,000 yuan/kg, it will creating value of 1 billion Yuan.

Standard formulation: The project has contributed to the formulation of national standard, the Hainan Provincial Local Standard and Enterprise Standard, etc.

Establishment of inspection and testing institutions: These include Hainan Analysis and Testing Center of Institute of Medicinal Plants, Chinese Academy of Medical Sciences (established in 2015), Hainan Li (South) Pharmaceutical Analysis and Testing Center (established in 2016), Hainan Wenwan Agarwood Appraisal Center (established in 2017), Hainan Plant and Its Products Judicial Appraisal Center (established in 2018), Hainan Agarwood Association Hainan Agarwood Appraisal Center (established in 2018).

Key Publications: "Agarwood Practical Cultivation and Artificial Agarwood Inducing Technology" published in 2015, "World Agarwood Industry" and "Modern Research on Agarwood" in 2017.

Demonstration base established: Demonstration bases established in Hainan are for agarwood-inducing technology, new varieties planting and collection of germplasm resources, mainly distributed in Haikou, Danzhou, Chengmai, Qiongzhong, Wenchang and other places, covering an area of more than 800 mu. The construction of overseas demonstration bases is mainly for planting and agarwood inducing. Among them, 200 acres of demonstration bases have been established in Penang, Muar and Kuching, Malaysia; 160 acres of demonstration bases in Bangkok and Chiang Mai, Thailand; and 180 acres in Kampot and Sihanouk provinces of Cambodia. In each demonstration zone, they have played a good role in demonstration.

Product research and development: The scientific research units and enterprises involved in the project have developed a variety of new products of agarwood, including agarwood skin care products series (face mask, eye cream, cream, moisturizing lotion, lotion, facial cleanser, hand cream), agarwood daily necessities series (shampoo, shower gel, handmade soap, gynecological lotion, pillow), agarwood food series (leaf tea, tobacco, wine, instant noodles), etc.

3 ANALYSIS

3.1 Political ownership, collaboration, approval, policy dimension

Hainan has unique advantages in geographical location and environmental conditions and has been favoured by national policies, especially following the speech of Chinese President Xi Jinping in 2018 and the spirit of the national policy document to build a national tropical agricultural science centre and support the prosperity of Hainan, as well as the introduction and transfer base of global animal and plant germplasm resources. In 2019, China's General Administration of Customs issued the "Customs Supervision Plan for the Import and Transfer Base of Global Animal and Plant Germplasm Resources" to support the construction of the Hainan Free Trade Pilot Zone (Port). Following this, Hainan Province is thoroughly implementing these mentioned above. The provincial government presided over the active preparations for the formulation of



the "Hainan Global Animal and Plant Germplasm Resources Introduction and Transfer Base Implementation Plan." Introducing global animal and plant germplasm resources into the transfer base and building it into a landmark project in the Hainan Free Trade Pilot Zone and a free trade port with Chinese characteristics, setting a benchmark for similar projects in the world. It has brought opportunities for the development of the agarwood industry in Hainan and even the world, further strengthened international cooperation, and serving the national strategy of "Belt and Road Initiative".

The Hainan Provincial Government issued the "Hainan Agarwood Industry Development Plan (2018-2025)" in 2018. In 2019, it proposed to emphasis agarwood development, requiring full efforts to build a scientific research support system and a standard system, product system, branding system, policy system, cultural system, and system of integration with the health industry, etc. In this context, the agarwood industry development was guided by market demand, supported by sciences and technology, provided with policy and financial support by the government.

3.2 Inclusiveness of partnership

Under the government's policy guidance and financial support, the scientific research institutions can build agarwood research teams, with advanced equipment to engage in basic research, demonstration and promotion, industrial services, and international knowledge exchange. Industry associations and enterprises also fully participate and play an important role. These are the leading groups in the primary, secondary and tertiary industries of agarwood, such as those investing in large-scale planting, variety, commercialization, and organizing international events e.g. agarwood expo, fair, exhibition. They promote industrial exchanges at home and abroad, and cooperate with the completion of new species selection trials in the research field, application and promotion of agarwood-inducing technology, standard formulation, product development, and so on. Farmers' cooperatives and farmers are direct beneficiaries of policy support through, for instance, financial subsidies, free seedlings. With the broad industry prospects and high-tech help, local farmer change their perspective, use abandoned land, or replaced the existing trees (such as rubber trees) and upgraded to agarwood forests. 779 agarwood enterprises in Hainan emerged in this project period, which promoted employment and increased income.

The project involved a large number of stakeholders, both within China and other participating countries. The domestic government agencies include the Ministry of Agriculture and Rural Affairs, the Hainan Provincial Party Committee and Provincial Government, the Hainan Provincial Department of Science and Technology, the Hainan Provincial Department of Agriculture, and the Hainan Provincial Forestry Bureau. The foreign government agencies include the Malaysian Timber Industry Bureau, Sarawak Forestry Bureau; Thailand's Ministry of Natural Resources and Environment; and Cambodia's Ministry of Agriculture, Forestry and Fisheries. The foreign scientific research institutions are Universiti Putra Malaysia, Chiang Mai University in Thailand, and the Royal Agricultural University in Cambodia. Hainan associations engaged with many enterprises. Foreign companies include Asian Plantation Capital Corporation (APC), Malaysia BBB Group, Malaysia Global Rainforest Resources Corporation (GRRSB), Tianyuan Agarwood Ecological Technology Co., Ltd., Feb Plantation Co., Ltd.

This project's main feature is to give significant role of the scientific research team to lead the development of the industry with science and technology. The team was headed by the Chinese Academy of Tropical Agricultural Sciences and the Institute of Medicinal Plants of the Chinese Academy of Medical Sciences to focus on the chemical components of agarwood with pharmacological activity, molecular biology,



metabolomics, new variety breeding, agarwood inducing technology research, standard formulation, establishment of inspection and testing institutions, product development, scientific and technological training, etc. In particular, nearly 1/3 of the chemical components of agarwood in the world have been published and established a database, released the whole genome sequence of *Aquilaria sinensis*, researched and developed the complete body/whole-tree agarwood inducing technology and was vigorously applied and promoted, selected and bred 3 agarwood fine varieties to encourage the upgrading and adjustment of the agarwood industry structure, and established a society of third-party inspection and testing institutions. The service guarantee system takes the "Belt and Road" as an opportunity to connect with foreign scientific research institutions/enterprises, increase mutual trust and cooperation, drive the economic development of countries in the tropical area, and promote the development of the agarwood industry worldwide.

3.3 Sustainability and transferability

Wild plant resources are one of the essential resources that humans rely on for survival. They play an irreplaceable role in the ecosystem. Additionally, they are a vital source of edible, medicinal and raw materials and essential materials to cultivate new varieties. Nowadays, all plant resources of the genus *Aquilaria* are included in the "IUCN Red List of Threatened Plants" and "Convention on International Trade in Endangered Species of Wild Fauna and Flora: CITES" for protection. To import and export wild resources, countries around the world all have established strict approval procedures, which are of great benefit to the protection of wild genetic resources of agarwood trees. Not only that, in Hainan, government agencies also delineate natural reserves and categories, provide annual financial support, and use forest police to crack down on illegal activities (e.g. illegal logging), solve the employment issues of local farmers (e.g. forest rangers), and protect wild agarwood resources. The national forest natural reserves in Hainan are mainly distributed in Bawangling, Jianfengling, Tongguling and Wuzhishan. Malaysia has Xinglou Yunbing National Park, Dahanshan National Park, Sarawak Mulu National Park, Sabah Kinabalu National Park, Penang Botanical Garden, etc. Thailand has more than 60 national parks, including Khao Yai National Park, Mae Wong National Park, Khlong Lan National Park, etc. Cambodia has Bokor National Park, Ream National Park, Phnom Kulen National Park and so on. With the increasing market demand, under government policies and the investment of industries/enterprises/cooperatives, agarwood cultivation at home and abroad has been carried out for 30-50 years and still expanding. Besides, planting technology, variety advantages, breakthrough of agarwood-inducing technology, advancement of processing technology, diversification and popularization of products, and the continuous improvement of the service guarantee system have all together contributed to a virtuous development of primary, secondary and tertiary industrial chains.

Since 2015, China's Ministry of Agriculture and Rural Affairs, the Ministry of Health, the Hainan Provincial Government and its affiliated units have continued to support the development of the agarwood industry, and provided policy and financial support for BRI related cooperation. In this regard, agarwood scientific research institutions and enterprises are encouraged to connect with overseas government agencies, scientific research institutions, enterprises, among others, to simplify the approval procedures and facilitate the export of new products, the exchange of germplasm, the construction of demonstration bases, and to gradually expand to other countries.



4 KEY MESSAGES AND RECOMMENDATIONS

Key messages

The project is originated from Hainan, and have global vision to applying sustainable conservation and using of agarwood approach to establish it industry for joint benefits and development. This project engaged all levels of government departments, enterprises and research institutions, practitioners in China and abroad, and gained support in policy, science and technology, capital, personnel and other aspects.

In the course of the project implementation, the research institute represented by the Institute of Tropical Biotechnology of the Chinese Academy of Tropical Agricultural Sciences has played an important scientific and technological supporting role. It involves in basic research, seed resource garden construction, variety selection, aromatis technology, standard-setting, inspection and testing service guarantee system establishment, demonstration base construction and product development. The successful selection of the good species of white wood agarwood, "Reke 1", "Reke 2" and "Reke 3" has promoted the upgrading of agarwood cultivation industrial structure. The establishment of a series of standards and inspection and testing platform is essential for market oriented development. A series of incense new product development, especially in line with the mass consumption of daily necessities and food series were developed to meet needs of general public.

