GMS Core Environment Program Yunnan's Biodiversity Landscape & Livelihood Project Result Report

Guiding Tropical Forest Restoration in Xishuangbanna

The Core Environment Program (CEP) supports the Greater Mekong Subregion (GMS) in delivering environmentally friendly economic growth. Anchored on the ADB-supported GMS Economic Cooperation Program, CEP promotes regional cooperation to improve development planning, safeguards, biodiversity conservation, and resilience to climate change – all of which are underpinned by building capacity. CEP is overseen by the environment ministries of the six GMS countries and implemented by the ADB-administered Environment Operations Center. Cofinancing is provided by ADB, the Global Environment Facility, the Government of Sweden, and the Nordic Development Fund.The Yunnan Environmental Protection Department (YEPD) is the focal agency for CEP implementation in Yunnan Province.

Yunnan Environmental Protection Department
www.ynepb.gov.cn

GREATER MEKONG SUBREGION CORE ENVIRONMENT PROGRAM
www.gms-eoc.org

1 Background

Xishuangbanna prefecture in Yunnan province has the greatest concentration of biodiversity in China. While covering only 2% of China's land area, Xishuangbanna is home to 1/7 of the country's plant species and 1/4 of its animal species. Tropical rainforest is the main forest type in the prefecture, and the only area in China where such forest is found.

Since the 1940s, the once extensive tropical forests of Xishuangbanna have been steadily reduced due to shifting cultivation and the development of rubber and tea plantations. Today, monoculture rubber plantations cover some 460,000 hectares of the prefecture, nearly 25% of the total area. Remaining tropical forests cover 12% of the land, and are nearly all within the prefecture's protected areas. The loss and fragmentation of the tropical forests has severely affected biodiversity and created serious ecological problems such as soil degradation, pollution, and greater climate change vulnerability.

Since 2006, the GMS CEP and YEPD have worked together to protect and improve biodiversity in the prefecture by increasing forest connectivity between protected areas ."Biodiversity conservation corridors"were established and included a range of integrated livelihood and development interventions, including forest restoration activities.

In 2016, a YEPD-led research team including experts from the Kunming Institute of Botany and the Xishuangbanna Nature Reserve created guidelines for forest restoration with funding support from CEP. The guidelines provide a mix of ecological and forest restoration theory and practical guidance, with a focus on species selection, restoration methods, and priority recovery areas. While targeting forest restoration in corridor areas, the guidelines also have applicability for non-corridor areas, including for developing more ecologically-friendly rubber and tea plantations.