Recommendations

(1) The development and utilization of agarwood genetic resources require a strengthened protection of its wild resources. Large-scale artificial breeding and cultivation of agarwood trees only protect wild resources at an indirect level. The security of wild resources helps enrich the gene pool and lays the foundation for further scientific research, such as species selection and breeding. Large-scale cultivation has continued for decades, but it still cannot meet the market demand. Thus, it is necessary to further expand the scale and standardize cultivation management.

(2) The development of the agarwood industry must be led by science and technology. With scientific innovation, together with support from government, industry and enterprise, technology will be transformed into productivity. The industry is promoted to develop in a sustained, rapid, healthy and orderly manner, to solve labour employment and increase farmers' income. Germplasm resources of agarwood in tropical countries along the BRI are vibrant. The relevant scientific research, like variety breeding, fragrance technology, product research and development, service system, and other foundations in these countries are still relatively weak. The agarwood industry's success story supported by science and technology can be shared with these countries.

(3) The development of the agarwood industry must break through the bottleneck problem. How to shorten the period of cultivation and agarwood induction? How to improve the quality of agarwood? How to increase production? The breakthroughs in large-scale cultivation technology, agarwood inducing technology, and selection and breeding of new varieties are the "motors" that promote the entire industry's development. The technologies and combinations in this project need to expand the demonstration scale further, increase publicity, increase public awareness, and turn the concepts to practical actions so that scientific and technological achievements can be transformed into productivity more quickly.



(4) The development of the agarwood industry must have a complete social service security system. This includes the necessity to establish a service guarantee system framework from multiple levels of law, technology, publicity, etc.; improve relevant laws and regulations; establish the standardization of cultivation, planting, agarwood inducing, processing, and products; establish agarwood identification and quality evaluation systems; and establish inspection and testing institutions. In addition, it is also crucial to strengthen market supervision and a crackdown on counterfeiting crimes, and earnestly safeguard the rights and interests of investors, operators and consumers.

(5) The development of the agarwood industry must broaden the scope of product application. Agarwood is still defined as a rich-consumer product. With the improvement of the social economy and agarwood's popularity, its price will return to relatively stable mass consumption in the future, forming a pyramid pattern from mass consumption to elite consumption. This is also the ultimate ideal pattern for the development of the agarwood industry. The agarwood daily chemical products, agarwood household products, and agarwood skincare products developed by the project participants are designed and developed to cater to this development concept.

(6) The agarwood industry's development must involve multiple parties for their respective advantages. Guided by the market and the government, a development model of "scientific research institutes + industry associations + leading enterprises + cooperatives + farmers" is established, which will serve the development of industries from the aspects of policy, technology, capital, circulation and services, and make full use of geographic location. Resource advantages, in-depth exploration of the cultural heritage of various countries, regions, and ethnic groups, create brand effects and promote the agarwood industry's joint development in multiple countries around the world with the "Belt and Road" as the link.



Case 9. Role of Women in Conservation and Sustainable Use of Agricultural Biodiversity: a Case from Guangxi, China

1 GENERAL INFO

LOCATION: Guzhai Village, Mashan County, Nanning City, Guangxi Zhuang Autonomous Region, China

IMPLEMENTATION PERIOD: 2000-present

KEY INITIATOR AND STAKEHOLDERS:

This is a project jointly supported by many research institutions and foundations such as the International Development Research Center (IDRC), the International Institute for Environment and Development (IIED), the German Food for the World Foundation (BROT), and Oxfam. The participatory action research team led by researcher Song Yiqing of the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences (formed the Farmers' Seed Network in 2013) was implemented. International partners include institutions from Peru, Kenya, India and other countries. Domestic partners include the Institute of Crops, Chinese Academy of Agricultural Sciences, Corn Research Institute of Guangxi Academy of Agricultural Sciences, Yunnan Agricultural University, Sichuan Agricultural University and many other scientific research institutions.

2 DESCRIPTION

2.1 Introduction

As the foundation of human survival and development, biodiversity is also deteriorating under the impact of climate change and human activities. In the past 100 years, global biodiversity has declined sharply, and agricultural biodiversity, which is closely related to human food security, is also rapidly decreasing. From the perspective of China's agricultural sector, the protection of domestic crop varieties resources is not optimistic, and the loss of crop heritage resources is very serious. For example, in the 1940s, there were more than 46,000 rice varieties grown in China, and by 2006, there were only about 1,000 rice varieties grown nationwide. With the rapid decline of on-farm varieties, the multiple negative consequences of the ecological and breeding fields, such as the sharp decline of biodiversity and the narrowing of germplasm resources, have become increasingly apparent. At the same time, a large number of hybrid varieties promoted and used in modern agriculture need to be combined with large-scale machinery and a quantity of chemical inputs, resulting in the gradual disappearance of applicable technologies, relevant local knowledge and culture in the traditional farming system, which features biological cultural diversity and environment. The friendly connotation of small-scale farmers' production methods and their farmers' seed systems are being threatened and destroyed by large-scale and single production modes.

At the same time, in the process of the transformation from traditional agricultural society to modern industrial society, the large-scale transfer of rural labor is an important feature. After the large transfer of labor, the phenomenon of "agricultural feminization" has appeared in China's rural society. This phenomenon, caused by the lagging transfer of rural female labor force, reflects the inequality of the status of men and women and the imbalance of gender development in China. In the context of the feminization of agriculture, smallholder farmers, especially women, play an important role in protecting agricultural



biodiversity and achieving sustainable development goals. They are the actual managers and developers of agricultural biodiversity.

The "International Treaty on Plant Genetic Resources for Food and Agriculture" adopted by the United Nations Food and Agriculture Organization in 2001 has recognized farmers' rights to maintain and develop their crop genetic resources. However, smallholder farmers are mostly disadvantaged groups, and it is difficult for them to ensure the sustainable use of plant genetic resources and share the benefits of using these resources. At the same time, most countries in the world have large-scale public agricultural research and extension systems with abundant experts and technicians. If this kind of public research and extension system is combined with smallholder farmers with women as the main force, and the protection and development of traditional seed resources are organically combined with modern science and technology, it will help realize community development, agricultural biodiversity protection, and climate change adaptation. At present, many parts of the world have developed such cooperative methods of "hiding the seeds from the people", the most important of which are participatory breeding based on community development and the establishment of rural seed banks.

Since 2000, under the coordination of the Participatory Action Research Project Team of the Chinese Academy of Sciences (hereinafter referred to as the "Project Team"), in cooperation with the Crop Institute of the Chinese Academy of Agricultural Sciences, the Corn Research Institute of the Guangxi Academy of Agricultural Sciences and other scientific research institutions in 6 villages in Guangxi, the Participatory Plant Breeding (PPB) project was implemented, and scientists and breeders joined farmers to start trials and research on "participatory breeding". This is a collaborative research conducted with research teams from Peru, India, Kenya and other countries. Guzhai Village in Mashan County is one of the first project communities.

Guzhai Village in Mashan County (administrative village and community are on the same scale, hereinafter referred to as "community") is located in a remote mountainous area in Guangxi, about 150 kilometers away from Nanning (the capital of Guangxi). The steep karst mountainous terrain and rushing streams are the main characteristics of local natural environment. This is an administrative village dominated by Zhuang and Yao minorities, with 26 villages under its jurisdiction. In 2018, the community had 1,515 households with 3,987 people. The elderly account for 30% of the community, and the aging is relatively serious. There are 1,800 laborers, 700 agricultural laborers, and 70% of female farmers. The feminization of agriculture is prominent. The community has a total of 2,052 mu of arable land, with an average land area of 1.35 mu per household, all of which are without irrigation facilities. Farmers grow corn (86% of the sown area), vegetables and various grains on the steep slopes between the rocks and on the flat and narrow land. In 2018, the per capita income was 6,500 yuan, of which agricultural income accounted for only 20%.

2.2 Objectives, uniqueness, driving forces

The project team conducts action research in more than 30 rural communities in 10 provinces across the country. The team encourage communities and research institutions to cooperate in the protection, utilization and innovation of farm seeds, improve farmers' livelihoods and enhance their dignity, and promote national seed security. Gender is an important perspective. Guzhai Village in Mashan County is a community that has been carrying out the project activities since 2000 and so far implemented in four phases, with the main objectives as follows:



Project phase I: 2000-2004

To carry out participatory action research and connect the two major seed systems through PPB to improve crop quality, biodiversity improvement and women's empowerment

Project phase II: 2004-2007

To focus on local traditional variety resources, carry out variety selection and improvement, register community variety resources

Project phase III: 2008-2011

To explore the cooperation of ecological agriculture and traditional species conservation, build a Community Supported Agriculture bridge, support women's cooperation groups to explore direct connections with urban consumers to improve farmers' livelihoods while conserving traditional varieties

Project phase IV: 2012-Present

To set up women's cooperatives, explore the sustainable development path of the community, establish a community seed bank.