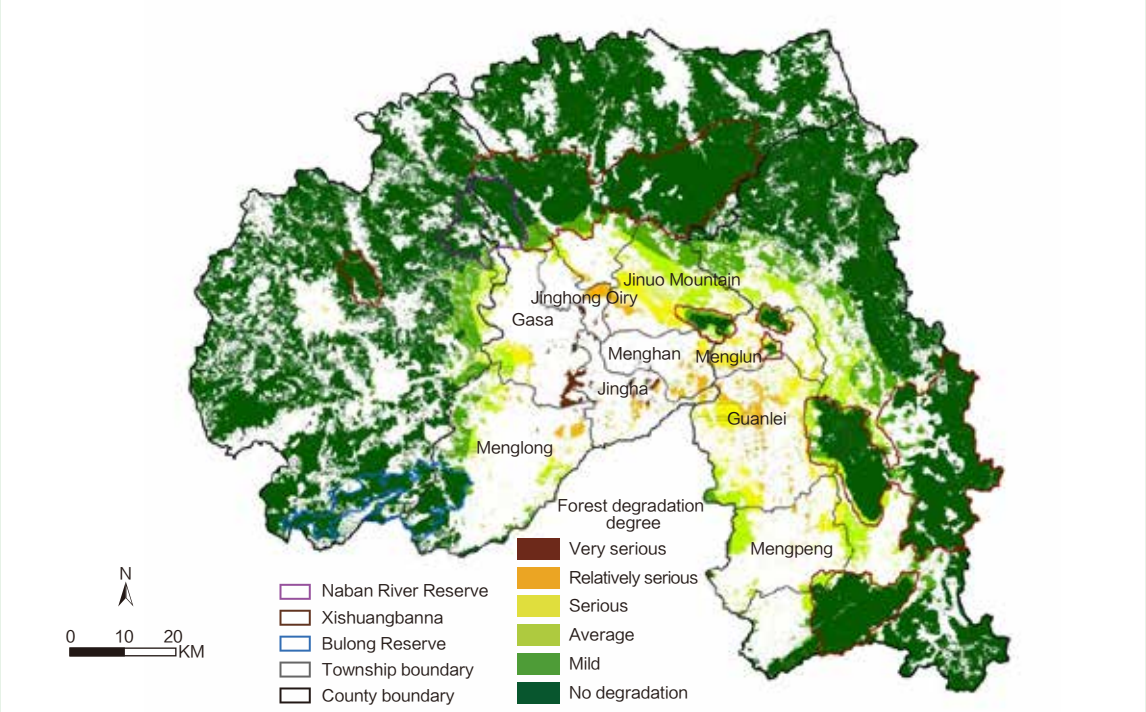
2 Forest Degradation Diagnosis

Understanding the causes and spatial distribution and severity of forest degradation is a pre-requisite for developing effective counter measures and was thus an important first step for the research team.

The team identified key drivers of forest degradation and deforestation, namely infrastructure development, population pressure, and land conversion. In combination with the current-state forest cover map, these layers were used as an input for the InVEST Habitat Quality module. The module produced maps showing the sensitivity of forest cover to each of the identified drivers

The results of the analysis showed that severe forest degradation and deforestation is mostly located in low elevation areas near human population centers such as Jinghong City, Keno Township, Menghan Town, Menglun Town, Guanlie Town and Mengpeng Town. Forests in high altitude areas such as the northern, middle, and eastern parts of Menghai County, as well as nearby Jinghong City are relatively less disturbed and suffer from less forest degradation. Overall, forest coverage in the prefecture forms a ring-shaped pattern concentrated in the peripheral area of Xishuangbanna.

Figure 1:Forest Cover and Forest Degradation Map – Xishuangbanna



3 Main Elements of the Forest Restoration Guidelines

Principles for Selecting Tree Species

Ecologists view forest restoration as a succession process with six stages of transformation where an unstable ecosystem transforms into a stable one through species migration, settling, clustering, competition, and reaction to stability. In the succession process, the planting of top-level tree species and pioneer tree species together will enable forest restoration to occur more quickly than through natural regeneration. The selection and allocation of plant species must be scientifically assessed according to the purpose of restoration and the expected resulting forest formation.

The guidelines provided five key principles for selecting and allocating tree species for forest restoration.

- Principle of Matching Tree Species: Understand the potential natural vegetation types based on the type and distribution of primary vegetation under the site conditions, and select the native trees species that are suitable for the growth under the existing site conditions.
- Principle of Coordinating Species: Select native species of different ecological niches which that are suitable for the degraded environment. A dynamic community model with reasonable structure, multiple layers, and complex species composition, should be configured to maximize benefits for the whole system.
- Principle of Resilience: Genetic diversity is a key to ecosystem resilience and thus as many appropriate species should be included for forest restoration. However, specific species that have strong resistance to pests and diseases, droughts, floods, fire and extreme temperatures, should be given preference.
- Multifunction Principle: Tree species with multiple functions, such as those that contribute to human livelihoods as well as ecological benefits should be considered for specific areas.
- Principle of Community Participation: Local people's development potential as well as material and cultural needs and preferences should be an important consideration in the selection of tree species.

According to the above principles, the selected species should have the following characteristics: a native species suitable for local planting, easy to breed and cultivate in a nursery, have a high survival rate after planting, and have high quality growth. The tree canopy is dense and wide, natural weed control is effective, and there is resistance to external environmental challenges, including future climate change. Socioeconomic and cultural benefits to local communities should be sought where possible. The guidelines provided explicit guidance on the range of tree species, their functions, and their suitability for different areas and elevations.

Forest Restoration Methods

The guidelines proposed three main forest restoration methods.

Natural Regeneration

This method requires the protection of degraded forest areas to avoid the further interference of damaging human activities and enable a process of natural restoration and succession. This method is most suitable for degraded areas where patches of forest remain or where natural regeneration is already happening. The method is cost-effective, can be applied in a large area, and happens quickly (relative to temperate forests) in tropical areas with substantial forest cover achievable within a decade.

Human-aided Restoration

This includes any human activities to enhance the natural processes of forest regeneration, such as the promotion of native tree species, the establishment of natural forests, and the prevention of forest damage such as from weeds, livestock, and fire. This method relies on existing natural processes and requires limited human labor input with only targeted tree-planting.