2.3 Interventions (tools and methods)

2.3.1 Participatory selection and breeding

Participatory Plant Breeding (PPB), also known as Farmer Participatory Breeding (FPB), is an approach of genetic improvement of plants within a species through the participation and close cooperation of researchers, farmers and other related parties. It also aims to improve the quality of cultivation methods, that meet farmers' needs, improve farmers' seed systems, and improve the narrow genetic base of breeding and the degradation of biodiversity. Throughout the cycle of R&D activities, researchers and farmers jointly choose the varieties that farmers prefer. While the researchers (breeders) contribute their modern breeding techniques, the farmers contribute their local varieties, breeding experience and local knowledge, as well as directly participate in field experiments and selection of variety traits. The involvement of end users, i.e. farmers, to the PPB breeding process not only reflects the real needs of agricultural planting, but also preserves local provenance, which is beneficial to protecting agricultural biodiversity.

2.3.2 CSA (Community Supported Agriculture)

The project team supports CSA to support smallholder farmers to develop ecological planting and breeding based on local varieties. In the community, farmers are guided to maintain and improve local varieties, but because of limited economic benefits farmers are not very enthusiastic about the protection, planting and improvement of local varieties. Therefore, the project team guided the community to cooperate with the local NGO-Ainong Association in Guangxi, combining local varieties with ecological planting and breeding methods, and selling them at a price higher than the market through the model of CSA. Therefore, this has increased the added value of local varieties and improved the livelihood of local farmers, which will increase their enthusiasm for planting and improving local varieties. Under the coordination of the team, the Guzhai Village Women's Cooperation Group has established close ties with the Love Farmers Association. The agricultural products sold through CSA include corn, soybeans, vegetables, poultry, fruits, and Chinese herbal medicines.



2.3.3 Support the development of women's organizations in the community to achieve women's empowerment

When the project was first involved in the Guzhai Village of Mashan Valley, it supported 5 interested women to form a women's cooperative group. Later, as the community's economic links became more frequent, the women's cooperative group was registered as a formal cooperative and a member of the cooperative at the Industrial and Commercial Bureau while the members are mainly women. The cooperative has a formal management structure with multiple functions. The cooperative manages the community fund, provides technical services for planting and breeding, and also builds capacity of the members by providing reading materials, organizing visits to other farmers and farmer groups, and regularly participating in local and regional training activities.

2.3.4 Register community resources and support the establishment of rural seed banks

In order to protect traditional varieties and traditional knowledge, the project has created a "genealogy" for the biological and cultural resources in the community, and preserved the diversity of crop varieties in the community through records. Under the guidance of the project team, Guzhai Village started to try to register local variety resources in 2006.

The rural seed bank refers to the community's own maintenance and management of the collection of seeds. The seeds can be stored in large quantities by the community to ensure that there are available production materials, or small samples can be used to store genetic materials that are available when the species is endangered. Guzhai Village's rural seed bank was established in 2018.

2.4 Key results and outcomes

2.4.1 Alive conservation and sustainable use of local crops and traditional varieties

Improvement, breeding and technology dissemination of traditional varieties: Since 2000, community women have carried out a series of activities such as protection, purification and rejuvenation, breeding, around traditional varieties of crops such as corn, soybeans, to ensure the continuation and development of traditional varieties of the community. From 2006 to 2008, they carried out PPB breeding experiments with breeders and successfully cultivated the "Gui Nuo 2006" variety. This variety have been welcomed by consumers within and outside the community until present. In the community, about 7-8 farmers conduct seed production on 3-4 acres of land each year, and can harvest about 200 kg of seeds a year, which brings continuous and stable income to seed farmers. In an exchange event organized by the Farmers' Seed Network in 2014, the women of Guzhai also taught seed production techniques to women in Shitocheng Village, Baoshan, Yunnan.

Rural seed bank: A rural seed bank was established in 2018, and currently 27 traditional varieties (including 15 beans, 2 corn, and 10 melons and vegetables) are preserved. The rural seed bank has also established a connection with the government gene bank. In 2019, researchers from the Maize Research Institute of Guangxi Academy of Agricultural Sciences collected three local germplasm resources of ink white corn, local yellow corn, and local waxy corn from Shanggulatun, and added them to preserve in the National Gene Bank and Guangxi Academy of Agricultural Sciences.

Community resource registration: By the end of 2019, the community has registered a total of 124 traditional varieties of resources (including 9 varieties of corn, 11 varieties of beans, 8 varieties of melons, 24



varieties of vegetables, 53 varieties of Chinese herbal medicine). The agricultural products such as vegetables, corn and dry lotus root that the cooperative is currently focusing on are mainly derived from traditional varieties.

Domestication of wild vegetables: The president of the cooperative takes the lead in the domestication of wild vegetables, hoping to develop local resources and expand community vegetable varieties.

2.4.2 Carry out ecological circular agriculture according to local conditions, protect biodiversity and community ecological environment

The "corn- pig-vegetable" ecological circular agriculture model explored by the cooperative uses cornmeal and remaining vegetable leaves to feed pigs. After the pig manure is treated by the biogas digester, it can not only fertilize the fields, but also produce biogas for family use. The organic vegetables and farmed pigs are mainly used for sales. In this process, farmers continue to explore the prevention and insect prevention technology of organic planting, such as interplanting shallots with other vegetables to prevent insects, and using insect killers to control insect pests. In the entire production process, organic planting does not use chemical fertilizers and pesticides, and raising pigs does not add feed, which reduces the pollution of chemicals to the soil and water, effectively protects the environment, and improves the farming environment in rural areas. At the same time, it provides consumers with natural, pollution-free, high-quality ecological agricultural products, which have been recognized by consumers.

2.4.3 Gradually optimize and expand the scope of production and operation, and increase the participation and economic benefits of farmers

Number of cooperatives has grown from 28 to 96, and the number of farmers in the community has gradually increased. In 2013, the cooperative only had 57 members. The total annual income of ecological vegetables and native pigs was 605,000 yuan, and the average household income was about 10,000 yuan. By the end of 2019, the Guzhai Women's Cooperative model had expanded to the surrounding 5 villages with 96 members. It has 150 mu of organic vegetables gardens and 26 vegetable varieties. It is estimated that in 2020, the sales income of vegetables would be 1.57 million yuan, and the average household income would reach 15,000 yuan.

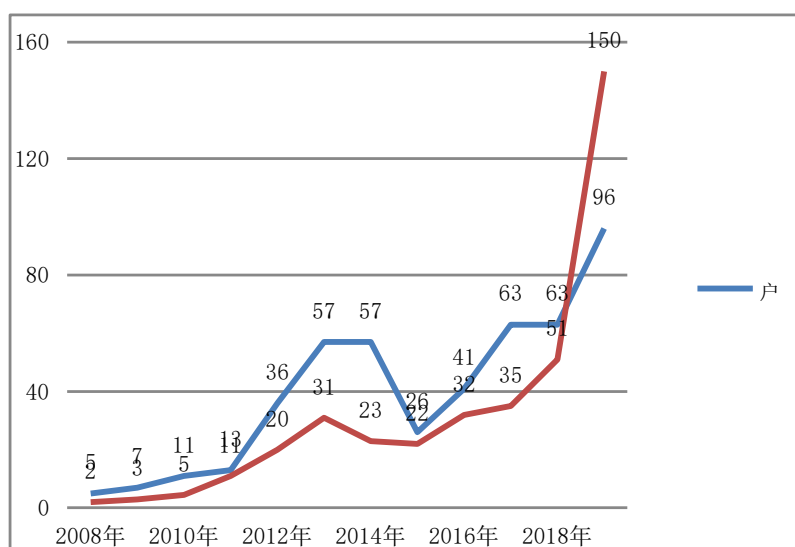




Figure 10-1: (above) The number of farmers in the cooperative and the area of organic vegetables. (below)
Picking organic vegetables (Photo: Simon Lim)

2.4.4 Enhance the leadership and capacity building of rural women to promote the sustainable development of communities

For 20 years, the leader has been leading community women to protect and improve traditional varieties, adhere to the concept of ecological recycling agriculture and fair and sustainable development, and actively participate in and assist in the organization of training and exchange activities for the project team. Under her leadership, from a women's cooperation group to a cooperative, the number of women participating in the cooperation has gradually increased. The female actively participates in the operation and management of the cooperative, and their ability has been greatly improved. At present, the core team of cooperative management and operation is mainly women, and the main body of planting and breeding is also mainly women. In this process, the rural women participating in the cooperation have awakened their subjective consciousness and their comprehensive capabilities have been improved, which has promoted the sustainable development of the community.

3 ANALYSIS

3.1 Achieving co-benefits and balancing trade-offs

Beginning with participatory breeding in 2000, to the sustainable use of agricultural biodiversity to increase farmers' income and improve the ecological environment of the community, from a female leader to a cooperative group of 8 women, it has grown to nearly 100 households. The cooperative has achieved the "three harvests" of economic, ecological and social benefits. 1) In terms of economic benefits, selling ecological agricultural products through the CSA model directly increased the economic income of local farmers, especially poor households. 2) Ecological benefits includes the interventions to promote ecological recycling agriculture, reduce the use of pesticides and fertilizers, improve the local ecological environment, improve and use traditional varieties to promote the protection of agricultural biodiversity. 3) In terms of social benefits, cooperatives not only promote women and the elderly, but also actively attract young people to join, which improves the inclusiveness and sustainability of development; at the same time, it improves the ecological and health concepts of community farmers.



3.2 Inclusiveness of partnership

Throughout the case, research institutes at all levels of agricultural sciences and government agricultural extension systems provided technical support for selection, breeding and ecological planting techniques, which improved the planting technical skills of women's cooperative groups; non-governmental organizations and restaurants sale organic product. Through direct cooperation with urban consumers, the women's cooperation group's marketing and organizational skills have been improved; while the participatory action research group provides a platform for communication networks, through communication with sister communities, visits and inspections, etc. This model has improved women's leadership and vision.

The first two phases of the project focused on mapping, conservation and improvement of agricultural biodiversity. The technical support provided to the community has improved the technical capabilities of farmers. In the phase 3 and 4, the focus is to explore the combination of protection of agricultural biodiversity and ecological agriculture, thereby improving the livelihood of farmers. During this period, the community has gradually supported the establishment of women's cooperatives, in which more than 85% of the main participating group is women. Women are also the direct beneficiaries of participatory breeding and cooperative development. In addition, the cooperatives also take the initiative to assume social responsibilities and attract poor people to join the cooperatives to develop ecological agriculture.

Under the coordination of the participatory action research team of the Chinese Academy of Sciences, research institutes at all levels of the Academy of Agricultural Sciences, non-governmental organizations, hotels, government agricultural extension service agencies, etc. have established contacts with the community. The development process of cooperatives is not only the protection and utilization of local agricultural biodiversity but also the process of women's leadership, community capacity building and empowerment

3.3 Sustainability and transferability

This case will be supported and sustained by funding, policies, and domestic and foreign resources in the longer-term future, whether the case is reproducible in other regions (especially the Belt and Road region), and the effectiveness and precautions of the relevant extended application demonstration case

With the support of multiple partners, from the project activities in 2000 to the present women's cooperatives, the entire development process of the community has achieved all-round sustainable development. First, in terms of agricultural biodiversity, cooperative member farmers have established seed banks, carried out community resource registration, and improved traditional varieties to maintain good characteristics through participatory selection and breeding. Second, in terms of community economy, combined with ecological planting and breeding models, and collaborating with urban consumers to develop diversified sales channels, mature ecological production technologies, stable and cooperative farmers and sales channels have gradually formed. Obtained the injection of the community fund economy, which ensures that the community farmers can obtain sustainable income. Thirdly, in terms of community ecological environment, the cooperative led farmers to continue to carry out planting and breeding, and improved the local soil and water, which played a positive role in maintaining the ecological environment. The capacity building of farmers, especially women, will play an important role in sustainable development.



As a case study, Guzhai Village in Mashan County has a demonstrative, sustainable and replicable development model. The community has become one of the demonstration projects of the participatory breeding team in Southwest China. More than 20 communities in Guangxi have visited Guzhai Village for investigation and study, hoping to exchange ideas. In China, the community story was summarized and promoted through the platform of the Farmers' Seed Network. In 2016, the book "Diversified Paths for Sustainable Agricultural Development in China" was published, which was well-received. In addition, communications with action researchers and partner communities from Peru, Bhutan, Tajikistan, etc. on the international exchange platforms organized by institutions such as the International Institute for Environment and Development (IIED) and the International Network for Mountain Indigenous Peoples (INMIP) ; participated in the "China-Southeast Asia Participatory Plant Breeding and Community Development Seminar" in 2017 to share community stories; and exchanged with practitioners from Myanmar, Laos, Cambodia, Malaysia, India, Italy and other countries in 2018. The side event of the 24th Conference of the Parties (COP24) of the United Nations Framework Convention on Climate Change (UNFCCC) exhibited and shared this successful case at one of the "Excellent Cases of China's Response to Climate Change", which was highly recognized by the guests and scholars.

4 KEY MESSAGES AND RECOMMENDATIONS

Women's empowerment: In the process of development, the leader of the cooperative, who was once an ordinary rural woman, has now become the pillar of society. This process has also strengthened rural women's leadership and socio-economic capabilities, awakened rural women's general sense of ownership, and improved their overall ability to contribute to and benefit from the sustainable development of the community.

Multi-party participation: Under the coordination of the project team, the community has established contacts with the Chinese Academy of Agricultural Sciences, NGOs, organic restaurants, government agricultural extension services and other departments at all levels. The participation and support of local governments have also played an important role. Cooperatives are not only an important means to strengthen the construction of farmers' seed system, but also the resources drawn by stakeholders at all levels enable the special form of cooperatives to adapt to rural society. The diversified and integrated development of farmer cooperatives can become an important path for China's rural development.

Policy publicity: The project team transforms research results into policies through dialogue, proposals, media publicity, etc., and submits policy recommendations to multiple government agencies through multiple channels, calling for the promotion of the healthy development of China's farmers' seed system through multi-faceted cross cooperation platform to enhance the influence of farmers' seed systems, promote the protection of agricultural biodiversity, and establish long-term strategic reserves for food security.

Replicability and promotion of the case: The successful experience of this case can be promoted and replicated in other regions of China and other "Belt and Road" countries. Through diversified cooperation, women's empowerment, relying on local agricultural resources, and combining ecological agriculture, the successful experience can be realized.



Case 10 Poverty alleviation by science and technology in Huanjiang County of Guangxi in Southwest Karst Region

1 GENERAL INFO

LOCATION: Huanjiang Maonan Autonomous County in Guangxi Zhuang Autonomous Region (Hereinafter referred to as “Huanjiang County”), China

IMPLEMENTATION PERIOD: From 1994 to present: First phase (1994-2003), Second phase (2003-2015), Third phase (2015-present)

KEY INITIATOR AND STAKEHOLDERS:

Poverty Alleviation Office of the State Council, Ministry of Science and Technology, People's Government of Guangxi Zhuang Autonomous Region and its directly affiliated units (Guangxi Science and Technology Department, Guangxi Poverty Alleviation Office) provide policy and financial support, technical support provided by Institute of Subtropical Sciences, Chinese Academy of Sciences, Chinese Academy of Sciences and Huanjiang County People's Government and its direct affiliates. The unit organizes implementation, Guangxi Huanjiang enterprises participate in investment and construction, and Guangxi Huanjiang County communities participate.

2 DESCRIPTION

2.1 Introduction

The goal of all the rural poor people in China should be cast off poverty by 2020 made it clear the direction to achieve poverty alleviation. To meet this goal, poverty alleviation of targeted groups is fundamental. Poverty alleviation through science and technology is an integral part of poverty alleviation and development strategy. It also makes an essential contribution to the steady advancement of the United Nations Sustainable Development Goals (SDG1)-"eliminate poverty".

The Chinese government attaches great importance to the control of rocky desertification. Since 2008, the Party Central Committee and the State Council have formulated and issued a series of plans for comprehensive management of rock desertification, which are linked to poverty alleviation, rural revitalization, ecosystem protection, and sustainable development, to further clarify the tasks of complete control of rock desertification in the future, in stages. It emphasized the support of various aspects with science and technology.

Huanjiang County, Guangxi is located in the karst region of southwest China. It is a contiguous impoverished area with a concentration of rocky desertification in Yunnan, Guangxi and Guizhou (246 out of 592 poor counties announced by the state in 2014, accounting for 42%). It accounts for 39.9% of the total area of the county. The particular geographical and geological background makes the poor county soil, low carrying capacity of resources and environment, fragile ecology, sharp human-land conflicts, low productivity and unstable, so it is one of the 28 national deep poverty counties in Guangxi, and the State Council also determined it is one of the five counties to be supported by the Chinese Academy of Sciences in 1996.



Guangxi Huanjiang County is the birthplace of Maonan nationality, and it is also the only Maonan autonomous county in the country. The county has six towns, five townships, one ethnic township, 148 administrative villages (communities), and 3,080 natural villages and immigration fields (points), with 380,000 population in total. It is the third-largest county in Guangxi by land area (4,572 km²). Since 1993, Huanjiang County has successively resettled 60,000 poor people in Duan, Dahua, and Donglan counties, and relocated more than 20,000 employees and their families from Hongmao Mining Bureau.

For a long time, the Chinese Academy of Sciences (CAS) has always regarded poverty alleviation work as an essential task. It was one of the first units to participate in national and regional poverty alleviation. It has successively undertaken national key research and development projects, 973 projects, national key fund projects, and other rocky desertification control scientific research tasks. The scientific and technological poverty alleviation work of the Huanjiang Karst Ecosystem Observation and Research Station (from now on referred to as the "Huanjiang Station") of the Institute of Subtropical Agricultural Ecology of the Chinese Academy of Sciences (from now on referred to as the "Subtropical Institute") began in the 1980s. By the unified national deployment, closely combining with local reality, scientific and technological poverty alleviation work has been carried out through cadre dispatch and achievement transformation, which has actively promoted the poverty-stricken population in rural areas to get rid of poverty and become rich.

2.2 Objectives

The goal is to solve issues like fragile ecological environment, apparent human-land conflicts, lack of industry, and economic backwardness in the Huanjiang impoverished County.

This project takes poverty alleviation of farmers as the core, focus on accelerating the establishment of agricultural science and technology parks, implementing scientific and technological poverty alleviation projects and conducting scientific and technical poverty alleviation demonstrations, accelerating the transformation of scientific and technological achievements and the upscaling of advanced practical technologies, strengthening scientific and technological capacity building, and giving full play to the positive role innovation and entrepreneurship. This project also cultivate unique industries, enhance self-development capacity and independent entrepreneurship, promotion of integration of poverty alleviation and ecological civilization, rural revitalization strategies.

There are three-phased goals for precision poverty alleviation through science and technology in Huanjiang County, Guangxi:

-The first stage (1994-2003)

Realize the dual goals of controlling rocky desertification and alleviating poverty, reduce the contradiction between people and land, and explore on ecological migration and poverty alleviation at alternative sites .