Framework Species Method

Framework species are indigenous tree species that survive challenging conditions, are fast-growing and dense, and attract seed-disbursing wildlife. They can play a role in accelerating forest regeneration and promoting the restoration of biodiversity in degraded and deforested areas.

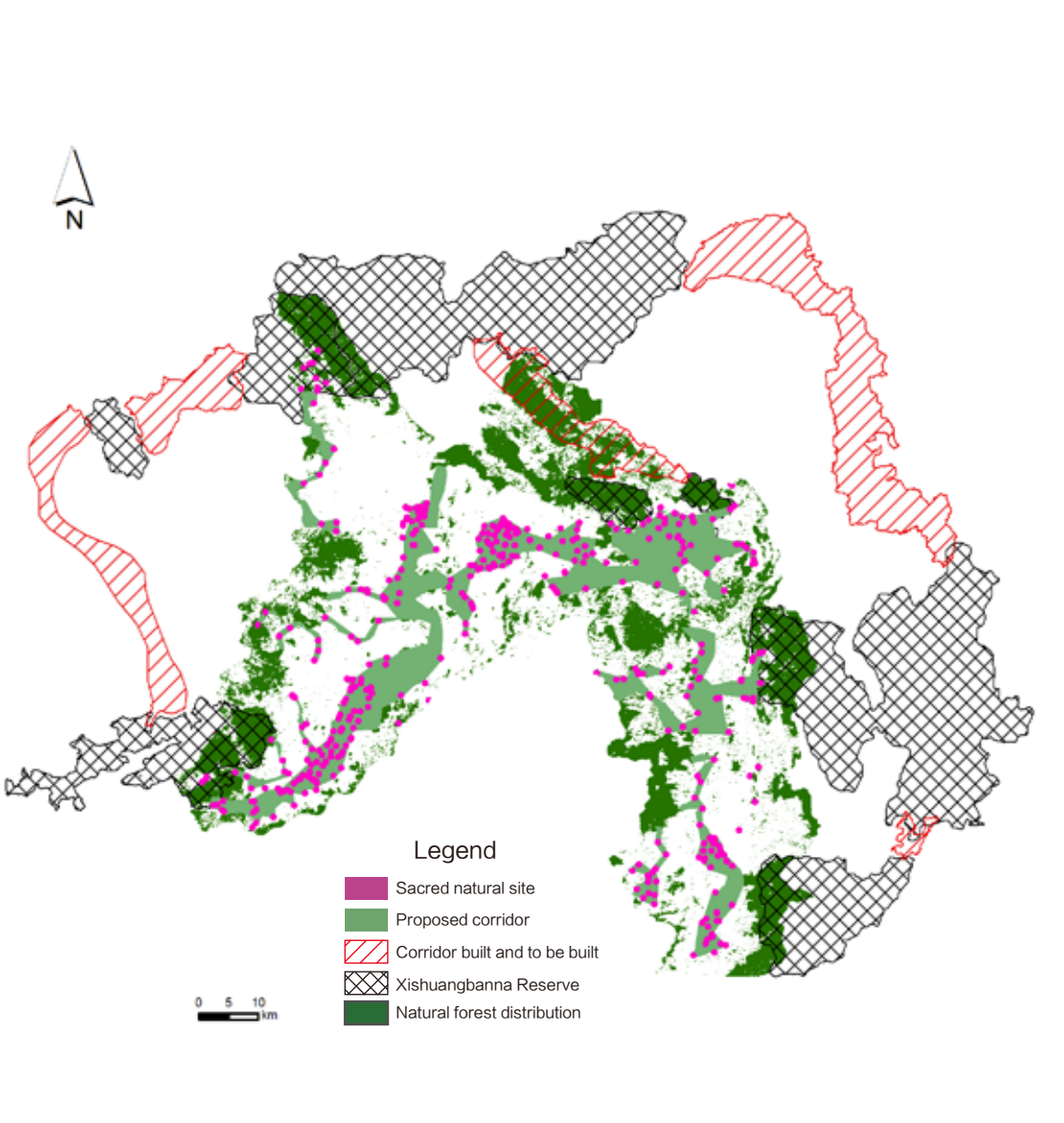
Forest Regeneration of Sacred Natural Sites

"Sacred natural sites" are specific areas of special spiritual significance to nearby local communities. In Xishuangbanna there are estimated to be 930 such sites, each averaging around 1.7 hectares in area. Many of these sites are home to important vegetation types and as they are usually close to village and pastoral areas, they often play an important role in water conservation and preventing soil erosion.