-The second stage (2003-2015)

Implement ecological governance and technological poverty alleviation measures, and carry out research and demonstration of vegetation management in karst mountainous area.

-The third stage (2015-present)

Cultivate featured ecological industries, demonstrate and upscale them to drive farmers to get rich and achieve full poverty alleviation by 2020.



2.3 Interventions (tools and methods)

Beginning in 1993, with the strong support of the government, the Institute of Subtropical Research of the Chinese Academy of Sciences sent researchers to Huanjiang County to carry out scientific and technological poverty alleviation work. Project implementation can be divided into three stages:

2.3.1 Ecological migration-relocation poverty alleviation model research and demonstration stage (1994-2003)

1) Establish Huanjiang Karst Ecological Migration Demonstration Zone: In the demonstration zone, industrial design, key technology research, mature technology integration, fine varieties improvement, migration training and sustainable development capacity building have been carried out. Comprehensive planning for the establishment and coordinated development of agriculture, forestry, and animal husbandry in the core demonstration area, designing four pillar industries of fruit, sugarcane, livestock and poultry, and vegetables that are suitable for the rational use of resources in the demonstration area and sustainable and healthy economic development. The geographical layout, industrial development steps and main measures of the company have created an enterprise-based technological innovation mechanism for poverty alleviation of "scientific research unit + company + demonstration base + farmer households". 2) Vertical zoning comprehensive control of rocky desertification in peak clusters and valleys: It mainly includes the optimal configuration of communities in karst degraded areas, soil leakage and control, flood avoidance and waterlogging resistance in peak clusters and valleys, and water and soil erosion prevention and control technologies

2.3.2 Research and demonstration stage of vegetation compound management in karst mountainous areas (2003-2015)

At this stage, the two-pronged approach of ecological governance and technological poverty alleviation has been emphasized. Because of the migration of low-income households in karst mountainous areas in the previous stage, the economic conditions of rural households have been improved, and rocky desertification has been curbed, this stage addresses the characteristics of uneven rainfall distribution in karst rocky mountainous areas, severe seasonal drought, and frequent waterlogging in depressions. The main work was introducing and selecting karst suitable cash crops, compound three-dimensional ecological agriculture in peak clusters and valleys, and karst alternative herbivorous animal husbandry development.

1) Introduction and selection of karst suitable cash crops

Given the uneven distribution of rainfall in karst rocky mountainous areas, severe seasonal drought, frequent waterlogging in depressions, shallow soil, and poor soil, the introduction and selection of suitable cash crops have been carried out. Drought tolerance and barren tolerance are critical inspection indicators. A series of drought-tolerant and high-yield corn varieties have been introduced, early-maturing, water-shedding, and high-yielding potato varieties have been screened. Simultaneously, the selection of suitable species for karst rocky desertification control has been carried out. More than 30 species have been screened in the rocky desertification area, of which more than ten are ideal for survival.

2) The development model of compound three-dimensional ecological agriculture in peak clusters and valleys



On the top of the mountain, we will implement enclosure measures focusing on closing the mountain for afforestation and protecting vegetation, planting high-value economic forest trees in the gaps between ecological forests on the slopes, and developing industries such as characteristic economic forests and fruits and under-forest Chinese herbal medicines at the foot of the slopes to ensure increased farmers' income, developing a composite three-dimensional ecological agriculture development model of "fruit-based, forest-fruit combination, inter-planting medicinal materials and comprehensive management". Through rational layout and limited space, three-dimensional integration of ecological agriculture development model, animal husbandry and forestry in the mountain are closely integrated and mutually supportive.

3) Development model of karst alternative herbivorous animal husbandry

Aiming at the problems of large stone mountain area, few arable land resources, difficult water resources utilization, and certain restrictions on traditional agricultural development in the southwest karst mountainous area. An optimized model of adaptive landscape ecological design was developed in order to optimize the combination of artificial grassland and pasture suitable for the ecological environment of the karst region, and propose an alternative herbivorous animal husbandry development model in the karst mountainous area of Southwest China.

2.3.3 Cultivation and demonstration stage of characteristic ecological industry (2015 year-present)

After the two stages of research and demonstration of the ecological migration-ex-situ poverty alleviation model in impoverished karst mountainous areas and the research and demonstration of vegetation compound management, local people's livelihood has been improved, and the fragile ecological environment has also been largely restored. At this stage, the main content of scientific and technological poverty alleviation is to cultivate characteristic ecological industries and carry out promotion and demonstration.

More specifically, carry out fixed-point poverty alleviation, establish a circular ecological agriculture model of returning farmland to forests to grow cattle and mulberry sericulture to raise silkworms, establish an ecological planting model of Chinese herbal medicine, establish agricultural science and technology normal parks and autonomous regions agricultural characteristic demonstration gardens, cultivate characteristic fruits, grow tea under forests and other industries and create brand effects.

2.4 Key results and outcomes (especially about biodiversity conservation and sustainable use)

2.4.1 Ecological migration and stony desertification control

1) Ecological migration

"Kenfu" Ecological Migration Demonstration Zone is the country's first ecological migration zone, which has achieved relocation and enrichment of food and clothing in 2 year. The "Kenfu" ecological migration model provides the scientific and technological basis and technical support for implementing "100,000 ecological migration" in Huanjiang County and offers scientific and technological support and demonstration models for large-scale ecological migration. By implementing the ex-situ poverty alleviation model, the per capita net income of ecological immigrants in Huanjiang County increased from 294 yuan in 1996 to 2,478 yuan in 2005. It reached 9,664 yuan in 2017 and 12,180 yuan in 2018. The implementation of this model improved the economic benefits of farmers in the ecological migration demonstration area and greatly enhanced the environmental efficiency of the demonstration area: vegetation coverage rate reached by 90%, soil erosion



modulus decreased by 31%, soil erosion reduced by 54%, the water use efficiency increased by 36%-45%. This ecological migration model is called the "Kenfu" model by United Nations Education Scientific and Cultural Organization (UNESCO) because of its perfect environmental and social benefits.

2) Control of rocky desertification

On December 13, 2018, the State Council Information Office held a press conference to announce the results of the 3th rocky desertification monitoring in karst areas across the country. "The Bulletin of the State of Rocky Desertification in Karst Areas in China" shows that compared with the results of the 2th rocky desertification monitoring in 2011, Guangxi's rocky desertification land has been reduced by 387,200 hectares, a reduction rate of 20.2%, and a net reduction of more than 1/5. The effectiveness of governance continues to rank first in the country.

2.4.2 Compound management of vegetation in karst mountainous areas

1) Introduction and selection of suitable plant varieties.

Introduce a series of drought-resistant and high-yield corn varieties and new potato varieties, and screen out early-maturing, flood-proof, high-yield potato varieties Kexin No. 3 and 4. Which has increased production by 50% above, and screening of suitable species for karst rocky desertification control at the same time. A total of 12 species of suitable species in karst rocky desertification areas were screened; 14 species of essential adaptable species; and nine under-adapted or unsuitable species.

2) Alternative herbivorous animal husbandry development model.

In 2001, Huanjiang County developed 180,000 mu of grass planting under forests and breeding 132,000 vegetable cattle, which increased the per capita income of farmers by 3,500-5,000 yuan. From 2016 to 2019, 2,850 mu of Chinese herbal medicines have been planted throughout the county totally, involving varieties such as *Euchresta japonica* Hook. f. ex Regel, *Callerya speciosa* (Champion ex Benth) Schot, *Spatholobus suberectus* Dunn and so on, directly driving 590 low households, with an average annual income increase of more than 300 yuan; through agricultural technology demonstrations driven by the park's radiation, the cumulative area of unique fruits such as red heart fragrant pomelo, fertile orange, ect. reaches 124,000 mu, with an annual output value of 45.5 million yuan, directly driving 1,100 low households, and has become one of the "eight poverty alleviation industries" in Huanjiang County.

3) Aquaculture pollution control.

In response to severe non-point source pollution in the aquaculture industry, the project team demonstrated *Myriophyllum quitense* Kunth. Wastewater treatment and resource utilization in Huanjiang County. The removal of nitrogen, phosphorus and COD (chemical oxygen demand) in wastewater reached above 95%; the water quality surpasses Class III standards.

4) Soil remediation.

Also, in response to the urgent need for heavy metal pollution of 9,400 acres of farmland and farmers' loss of land due to tailings dam break in Huanjiang County, the project team worked with the relevant section of the Institute of Geographical Sciences and Resources of the Chinese Academy of Sciences to carry out heavy metals bioremediation in the farmland of the large Huanjiang River Basin. A model of the Huanjiang farmland soil remediation project led by phytoremediation technology, with "local government-led, scientific



research unit technical support, and farmers' active participation" model was explored to restore farmland 1,280 mu.

2.4.3 Demonstration and promotion of featured ecological industries

1) Return farmland to forest/grass

Establish a cyclic ecological agriculture model demonstration base for returning farmland to forests, grasses and cattle raising 500 mu, returning farmland to planting sericulture and breeding silkworm demonstration bases 200 mu, ecological forest demonstration bases 300 mu, key households planting grass and raising cattle 91 homes, cow houses 2,770 square meters, High-quality forage grass 516 mu, Hay cutter 21 sets, forestry afforestation 365 mu, farm roads 420 m, improvement of slope farmland 120 mu.