To strengthen biodiversity protection in Xishuangbanna, the research team promoted the importance of biodiversity corridors connecting not only to the protected areas, but also to as many sacred natural sites as possible. For this, the team proposed expanded corridors (see Figure 2) to form a continuous habitat protection network for Xishuangbanna .

The restoration of the proposed corridor and sacred natural sites must adhere closely to the principle of respecting local people and culture, including for tree species selection.

Figure 2:Proposed Biodiversity Corridor and Sacred Natural Site Network



Ecological Improvement of Plantations

In response to the growing concerns over the environmental issues caused by mono-culture rubber plantations, Xishuangbanna has recently become a center of knowledge on how to restore rubber plantations to natural forest and create more ecologically beneficial plantations.

The forest restoration guidelines include key approaches for restoring and improving both rubber and tea plantations.

- "Cap, Lace and Shoe:" This approach is mainly used for improving the ecological environment of large scale rubber plantations located in hilly or mountainous areas. The aim is to create interconnecting 'corridors' of different tree species along ridges (the cap) in gullies (lace) and around the foot of the hill or mountain (shoe). The timber mix should include broad-leaf species, indigenous tree species, precious timbers, and economic trees. The cap, lace, and shoe approach enables partial natural vegetation coverage within large plantation areas and thus contributes to improved ecological functions.
- Agroforestry Patch: Applied in smaller rubber plantations, this approach involves developing agroforestry 'patches' within the rubber plantation. A multilayer forest is built that includes dipterocarps and other tall tree species. Cocoa and coffee plants and small shrubs contribute to the multi-layer system. Poultry and other livestock can forage in the area.
- Shelter Forest: This approach is applied to large size but low yield rubber plantations and involves dividing the rubber forest into plots and planting a ring of rare tree species around each plot.
- Interplanting then Replacement: This approach is suitable for low yield rubber plantations established in unsuitable growing areas. Firstly, economic and important indigenous tree species can be interplanted with existing rubber trees. Once the rubber plantation ages to the point that economic returns are too low, the rubber trees are cut out. The entire plantation area is then returned to a more mixed forest type with both economic tree species and those with cultural and high ecological value. These forests will become 'green islands' in rubber plantation areas.
- Eco-tea Plantations: Most tea plantations in Xishuangbanna are monocultures but as tea trees are small, there are excellent opportunities to create more ecofriendly farm systems by planting a wide range of taller trees within these plantations. The guidelines provide extensive detail the appropriate plant species and locations for creating multispecies, multilayered eco-tea plantations.

Guidance on Eco-tea Plantation Species and Locations

Altitude	Area	Character	Reconstruction direction	Planting combination pattern
1000-1300m area	Mountain peak and ridge area	Low yield of tea leaves and poor quality due to poor water and fertilizer conditions	Improve soil moisture and nutrients, and soil and ecological environment	Fast-growing species (Southwest birch and alder) +tea trees + nitrogen fixing green manure plant.
	The slope more than 25°	Steep slope, week soil water conserva-tion ability and poor conditions of water and fertilizer	Protecting water, fertilizer, soil, improving the ecological environ-ment, and promoting the growth of tea and tea production.	Fast-growing species (Southwest birch and alder) +tea trees + nitrogen fixing green manure plant; Aromatic plant (camphor, cinnamomum cassia) + tea trees+ nitrogen fixing green manure plant Precious tree species + tea trees+ nitrogen fixing green manure plant
	The slope of 15-25°	-	Mainly for the cultivation of rare trees and fragrant plants,	Aromatic plant (camphor, cinnamomum cassia) + tea trees+ nitrogen fixing green manure plant Precious tree species + tea trees+ nitrogen fixing green manure plant
	The region of slope <15°	-	Mainly for macadamia nuts and precious tree species	Macadamia tree + tea trees+ nitrogen fixing green manure plant; Precious tree species + tea trees+ nitrogen fixing green manure plant
1,300-1,600m area	The planting pattern at the mountain peak and in the mountain ridges and in areas of different slope is the same as that in the region from 1,000-1,300m except the rare species of Dalbergia odorifera, special economic forest - macadimia nut.			
above 1600m area	The macadamia nuts and some rare species cannot be planted in the ecological tea garden in this area as they are not adaptable due to the high altitude. The precious trees can be planted are calophyllum polyanthum, Michelia hedyosperma, mahogany, Xishuangbanna ebony, watter milkwort root leaf or bark, and the planting pattern at the mountain peak and in the mountain ridges and in areas of different slope is the same as that in the region from 1,300-1,600m