2) Ecological cultivation of Chinese herbal medicine

The protection and breeding base of rare and endangered Chinese herbal medication has been established to conduct research and promote and demonstrate Chinese herbal medicine, wild tending, ecological planting, and forest ecological planting techniques. The county has planted more than 3,000 mu of Chinese medicinal materials, involving varieties such as *Euchresta japonica* Hook. f. ex Regel, *Callerya speciosa* (Champion ex Benth) Schot, *Spatholobus suberectus* Dunn, *Sarcandra glabra* (Thunb.) Nakai, *Paris polyphylla* Smith, *Anoectochilus* sp., *Dendrobium officinale* Kimura et Migo, etc.

3) Featured fruit industry

It has cultivated characteristic and high-value economic fruit forest industries such as red heart fragrant pomelo, sugar tangerine, fertile orange, macadamia nut, etc. The promotion area has reached 135,000 mu, the promotion area of red heart fragrant pomelo is 68,000 mu, the output is 7,200 tons, and the output value is 43.2 million yuan. It has become one of the "eight poverty alleviation industries" in Huanjiang County. In 2017, Huanjiang County established the first autonomous region agricultural science and technology demonstration park and autonomous region agricultural characteristic demonstration park, with a demonstration area of 10,000 mu.

4) The tea industry

The "Jupeng Shiya Tea" cultivated by the Subtropical Institute and Huanjiang County Agriculture Bureau and other related units was designated as a tea for the state guests of the ASEAN Expo in 2016; the annual processing capacity of the tea factory reached 132,000 kilograms; more than 100,000 seedlings were distributed, benefiting more than 2,000 households, and the annual income per capita increases by more than 2,000. Huanjiang County has also established 89,100 mu of oil-tea camellia industrial park, with as many as 64 demonstration bases. Five has been recognized as autonomous region-level high-yield and efficient demonstration parks or demonstration sites.

5) Brand cultivation

The cultivated Guangxi Mulun Natural Food Co., Ltd. has become a well-known brand in Hechi City, Guangxi. Its packaged drinking water has become a regional pillar industry, and its products are widely sold in Guangdong and Guangxi. In 2015, "Mulun Si Spring" won the "World's Best Water Source" and "Best Health Water" Best Recommendation Award at the 8th China High-end Drinking Water Exhibition. The large Maonan flavour food factory cultivated has developed high-end products such as Huanjiang speciality beef



and fragrant pigs, increasing the production value and benefiting six low households in towns and villages. The annual per capita breeding income has increased by more than 2,000 yuan.

3 ANALYSIS

3.1 Political ownership, collaboration, approval, policy dimension

1) Since the 18th National Congress of the Communist Party of China, solving the "three rural issues" has been an essential task of the whole Party's work. It has been required to accelerate the overall urban and rural development further, promote the rural economy's rapid growth, narrow the gap between urban and rural areas, and promote new farms' construction. Poverty alleviation and development strategy, comprehensively improve rural production and living conditions and strive to achieve the grand goal of building a well-off society in all respects by 2020. Since the 19th National Congress of the Communist Party of China, targeted poverty alleviation has been emphasized again, and technological poverty alleviation is the only way for targeted poverty alleviation and the pioneer of poverty alleviation development strategies.

2) The Chinese government attaches great importance to the control of rocky desertification. In 2008, the State Council formally approved the "Plan for Comprehensive Treatment of Rocky Desertification in Karst Areas (2006-2015)". Since then, the control of rocky desertification has been officially launched as an independent ecological project; in 2012, the "Regional Development and Poverty Alleviation Plan in Yunnan-Guizhou-Guangxi Rocky Desertification Area (2011-2020)" to further accelerate the pace of rocky desertification control; in 2016, the "13th Five-Year Plan for Comprehensive Control of Rocky Desertification in Karst Areas (2016-2020)" was officially implemented; In 2018, the Central Committee of the Communist Party of China and the State Council issued the "Strategic Plan for Rural Revitalization (2018-2022)", which requires the full exploitation of resource advantages, the development of industries, and the promotion of comprehensive rural revitalization; the 2020 "National Major Ecosystem Protection and Restoration Major Project Master Plan (" 2021-2035)" was released and implemented to further clarify the task of comprehensive control of rocky desertification in the future.

3) Governments at all levels and relevant poverty alleviation departments are the main body of policy formulation and implementation, responsible for policy implementation, tracking, and supervision, responsible for providing special funds, attracting funds and resources from all parties, and cooperating with scientific research units (Chinese Academy of Sciences) to explore and demonstrate innovative models, training and promotion work, solve the implementation of the relocation of low households and follow-up measures, solve the problems of housing, water supply, power supply, rural roads, children's education, primary medical care, and labour employment. Low-income households are the beneficiaries of policies and technology. They fully understand the Party and the state's policies and can feel the benefits of poverty alleviation policies and the changes brought about by technology. Therefore, they also fully participate in it. Most poor households can change from passive to proactive, and all parties cooperated, and the poverty alleviation work in Huanjiang County is progressing fast, smoothly and sustainably. On October 16, 2020, Huanjiang Maonan Autonomous County, Hechi City, Guangxi Zhuang Autonomous Region, won the title of "2020 National Poverty Alleviation Award Organization Innovation Award".

4) In 1996, the State Council determined that the Chinese Academy of Sciences would assist Huanjiang County at designated locations and implement scientific and technological support for targeted poverty



alleviation. Based on ecological research, the Chinese Academy of Sciences puts forward a three-stage development plan. First, environmental migration and stony desertification should be managed to solve the contradiction between man and land; secondly, a compound management model for vegetation in the leaching area should be established to restore people's livelihood; and the characteristic ecological industry should be cultivated again. Promote wealth and earnestly use scientific research to support ecological, environmental governance in karst areas and scientific and technological poverty alleviation.

3.2 Inclusiveness of partnership

The Party Central Committee, the State Council, the Guangxi Provincial Party Committee and the Provincial Government, the Huanjiang County Government, relevant departments for poverty alleviation, the Chinese Academy of Sciences, enterprises, and the people of Huanjiang County, towns (townships), and villages (communities) fully participate in remote poverty alleviation and desertification control in Huanjiang County, a series of activities such as the exploration of compound business models, the cultivation of characteristic ecological industries, brand building, etc., forming a structure of "government departments + scientific research units + enterprises + communities + poor households" for joint poverty alleviation, fully integrating policies, funds, scientific research, transformation, etc. advantages, given full play to the role of science and technology as the primary productive force, multi-party cooperation, ecological governance, adapting measures to local conditions, improving people's livelihood, developing industries, resolutely winning the fight against poverty, and contributing to the country's completion of the "two-hundred-year goals".

Huanjiang County innovates various systems for poverty alleviation: innovative operating mechanism: implements the weekly meeting system of the staff in the poverty alleviation headquarters, the weekly meeting system of the township poverty alleviation team, and the implementation of the prominent leaders of the county-level units to study and solve the poverty alleviation work and help cadres every month, monthly visits to the village to carry out paired assistance and other mechanisms, which are, through open letters, post slogans, distribution of materials, and text messages, a monthly work mechanism for publicizing poverty alleviation information to the masses have been established. The overall formation of the party and government leaders' attention, departmental linkage, and the whole people participated in the overall poverty alleviation work pattern. Innovative supervision methods: Fully mobilize social forces, establish a supervision mechanism of "two representatives and one committee" and specially invited supervisors for retired cadres to supervise the work of poverty alleviation; explore the establishment of a "three inspections and one notification" system, and adopt on-site verification, random telephone checks, GPS location checks, and strengthen supervision of the village "first secretary" and the poverty alleviation team. Innovative party-building + poverty alleviation model: give full play to the role of party building in leading poverty alleviation, relying on Hechi Vocational School to carry out the "Party Building + Education Poverty Alleviation" action, and explore the campus "one introduction, two driven and three development" party-building model. In addition, there are innovative supervision methods, innovative investment models, innovative demonstration zone construction and innovation incentive mechanisms.

The Institute of Subtropical Sciences of the Chinese Academy of Sciences and Huanjiang Karst Ecosystem Observation and Research Station (hereinafter referred to as "Huanjiang Station") are national-level ecological observation and research stations, catering to the significant needs of ecological environment management and technological poverty alleviation in the karst region of Southwest China, and focusing on the ecosystem pattern-process-service change research, give full play to scientific and technical advantages,



systematically carry out long-term field observations, experiments and demonstration studies, clarify the degradation mechanism of karst ecosystems, reveal the impact of human disturbance on karst degraded ecosystems and the mechanism of action, and develop karst ecology system adaptive restoration technologies and models, constructed a model of scientific and technological poverty alleviation in karst ecological fragile areas, put forward the theory and technical system of karst ecosystem services optimization and regulation, led the research of karst ecology in China, and successfully demonstrated and promoted the research results. It provides important scientific and technological support for karst rocky desertification control, soil erosion control regional science and technology poverty alleviation in China.

3.3 Sustainability and Transferability

Compared with the hard work of poverty alleviation, ecological civilization's construction and the revitalization of rural areas require more urgent, more extensive and more long-term support for the technology. To this end, the Party Central Committee and the State Council have successively issued the "Strategic Plan for Rural Revitalization (2018-2022)" and the National Master Plan for the Protection and Restoration of Important Ecosystems (2021-2035), providing policy, funding, resources and other aspects. Firm support, continue to consolidate poverty alleviation results, and put forward a development strategy for the new era, after eliminating absolute poverty and solving regional poverty, reducing poverty alleviation, and making a sufficient connection with the rural revitalization strategy. Not confined to the primary industry, but should focus on optimizing it, and on this basis, vigorously develop the secondary and tertiary industries, promote the integrated development of the primary, secondary and tertiary industries, and at the same time, we should pay attention to the protection and restoration of the ecosystem to form a sustainable industry.

The "Kenfu" ecological migration model provides the scientific and technological basis and technical support for implementing "100,000 ecological migration" in Huanjiang County and offers scientific and technological support and demonstration models for large-scale ecological migration. This ecological migration model is called the "Kenfu" model by UNESCO because of its perfect environmental and social benefits.

Huanjiang County explored the new concepts of "green ecological poverty alleviation" and "featured industries poverty alleviation", introduced 22 technologies, 47 new varieties, expanded the area of the demonstration area from 4,000 mu to 58,000 mu, and trained 8,400 person-times, each immigrant mastered 2-3 technologies and have made significant contributions to society, economy and environment. The development model explored has been extended to the counties in Guangxi, such as Tiandeng County, Debao County, Mashan County, Dahua County, Fuchuan County, Bobai County, Luchuan County, Rong County, Ningming County, Guizhou Dafang County, Bijie City Qixingguan District, Qinglong County, and Yunnan Xichou County, Luxi County and other places. In the "Evaluation Report of the Three-Year Pilot Phase of the Comprehensive Treatment Project of Rocky Desertification in Karst Areas" (2012), China International Engineering Consulting Corporation established the alternative herbivorous animal husbandry development model as a typical model for the control of rocky desertification in Southwest China. The National Development and Reform Commission selected the governance model and experience as a specific case of industrial development in karst mountain areas and carried on the promotion application.

Karst landforms are widely distributed in the world. Soluble rocks account for 10.2% of the earth's area, and are the largest in China, accounting for 1/3 of China's land area. They are concentrated in Guangxi, Guizhou, Yunnan and other provinces, resulting in poor contiguous area. It are mainly distributed in the Dinara



Mountains of Bosnia and Herzegovina, the Central Plateau of French, the Ural Mountains of Russia, southern Australia, the central and eastern United States, the Great Antilles and the central and northern regions of Vietnam. The successful case of Guangxi Huanjiang can provide an excellent example of rocky desertification control, ecosystem restoration, and people's livelihood improvement in China and even in the world's karst areas.

4 KEY MESSAGES AND RECOMMENDATIONS

Summary

In the process of helping Huanjiang County to get rid of poverty; To focusing on General Secretary Xi Jinping's critical exposition on precision poverty alleviation, combined with primary national needs, targeting the fragile ecological environment, major human-land conflicts, lack of industry, and economic backwardness and other issues, the Chinese Academy of Sciences explored the new concepts of "green ecological poverty alleviation" and "featured industries poverty alleviation" in Huanjiang County. An appropriate environmental capacity for immigrants and a reasonable resettlement model was proposed, a large-scale ex-situ poverty alleviation and planned resettlement for Guangxi was carried out. 400,000 people provided a basis for decision-making and a demonstration model and offered technical support for Huanjiang County to relocate poverty alleviation work.

In the practice of scientific and technological poverty alleviation, the Institute of Subtropical Research of the Chinese Academy of Sciences has developed technologies such as the near-natural transformation of degraded vegetation, the selection and directional cultivation of high-value ecological functional plant species, the compound management and efficient use of artificial vegetation, and the cultivation of three-dimensional and efficient ecological derivative industries; standardization demonstration has been established base for precision experiments; cultivated sectors such as economic forests and fruits, planting and processing of Chinese medicinal materials, and livestock and poultry breeding; established a technological poverty alleviation system such as environmental migration in karst mountainous areas-ex-situ poverty alleviation, vegetation compound management, and cultivation of characteristic ecological derivative industries to provide the technical support and model for targeted poverty alleviation in southwest ecologically vulnerable areas.

These works brought tangible benefits to the masses and played an exemplary role in Huanjiang County. In 2020, the Guangxi Zhuang Autonomous Region government announced that the Huanjiang Maonan Autonomous County, which was designated by the Chinese Academy of Sciences, will withdraw from the poverty-stricken counties after the assessment organized by the autonomous region and the third-party evaluation by the state.

Recommendation

To consolidate the results of poverty alleviation, and gradually face the national ecological civilization construction and rural revitalization strategy, scientific and technological support to poverty alleviation needs to be integrated with the improvement of ecosystem services. In future work, it is also necessary to:

- Coordinate the overall governance and system restoration of low-income areas.
- Promote the restoration of vegetation landscapes in poverty-stricken areas.



- Develop sustainable ecological derivative industries.
- Improve the synergy between environmental governance and community green development.
- Establish an important ecological space zoning management and control policy for poverty-stricken areas, aiming at national environmental protection in 2035, provide essential scientific and technological support for the implementation of major restoration projects and the steady realization of the United Nations 2030 sustainable development goals.



Case

11. Nature-based solutions in the Yangou watershed, Loess Plateau of China⁴

1 GENERAL INFORMATION

LOCATION: Yangou, a watershed located in the northern region of the Loess Plateau, China

IMPLEMENTATION PERIOD: 1997-2003

KEY STAKEHOLDERS:

Implemented by: The Institute of Soil and Water Conservation (ISWC), Chinese Academy of Sciences (CAS), Ministry of Water Resources (MWR) of the People's Republic of China, Yan'an Municipal People's Government

Donors: State Forestry Administration of the People's Republic of China, Ministry of Water Resources of the People's Republic of China, Ministry of Science and Technology of the People's Republic of China, Science and Technology Department of Shaanxi Province

Partners: Yan'an Municipal Bureau of Land and Resources, Yan'an Municipal Bureau of Agriculture, Northwest Sci-Tech University of Agriculture and Forestry

2 DESCRIPTION

2.1 Background information

Soil erosion is one of the most serious environmental problems in China. In 2000, the area prone to erosion by wind and water was 3.57 million km², accounting for 37.6% of the national territory, and the annual volume of soil erosion reached 5 billion tonnes (Li et al., 2009). This severe problem was partially due to the over-farming on steep slopes and continuous reclamation of forest and grassland for cultivation during the late 1900s. Devastating environmental and socio-economic impacts to communities were observed. The severe droughts in 1997 and the massive floods in 1998 have drawn the country's attention, and driven China to take strong initiatives. In response, in 1999 the central government initiated the "Grain-for-Green programme" to combat soil erosion, ecological degradation and to alleviate poverty, through reconverting cropland back into forest and grassland as well as afforesting barren land. This programme started in the western China in three provinces – Sichuan, Shaanxi and Gansu – the most ecologically fragile areas after the serious flood in 1998 and with high levels of rural poverty. It became nationwide in 2002 (Liu and Wu, 2010) and is still ongoing until today. It is among the biggest programmes in the world (Liu et al., 2008), owing to its ambitious goals, massive geographical coverage, huge payments, and potentially enormous impacts. Policy support and financial support provided from the national level are the two major significant interventions. The central government has issued laws to prohibit cultivation on steep slopes in ecologically fragile areas and to regulate the right of land management (Order No.367t of the State Council, China). In addition, China has adopted an innovative Payment for Environmental Services (PES) mechanism, providing

⁴ This case was building upon to the case published by the EbA south website "Mitigation of soil erosion and water shortage in the Yangou watershed, Loess Plateau of China", and wrote by the same authors.



farmers with, for example, cash and grain subsidies and tax incentives for converting cropland on steep slopes to forest and grassland (Liu et al., 2008; Gauvin et al., 2010). Overall, this programme has generated both immense positive ecological and socio-economic effects. It has reduced surface runoff and soil erosion, enhanced carbon sequestration, reduced nutrient loss for maintaining soil fertility and ultimately increased food productivity (Lü et al., 2012; Liu et al., 2008). In the Loess Plateau region (covering parts of 7 Chinese provinces, including Shaanxi and Gansu), by 2008 surface water runoff has decreased with an average of 10.3 mm/year and around 3.44 billion tonnes per year of soil has been retained. Moreover, carbon sequestration in both soil and the rehabilitated vegetation has found to be 35.30 teragram (Lü et al., 2012). In addition, this programme has helped alleviate poverty through the PES mechanism, and supported numerous farmers to change their income structure by shifting farming to alternative industries, such as transportation and restaurant businesses.

Yangou watershed is located in a priority area for the programme, the Loess Plateau, where slope gradients are greater than 25 degrees and suffers soil erosion, ecological degradation, water scarcity and poverty, plus additional pressure from climate change. As an exemplary case, the project in Yangou watershed focused on a variety of interventions including: i) financial support set up; ii) land use adjustment on slopes; iii) water conservation for agriculture; iv) improvement of fertilizer efficiency; v) industrial structure adjustment; and vi) demonstrations.

Water shortages, soil erosion, ecosystem degradation and poverty are the four main concerns in the Yangou watershed of the Loess Plateau, China. Agriculture, especially the cultivation of food crops, is the main livelihood option of communities in the watershed. Most of the arable land consists of highly erodible loessial soil on steep slopes. Intensive rainstorms, though occurring at low frequencies, trigger floods which result in severe soil erosion and water loss. In this region, the annual precipitation during the period from 1950 to 2006 showed a decreasing trend (Liu et al., 2008), while the temperature increased from 1960 to 2013 (Yan et al., 2014). In addition to anthropogenic deforestation, climate change is causing a progressive decrease in land productivity and a loss of ecosystem functions, which further impact local livelihoods. As a result of the low productivity of arable land and the mountainous environment, poverty is a severe social problem. Starting in the 1990s, the national government intended to improve the ecology of the Loess Plateau through the Grain-for-Green programme, the National Key Technology Research and Development Programme.

2.2 Intervention technologies

Set financial and policy support. In 1999, the central government launched the “Grain-for-Green programme”, in order to combat deforestation, ecological degradation, over-cultivation of slopes and soil erosion. The Loess Plateau, with fragile loess ecosystem, was a priority area for the programme, where slope gradients are greater than 25 degrees. The government financed the investments needed for revegetation by adopting Payment for Environmental Services (PES) mechanism. The Grain-for-Green project provided compensation for the abandonment of crop planting in the form of both money and grain. In addition, the right of land management is guaranteed by the Act of Conversion of Degraded Farm Land into Forest (Order No.367t of the State Council, China) in 2002. In this Act, the right of management of contracted land extends from 30 years to 70 years. Local communities have the ownership of the timber on the revegetated land. They also have financial support for construction of small energy infrastructures and support of free tax for producing agricultural and forestry productions.



Eco-restoration and adjustment of land use on sloping lands. The first step of the project was replacing sloped croplands with terraced cropland, together with the construction of dams in the incised valley to reduce the loss of water and soil. The ponds affiliated by dams also became sources of drinking water. The second step was revegetation of abandoned sloped cropland by increasing the coverage of grass, shrub and trees.

Multiple water trap techniques employed to promote agricultural productivity. Terraced farmland construction, deep furrows (Wang et al., 2001) and plastic mulch were applied to help to replenish and conserve water in the soil; ISWC selected drought-tolerant crop species as to promote agricultural productivity under climate change (i.e. reduced annual rainfall); ponds and cement tanks were built to collect rainfall runoff to increase water supply for irrigation and drinking. In addition, the “hole irrigation” technique was adopted for sustainable water consumption (Wang et al., 2001).

Improvement of fertilizer efficiency. During the first 3 years, the fertilizer input increased 4-fold to provide nutrition, and corresponding fertilizer-use efficiency increased by 4.33% (Wang et al., 2001).

Adjustment of industrial structure. ISWC introduced supplemental and diverse livelihoods to ensure that the wellbeing of local communities was not adversely affected by the reduction of total area of arable land. The livelihood diversification includes, for example, new orchard crops such as Fuji apple and Pink Lady apple, fish-farming for both local sale and recreational fishing, and other commercial activities like labour services for the manufacturing sector, and shop running (Dang and Liu, 2009).

Demonstration of agricultural activities. It comprises four aspects: i) crop and orchard planting; ii) management techniques; iii) techniques to promote efficient water use (Liu et al., 2005); and iv) technologies of livestock captivity (Xie, 2001).

2.3 Description of the results

The annual income per person increased from 763 RMB in 1997 to 1,855 RMB in 2005 (130% increment). In addition, the sources of income of local communities significantly changed as a result of the project. From 2000 to 2005, the proportion of the planted cropland in the total arable area decreased from 78% to 57% (Dang and Liu, 2009). Also, the proportion of income from crop planting decreased from over 50% in 1997 to 36% in 2005 (Dang and Liu, 2009). Orchard increased rapidly. Apple planting became one of the key pillars of the local economy. In addition, non-agricultural incomes such as income from handcraft industry and wages also increased. Between 1998 and 2000, investment in local labour for infrastructure construction and revegetation for soil erosion control increased to one-third of the total investment (Ju et al., 2007). These changes in income sources imply an alleviation of the pressure on ecosystem through agricultural activities which are the most influential land use activities on the ecosystem

Land structure has changed in mainly two aspects. (1) Of the total Yangou basin of 47 km², the sloped cropland dropped from ~34% of the total basin area in 1997 to ~3% in 2003, and ~0.5% in 2009 (Xu et al., 2012). Now, dam farmlands and terrace cropland occupy 97.3% of the arable land. As compensation for the decline in cropland, the grain productivity increased by 63% (Wang et al., 2001). The crop yield in the terrace farmland increased to 8.25 t/ha, with an increment of approximately 3 t/ha (Wang et al., 2001). (2) From 1997 to 2003, vegetation restoration proceeded successfully. The coverage of vegetation in the watershed increased from ~27% to ~70%.



Soil erosion was successfully controlled. After the project, the average rate of soil loss decreased by 100-fold and now it is below the tolerant erosion rate of this region. The average concentration of sediment in the runoff dropped by 6-fold (Xu et al., 2012). The base flow steadily increased after the project, while the proportion of flood runoff showed a decreasing trend. It indicated a replenishment of the soil water (Xu et al., 2012).

The threats from water shortage were reduced. The volume of water lost through floods was minimized due to the dams, terraces and gathering infrastructures for rainfall runoff (Xu et al., 2012). Additionally, the efficiency of water use in agriculture has increased by 59.1% (Wang et al., 2001).

Through the demonstration of technology in situ, local communities acquired knowledge of mitigating water loss, promoting the productivity of natural ecosystems and conserving ecosystems. After initial trainings, local community members had acquired sufficient capacity to develop alternative livelihoods such as fish farming. From 1997 to 2010, though the warm-dry climate affected land and crop, the local's income, crop yields and vegetation coverage increased.

3 ANALYSIS

Political ownership, collaboration and approval

Yan'an government, together with CAS, initiated and executed the mitigation action in Yangou watershed. Also, the project was aligned with the policy of central government: Grain-to-Green policy. The three key project stakeholders had different motivations in the project, namely: i) government wanted to achieve its political goals of increasing the income of local residents and restoring local ecosystems; ii) scientists wanted to establish their evidence base through the project activities; and iii) local communities benefitted from the increased incomes and improved ecosystems.

Achieving co-benefits and balancing trade-offs

There are multiple benefits of Yangou watershed interventions, besides the mitigation of soil erosion and water shortage. The benefits include: i) the expansion of non-agricultural vegetation; ii) the restoration of native vegetation over large areas; iii) biodiversity conservation; iv) increased food production; v) diversified livelihoods; and vi) increased local job opportunity from infrastructural construction and revegetation. The project provides a win-win situation where both ecosystem conservation and economic development are supported. However, some trade-offs and long-term negative impacts have also been identified. For example, in order to compensate for the decline of croplands, the project included the activity to increase the crop productivity. In addition, some experts are worried about the problem of 'water trap' at the source of watersheds, such as Yangou, that the overuse of water in Yangou may reduce the water flow to the lower part of the river basin. Also, restoration of the vegetation, especially artificial reforestation in this semiarid environment, may increase the evapotranspiration of the ecosystem – a factor that directly contributes to the appearance of a dry soil layer (Wang et al., 2011). These possible problems need to be addressed.

4 SUMMARIZE KEY MESSAGES

Combining Payment for Ecosystem Services (PES) with laws encouraged the participation of households and promoted the implementation of project activities. The financial support attracted local communities to



participate in the project. Furthermore, funds were also vital for the sustainability of interventions as they were invested in the construction of infrastructure and ecosystem restoration.

Cooperation between research organizations and local government is fundamental to seek solutions at the community level. This is vital for solving problems fundamentally. For the Yangou project, research-demonstration-transfer is a good practice principle to mitigate watershed degradation. Research organizations provided both support for applying current technology and developing new technologies to solve challenges. To complement the work of research organizations, local government provided opportunities for local communities to participate in training and demonstrations as to encourage these communities to adopt new technologies.

A joint sponsorship from multiple sponsors is more realistic and necessary. Multiple stakeholders including administrative departments at different levels played their own roles with relevance to their respective mandates. For example: The State Forest Agency of China sponsored the Grain-for-Green project, which promoted the sustainability of land use adjustment; The Ministry of Science and Technology of the People's Republic of China sponsored The National Key Technology Research and Development Programme; The Technology Department of Shanxi Province sponsored the key projects as to support scientists to conduct coordinated research experiments to demonstrate the necessary techniques in the Yangou watershed and transfer knowledge to local communities; Local government provided communities with basic infrastructure and funding to initiate activities. In addition, some private donors also sponsored certain mitigation actions.

Educating and training local communities on multi-benefits of eco-restoration and relevant technologies – and thereby increasing their adaptive capacity to climate change.



Conclusion

Biodiversity is vital to human well-being and is an important basis for human survival and development. More than half of global GDP (about \$44 trillion) is partly or highly dependent on the contribution of natural resources. Four billion people around the world rely mainly on natural medicines to treat diseases, and at least 70 percent of the poor earn their living through natural resource-dependent activities such as agriculture, fishing and forestry. Ecosystems such as forests, grasslands and wetlands mitigate climate change and can also help mitigate the effects of natural disasters. At present, the global rate of species extinction is accelerating, and the loss of biodiversity and ecosystem degradation pose major risks to human survival and development. According to an April 2019 report by the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES), by 2020, only four of the 20 "Aichi Biodiversity Goals" were achieved, and most of the targets will not be met.

The Belt and Road Initiative aims to achieve sustainable, balanced and inclusive growth of the world economy and create a peaceful and prosperous community with a shared future for mankind. With green as the background, BRI will bring new opportunities to implement the 2030 Agenda for Sustainable Development and promote green and sustainable development around the world. The BRIGC takes biodiversity conservation as one of the core areas of cooperation, and is committed to providing a platform for policy communication, knowledge sharing and technology exchange for global partners, so as to make new contributions to global environmental governance.



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